Curricula and cultural diversity

A culturally responsive curriculum for Roma students of primary education

Georgios V. Kyriakopoulos

A thesis submitted for the degree of

Doctor of Philosophy

University of Thessaly

School of Humanities and Social Sciences

Department of Special Education

Volos, Greece

December 2021

Statement

I hereby declare that this thesis has not been, and will not be, submitted in whole or part to another University for the award of any other degree.

Georgios V. Kyriakopoulos

Three-member advisory committee:

1. Stathopoulou – Vasilonikolou Charikleia, Professor of Department of Special Education of University of Thessaly, Greece and thesis supervisor
2. Sakonidis Charalampos, Professor of Department of Primary Education of the Democritus University of Thrace, Greece
3. Appelbaum Peter, Professor of School of Education of Arcadia University, Philadelphia, United States

Seven-member examination committee:

1. Appelbaum Peter, Professor of School of Education of Arcadia University, Philadelphia, United States
2. Gana Eleni, Assistant Professor of Department of Special Education of University of Thessaly, Greece
3. Kalavasis Fragkiskos, Professor of Department of Special Education of University of Thessaly, Greece
4. Moutsios-Rentzos Andreas, Assistant professor of Department of Primary Education of the University of Athens
5. Sakonidis Charalampos, Professor of Department of Primary Education of the Democritus University of Thrace, Greece
6. Stathopoulou – Vasilonikolou Charikleia, Professor of Department of Special Education of University of Thessaly, Greece and thesis supervisor
7. Xenofontos Constantinos, Associate Professor of Oslo Metropolitan University, Oslo

Abstract

I have been a teacher for fourteen years, the past eleven in a school with Roma students. My experience teaching Roma students has been characterized by patterns common to Roma school experiences throughout Greece: comparatively high school dropout rates; limited student participation and engagement in the educational process; and inadequacies of the existing mathematics curriculum for meeting the needs of Roma students. I identified mathematics for my research focus because I understood it in the common sense perspective as a global language that would help students to face real-world problems. However the school mathematics curriculum is limited to its technical aspects, minimizing the pursuit of meaning and real-world connections. I began to reexamine the mathematics curriculum in order to provide Roma students with an understanding of mathematics as a living and growing field. My research quickly discovered that this kind of reconceptualization of the mathematics curriculum cannot be accomplished through conventional humanistic research or qualitative research methodologies. The research I then pursued, and which is reported in this dissertation, is grounded in post-qualitative inquiry. The goals of post-qualitative research are not directed at representing something that exists in the real world, but instead to reorient thought toward experimentation, and toward the creation of new forms of thought and life. Rhizomatic analysis offered the opportunity to co-create an emerging, alternative, mathematics rhizocurrere together with Roma students. Similar to qualitative approaches, the rhizocurrere is based on real-life experiences; the difference is in the outcomes, which are not an ideal curriculum, or set of concrete pedagogical recommendations, but instead a prototype story of new relationships with teaching, learning, and research that can be shared by other teachers and students co-creating their own rhizocurrere in their own unique settings. Rhizomatic analysis entailed the mapping of relations and differences as they emerged, during performance-in-motion. This mapping generated potential pathways and directions, plateaus or planes of immanence among theories, mathematical ideas,

moments of interaction, pieces of qualitative data, etc., pathways or directions of connection or difference that could be followed and extended as potentialities. Through this mapping process emerged a vibrant, evolving and dynamically adapted mathematics rhizocurrere that has such a dynamic for Roma students that, on the one hand, helps them to acquire substantial and comprehensive mathematical knowledge related to real life, and on the other hand, becomes a vehicle both for emancipation and for changes in their daily life. Re-examination of the students' reality and the breaking down of existing stereotypes created potential plateaus with the ultimate goal of restoring social justice. During the research process, there was a reduction in school dropout rates, an increase in student participation in mathematics activities, a spontaneous implementation of interventions that contribute to the improvement of everyday situations that make life difficult for Roma students, and extension of the school curriculum to include interaction with the outside community within mathematics lessons. Research created the opportunity to reconsider relationships and interactions constituting students' experiences in relation to socialization processes within the Roma community, and to a softening of power relations between school and Roma culture. Finally, the rhizocurrere cultivated a spirit of searching for mathematics involved in the simple events of everyday life, so that Roma students demonstrated evidence of acquiring an active mathematical identity, of learning to think mathematically, and of respect for people with whom they interacted, as they tried to change their daily lives for the better.

Acknowledgement

Table of contents

Part A
Literature Review

Chapter 1: Introduction

1.0 Summary

In the first section of chapter 1 of this research paper, the wider belief around culture and mathematics will be presented. The fundamental beliefs on how culture and mathematics are related along with the influence of society in the teaching methodology adopted to teach mathematics will be analysed.

The second and third section of chapter 1 focus on the analysis of the theoretical basis used in curriculum design of teaching mathematics and how this process is interrelated with and impacted by the social and ethnicity norms which are depicted in everyday life of minorities. Finally, the aims of this research paper are summarised and linked to the theory of teaching of mathematics to facilitate understanding of the following chapters.

1.1 Introduction

People usually ignore the relation between mathematics, cultural diversity and social justice. Such a relationship has been evident to me during the eleven years I have spent teaching at primary schools in Athens. At the same time there is a widespread perception that mathematics is a universal language which is neutral and culturally free (Vanegas et al, 2019; Bishop et al., 1993; D'Ambrosio, 1990). This obdurate difference between reality and the general public beliefs of school mathematics explains my interest in this field of study and why I have concluded to research this specific topic of fundamental importance for education.

Mathematics is traditionally taught in schools as a culturally loose subject that concerns studying supposedly universally accepted facts, contents and concepts such as knowledge of facts, algorithms, axioms and theorems. While people talk of universals; it is vital to recognise that regularly something perceived as universal, is merely universal to people who share the same cultural and historical background (Sharma et al, 2020). Concurring to this setting, numerous teachers work with the presumption that mathematics is

acultural, ignoring the link between mathematics and culture (D'Ambrosio, 2001). Since mathematics in any culture is based on specific values and needs, students' cultural and linguistic awareness may interfere in the learning of concepts in the educational process (Rosa & Orey, 2016).

This thesis aims to recognise that there are various approaches to performing mathematics taking into account the appropriateness of the school mathematical knowledge apparent in the curriculum in the light of different methods in which culturally diverse societies negotiate their mathematical practices (D'Ambrosio, 2001). Ethnomathematics is progressed as a project, which discusses the interpretation and the application of concepts and practices by the members of the different cultural groups and mathematical practices (Rosa & Orey, 2016).

The focus of this thesis is to reconceptualise the mathematics curriculum highlighting a dynamic curriculum which adapts and transforms according to the experiences and life knowledge of elementary school Roma students. The under proposition culturally-oriented mathematics curriculum aims to deterritorialize the existent knowledge about approaching mathematics as a school subject. The dominant research question is:

Is it possible devotion towards education for social justice to be translated into a lived mathematics curriculum experience which supports cultural diversity and promotes social integration?

This fundamental research question can be analysed into some more detailed research inquiries. Firstly, it aims at creating a conceptualisation for such a mathematics learning experience by examining and reforming the curriculum.

How students' accounts for their learning experiences, competing forces and interests allow us to build alternative forms of mathematical knowledge if the curriculum could be more committed to their cultural, historical and political contexts?

Secondly, it examines the role of students' existing knowledge when they come to the classroom and how it can be transformed into relevant and valuable knowledge of mathematics with an impact on learners themselves.

How can the application of students' lived experiences by using cultural and historical rhizomatic systems make mathematical teaching and learning processes more admissible, applicable and purposeful?

How can we inspire[1] students to search for mathematics in their everyday life?

The question is not how to relate formal and informal knowledge, but how school practices may allow senses and knowledge existent in life practices to find space to emerge. The challenge is to understand school learning from the perspective of social practices so that senses, meanings and knowledge are no longer a mere cognitive subject.

The history of research in ethnomathematics has been ruled by the ponder of the essential contrasts in ways of doing mathematics among different societies. Considering these differences allows students and teachers to transcend culture and mathematics by developing a transformational and inclusive environment where diversity is considered as significant, critical, and fundamental to living in a modern world (Rosa & Orey, 2016).

1.2 Translating theory into practice

Relevant literature (Gemmink et al, 2020; Bishop, 2002) highlights that researchers have troubles relating research implications to the practice of teaching and learning of mathematics. These difficulties are associated with the adoption of business-style administration in schools and growing presence of politics in the school environment. He details how research frequently is demoted to require sufficient report of ordinary classroom interactions, settings and limitations confronted by teachers. Skovsmose (2011) contends that by far most of the classroom-based research happens in 'prototypical arithmetic classrooms' where the environments are perfectly organized, social equity issues might be more subtle and teachers are facing less stressful conditions.

School is viewed as one of the instruments for sustaining the information of the prevailing society, and working in it deals only with the dominant,

[1] Inspiration in this point is explored as emancipation and empowering of students to relate mathematics to their everyday life.

monocultural learning as imposed by government instructional design (Peña-Rincón & Blanco-Álvarez, 2015). The influx of reorientation in mathematics education which is spreading worldwide is not competent to change existing practices, and the methods teachers use to teach mathematics in classrooms. Students are very often trained to remember data and to create capability in calculating and applying theorems without comprehension and with no connection whatsoever to their out of school lives. This thesis aims at utilising the mathematics knowledge experienced by students in their locality setting as methodological support for the teaching-learning process of school mathematics.

The outcomes of the existing instructive practice have concluded that the learning of mathematics happens by collecting mathematical relationships or rules expressed in symbols and calculations, which is not connected to the life of the humankind and which intensifies an assemblage of genuine, static, and unbiased ideas that nobody doubts or questions. For example, typically, teachers do not have the time to elucidate the background or the usage of bound mathematical techniques included in the school curriculum to their students (Goos et al, 2020). Consequently, students begin to feel mathematics as a field full of senseless rules assuming that mathematics could be a set of rules to form things with symbols, calculations and processes.

Researchers (Baroud, 2020; Moreira & Silva, 2002) affirm that 'curriculum for an extended time ceased to be a mere technical area, dedicated to queries referring to procedures, techniques, and methods'. Currently, the curriculum is guided by sociological, political and epistemological questions. Curriculum reconceptualisation is based on two specific presuppositions:

The curriculum is inextricably linked to social totality[2].

[2] Niklas Luhmann offers a radically different view of society, although like Latour he conceives of contemporary society in terms of complexities and contingencies rather than as the social totality (albeit based in struggle) implied in Bourdieu's work. For both of them, there is no overarching, integrating space from where the development of society can be measured or co-ordinated elaborating, thus, the view of society that is structured according to a principle of functional differentiation (Luhmann, 1985; 1995, 2006). The world is constituted by a multiplicity of

Reconceptualisation is a political act that aims at the emancipation of lower classes and restoration of social justice.

Classroom practice is not neutral and objective so translating theory into practice through curriculum reconceptualisation cannot be a series of unarticulated contents (such as individual teaching projects) that are disconnected from social, political and cultural aspects. However, theory-based practice is an integrated part of the curriculum which frequently generates dialogue and contradictions. Various curriculum researches have featured the need to examine attainable connections between ordinary learning and related pedagogical practices. This practice has been constrained to a mere rhetorical role (Balibar, 2011).

Theoretical knowledge is methodologically tested and incontestable, and it becomes a widely accepted truth that may only guarantee diversity, respect for others and educational inclusion of the diverse individuals and presuppose cultural pluralism to be no longer residual or subordinate but constitutive. However, this attempt has been questioned by data evolved by research which is apparently more advanced. School learning, thus, when it looks for groundworks on theory, prohibits practice-based knowledge. In the search for scientific credibility, schools superimpose themselves over common knowledge and in this way, they produce a couple of problems identified by the absence of significance and the lack of interest present in practices and activities conducted in school.

Researchers (Silva-Laya et al., 2020; Conell, 2000) mention that imposing a discourse based on the “superior” theoretical knowledge starts a process of segregation of poor, proletarian children since their knowledge, values and discourse practices are silenced by the discourse that is considered legitimate by the ruling class. School is the place where scientific knowledge should be selected according to the students’ needs while at the same time this knowledge is transformed into school knowledge which is supposed to lend a higher degree of meaning to mathematical concepts taught.

---

functional systems and what he refers to as the environments, inhabited by humans and non-humans alike, that surround them (Routledge Encyclopedia of Translation Studies, 2009; p. 281).

Centred in a political approach of translating theory into practice in favour of minorities and socially excluded groups, ethnomathematics is one of the first movements that support that mathematics are affected by social and cultural commitment. A significant social and cultural responsibility supports that different kinds of mathematics exist because of the unique requirements and needs of various social groups and settings. From a psychological perspective, these different types of mathematics may be used as a type of previous knowledge which, once explored and translated into a version of formal mathematics, may be of great importance for the learners. From another perspective, the analysis of ethnomathematics has generated discourses pushing cultural knowledge with the intent to evade the tainting of them with typical school learning process (Robinson, 2017).

Practically it should be noted that informed practice is not something present just inside the school building, however, as a social practice, it is apparent in our behaviour when, for example, cooking and utilising units of estimation. These strategies of ethnomathematics can influence the school education field. The idea of mobilisation of ideas leads to considering potentialities in relevance to using the school context as a flow space helping us to conceptualize the curriculum in a way that facilitates incorporating an assortment of cultural practices.

Miguel et al. (2010), contend that the implications attributed to knowledge are coming from meanings produced by students who use and share this knowledge in activities engaged in their various and diverse practices. Considering good practices as forms able to empower this mobilisation and transmission becomes a significant change in the way school curriculum, and educational practice is viewed (Philip et al., 2018).

Lave (2002) for example, examines shopping practices in the supermarket which is not a simple activity of picking up products, adding the values and paying. She mentions that when shopping, numerous factors are part of the procedure. In her research she indicates that to purchase specific food, people need to think about the dietary patterns of their home, the circumstances for which the shopping is for and other criteria that school

environments dismiss. Accordingly, when we sort out an activity about shopping in a grocery store to talk about in class, we are working with students' circumstances, to integrate the everyday into school practice.

On the other hand, researchers and teachers should remember that a part of mathematical knowledge systems and, consequently, mathematical diversity are in danger of extinction once neoliberal policies limit these systems to simple instrumentation and use of calculation techniques supported by trade and commerce. It is vital to examine myths, religions, folklore, medical practices, old garments, and existent mathematical knowledge developed by the members of distinct cultural groups (D'Ambrosio, 2011) with the perspective to include them in the mathematics curriculum. This is a political action that reduces curiosity for different societies and reasons for mockery while at the same time limits the symbolic violence sent through language (Skovsmose, 2015) even within the school classrooms.

Understanding these distinctions makes it possible for students and teachers to integrate culture and mathematics by creating a transformational and comprehensive environment in which diversity is considered as acceptable, essential and important to living in a modern world. Therefore, educational practices focused on ethnomathematics are situated at the incorporation of mathematical ideas and activities which reverberate a decent range of societies, particularly those who face oppression, ghettoing and exclusion from society. Ethnomathematics is a pedagogical action that begins with teachers and students who figure out to think flexibly about how they use mathematics in everyday and academic contexts (Rosa & Orey, 2016).

A thorough perspective of the mathematics curriculum is hinted at from an ethno mathematical point of view. Students have the potential for comprehension and correspondence through an assortment of mathematical signs and systems within social settings. This permits them to advance new prospects on human potentials and the structure of the mathematics curriculum. Mathematics can be better learned and instructed if they incorporate parts of the way of culture, language and representations that are culturally significant to learners and teachers alike. Wilson & Urick (2021)

support the cultural reproduction perspective by demonstrating that students who have more access to normative education-based resources outside of school and academically aligned social networks tend to report more opportunities for problem solving and student-oriented instruction during math lessons.

In this way, in order for students to achieve their full mathematical understanding, guidance ought to be given in manners that advance the procurement of progressively complex numerical learning, dialect aptitudes and capacities in a sociocultural context that cultivates joint effort and positive communications among teachers and students (Simamora et al., 2018). Significant features of such settings incorporate both elevated standards and an interaction with an academically rich and comprehensive mathematics curriculum content and resources that are culturally and linguistically appropriate to student needs, to improve their mathematics learning and achievement.

An ethno mathematical point of view to the transformation of theory into practice through the reconceptualisation of the mathematics curriculum encourages students to comprehend and acknowledge alternative viewpoints in mathematics. Reorienting teaching and learning to incorporate ethnomathematics can draw in and energise students about learning and urges them to consider themselves to have the capacity to do mathematics by using their very own cultural backgrounds, which is a fundamental part of understanding and celebrating the differences between diverse cultural groups (Rosa, 2013).

In conclusion, this view urges teachers to perceive that there is mathematics in all things, not merely the school mathematics found in the school curricula and books. Living in the classroom reality we identify how despite their formal tutoring encounters, they really come to learn, measure, group, arrange and compose, derive, and show are an incredibly important part of the various teaching and learning methods of mathematics. As teachers, we must build connections between the mathematics being proposed and the racial and mathematical identities of our students (Edelen & Bush, 2020). Admittedly,

this is difficult, and it is impossible to do without first acknowledging that certain groups have been historically positioned as unintelligent (Delpit, 2012).

Teachers have the opportunity to challenge this notion every chance they get. To encourage our students to see themselves as doers of mathematics, we must first acknowledge that all students are intelligent, and position them to see the usefulness of mathematics in their own lives, both inside and outside of the classroom. This is where a mathematics rhizome, as framed in the next chapters, is key for our students' success and involvement. The present thesis proposes that when choosing a series of mathematical tasks, we posit that these should be representative of your students' experiences and worlds.

1.3 Defining the research field

Starting with the review of the field it is interesting to think about how mathematics as a science discipline is transformed to end up 'school maths' (Bernstein, 2000). Bernstein recognised three areas of tenets by which learning is turned into the form of a lesson in schools. These three areas comprise of: distributive standards identified with learning generation; recontextualising rules identified by official curriculum policy and the educational impact of teachers on this material; and evaluative guidelines identified by reproduction of knowledge by students in classrooms, tests and examinations (Blausten et al, 2020; Boyd & Ash, 2018; Puttick, 2015; Bernstein, 2000).

As far as mathematics is concerned, this procedure gives off an impression of being affected by convictions held about the challenging idea of the subject itself. Lakatos (1976) distinguishes one point of view affected by Euclidean system where mathematics might be considered as a set of worthy truths and another point of view where mathematics might be changed into a type of school discipline which is related to a teaching method "dominated by teacher demonstration followed by individual practice and high stakes testing with strict rules and right or wrong answers" (Boyd & Ash, 2018). Alternatively, mathematics might be viewed as a human activity as described by Polya (1957) as 'mathematics in the making'. This mathematics might be changed

into school mathematics that presents ‘fallible, refutable, and uncertain and which promotes critical thinking, creative reasoning, the generation of multiple solutions and of learning from errors and mistakes’ (Hudson et al., 2015).

According to Boaler (2016) school mathematics are related to two harming legends: first that just a few people, because of their unique ability, can do mathematics; and second that being great at mathematics is a definite sign that you are brilliant. These myths about mathematics have created a classroom environment that is traditional and the teacher is believed to be in possession or in control of the growth and development of understanding and monopolize communication during classroom instruction. Students individually solve exercises in a teacher-dominated environment; which reflect the authoritarian, didactic approach to classroom instruction where the mathematics teacher monopolizes classroom activities (Bature, 2020).

A move towards a more constructivist and dynamic learning approach in mathematics capable of contributing to some degree to “mathematics in the making” (Polya, 1957), have attempted to be embedded in schools (Hudson et al., 2015). Relevant studies in England for children aged between 4-11 years old show that the teachers teach the class across the high stakes school inspection National Curriculum, they are not mathematics specialists (Boyd & Ash, 2018). Additionally, the teachers’ educational and work environment histories impact their beliefs around mathematics and how to teach is a school subject (Rogers et al., 2011).

As teachers create their character as instructors of mathematics amid engagement in an educational curriculum development project, they are likely to differentiate their criteria for active learning. Teachers may feel most successful when they teach mathematics by ‘telling’ as they believe that the answer to mathematical problems is in books with the teacher acting as an interpreter (Stephan, 2014; Smith, 1996). On the other hand, Cognitively Guided Instruction[3] (CGI) has been tested to include underpinning values and beliefs, and it focuses on specific values related to inclusion.

[3] Cognitively Guided Instruction (CGI) professional development enhances teachers’ abilities to teach maths with understanding through a focus on students’ mathematical thinking. CGI teachers start with

Contemporary research in mathematics education focuses on making and sustaining practices that support the different dimensions of mathematics learning (Gutiérrez et al., 2018). Decades of classroom-based research and standards-based policies have featured the significance of curricular characteristics that support learners for good mathematics learning, responding thus to a growing demand for high-quality teaching and learning in mathematics classrooms (Tekkumru-Kisa, 2020; Boaler & Staples, 2008; Esmonde, 2009; Hand, 2010; Langer-Osuna, 2011). These studies form part of developing literature that explores students' perception of essential identity and power-related problems. Such studies provide an overview of school-based experiences; disclose patterns of participation and point identities as brief periods of time occur.

Certain analyses of student interaction during moments of mathematical activity reveal variation in how students assist each other in the learning process of mathematics, which may finally impact long haul directions of personality and commitment (Gutiérrez et al., 2018). Unfortunately, although these researches conclude to higher levels of 'relational equity' (Boaler, 2008), raise the status of students who are less confident and identify actions of responsibility for the learning of others, they have a remarkable impediment as they do not dive profoundly into the cognitive parts of mathematics learning that takes place in schools.

Relevant literature suggests that students-centred education provides opportunities for students to share their experiences and knowledge holistically and celebrate its authenticity through collaboration of ideas with their peers. It ensures students and teachers get involved in learning communities in which all participants have opportunities to engage in productive discourse. Similarly, it was observed that the mathematics teachers fostered positive relationships with their students, created classroom environments that are more conducive for learning and helped foster social,

what students know and build on their intuitive problem-solving processes so that each and every student understands rigorous math concepts. CGI enhances teachers' use of any textbook or curriculum materials by developing teachers' abilities to listen to students, ask good questions, and engage students with each other's ideas (CGI Math, 2018).

developmental, emotional and academic needs of their students (Bature, 2020).

Sebba et al. (2012) report how the 'Complex Instruction' . methodology was then explored by teachers of mathematics at the school of England in highly socio-economic deprived regions. They claim that the increments in learning experienced by students is due to the changes in pedagogical actions in ways that advance students' reasoning and problem-solving aptitudes, and increase comprehension depth[4].

Lundin's (2012) sociological approach[5] to mathematics education, demonstrated that researchers have to accept that a diverse, more equitable, mathematics education could be conceivable if we could leave back all the external pressures that weaken this school subject. The focus should not be on mathematics but the way this school subject gets sullied by a set of approaches that weaken its authentic existence (Valero & Pais, 2014).

A primary use of a sociological approach in mathematics education has to do with the capture of mathematics as a result of the position they have in modern societies. Mathematics itself is nothing if examined out of the different contexts where it is used. There is no sense of how much we would like mathematics to be an adventure in knowledge or a set of problem-solving methodology. By using methods of empirical investigation and critical analysis, such an approach engages with the complex relationships between individuals, groups, knowledge, discourse, and social practice, aiming at a theoretical understanding of social processes in mathematics education. These relationships are often conceived as tensions between the micro level

[4] Complex Instruction is a general pedagogical approach that addresses the problems of under-achievement and unequal participation in mathematics by the teaching of students in mixed ability groups, where the focus of teaching and learning is on group work-based, mathematical problem-solving that also involves collaborative problem-solving. This approach has been used and evaluated in the US since the 1980s. The authors suggest that this approach has been shown to increase students' engagement and achievement in mathematics (Welsh Government Social Research, 2012).

[5] Emile Durkheim was the first person who indicated the need for a sociological approach to education. He considered education "to be essentially social in character and in its functions and that as a result the theory of education relates more clearly to sociology than any other science." He emphasized that education is not a static phenomenon but a dynamic and ever-changing process. Educational sociology is by definition a discipline which studies education sociologically, with the premise that it recognizes education as a social fact, a process and an institution, having a social function and being determined socially. Educational sociology could appear only when it accepted the social nature of education (Ballantine et al., 2017)

of individual agency and interaction and the macro level of the social structure of society. The institutions of mathematics education and their functioning, often in terms of social reproduction, are of crucial concern (Shimizu, 2020).

Integrating mathematics into the social studies curriculum is welcome and positive. Trying to make the most of existing course books resources (Roberts, 2014), it is not hard to design lessons that tap into the mathematics as means to advancing the democratic, civic and participative notions of a sociological approach in education (Azevedo et al., 2019). Such approaches look to enable students to create a sense of themselves as social and historical beings and to engage the world in democratic and transformative ways. To extend on those thoughts, consider the basic education approaches established by Paulo Freire and the Pedagogy of the Oppressed[6] (1970) and their instantiation in mathematics education.

As Gutstein (2006) clarifies through his pedagogical model of 'reading and writing the world in mathematics', "Students need to be prepared through their mathematics education to investigate and critique injustice, and to challenge in words and actions oppressive structures and acts". He concludes by developing critical understanding of mathematics by students based on projects which are focused on their familiar circumstances and experiences.

Brown (2017) reports on his experiences of teaching the year 7 class in an urban primary school in Australia. 'Complex Instruction' (Boaler, 2008) is practised in adopting collaborative, problem-solving teaching methods and creating a sense of shared responsibility and participation among the students. He portrays how these methods enabled a learning group to evolve, to value the efforts and ideas of students and to encourage the mathematical arguments in a conscious socio-political sense.

[6] ***Pedagogy of the Oppressed*** written by educator Paulo Freire (1970), proposes a pedagogy with a new relationship between teacher, student, and society. The book is considered one of the foundational texts of critical pedagogy. Dedicated to the oppressed and based on his own experience helping Brazilian adults to read and write, Freire includes a detailed Marxist class analysis in his exploration of the relationship between the colonizer and the colonized. In the book Freire calls traditional pedagogy the "banking model of education" because it treats the student as an empty vessel to be filled with knowledge, like a piggy bank. He argues that pedagogy should instead treat the learner as a co-creator of knowledge.

Dixon et al. (2015) mention that prejudice reduction in members of the dominant society will solve the intergroup conflict. This statement shifts the power to make social change happen, even further away from the stigmatised minorities. Paule Freire (1982) presented the term “transformative education” to depict an instructive methodology that includes the remaking of social reality through critical discourse among teachers and students. Transformative education makes students comprehend and appreciate themselves, to utilise the knowledge as a method for esteeming and respecting cultural variety, to react upon their encounters so that they can provide a critical response to the world around them (Kyuchukov, 2000).

Panthi et al. (2018) address in their paper the question ‘How secondary school mathematics teachers perceive social justice in mathematics classroom?’. It is eminent that, in spite of the fact that the matter of value has ever considered being more important in mathematics teaching and learning, there is still little literature on how the term ought to be defined, framed and worked in the direction of social equity in classroom learning (Esmonde & Casewell, 2010). Esmonde & Casewell (2010) utilise the terms ‘value’ and ‘social equity’ reciprocally. Social equity in training has different implications, and consequently, it does not have specific or generalizable importance as it is open to question issues with several meanings.

Bolyan and Woosley (2015) demand that our comprehension of social equity is established in the significance of receiving both distributive and social point of view as well as perceiving a participative dimension. Teachers’ perceptions of social justice presuppose appreciation and value of the students’ particular culture and equal access to educational materials for all. However, is the access of culturally diverse students to curriculum materials provided by the central government for the students of the mainstream effective and efficient in order for education overall to be characterised as equal?

Participatory dimension implies capacity and potential for effective decision-making (Cochran-Smith, 2009). Social justice in education concretises individual and social issues, but it should not be spent just in addressing these issues. Tonko (2012) characterised “socially” simply teaching as a method for

encouraging students to comprehend their reality better and empower them to look for their plausible rights in their society while contributing to its improvement. More than that, teaching “socially” entails issues of equal access to employment and income which is an underlying factor of social exclusion, civic participation, and support for one’s personal life. Social equity signifies equity for poor and mistreated individuals, thus, Keddie (2011) proposes that schools should provide comprehensive conditions under which minimized voices are heard (political equity), minimized culture is perceived and valued (cultural equity), and underestimated students are encouraged in their educational achievements to obtain material benefits of society (economic equity) effectively.

In spite of the fact that the research community provides educational community with relevant scientific research knowledge about what sort of mathematics knowledge is of value for pre-service teachers (Lin, 2021; Ruthven, 2011) and what sort of education can make students able to deal with mathematical tasks effectively, existing culture is difficult to change (Lithner, 2017; Cohen, 2011; Morris, Hiebert, & Spitzer, 2009). Until now the literature remains relatively unclear about what translating theory to practice might resemble. While thinking about the connection between theory and practice, we do not accept the metaphor of a gap between theory and practice in teaching (Oank, 2015). Lampert (2010) mentions that the “notion that theory and practice are different from each other and that in the organisation of learning to teach, there is a ‘gap’ to be ‘bridged’”.

Venkat & Askew (2017) examine how mathematics can be taught in ways that pay attention to, and help develop an understanding of the underlying structures of mathematics at primary school from a sociocultural perspective which views the teacher as the principal agent mediating between the objects of learning of mathematics and the students. They propose a combination of theoretical derivation and empirical sensitivity is vital in that it provides a hypothesis about what counts as improving quality of instruction (the roots of change) while empirically illuminating some routes towards change.

Viladot et al. (2017) examined the relationship between mathematics and music analysing three areas: academic literature, the curriculum frameworks and publications, and resources prepared by and for teachers. It is suggested that a cross-curricular approach for mathematics can deepen children's understanding by providing opportunities to reinforce and enhance learning in general. Although mathematics is conceived as an instrument of knowledge, reasoning and critical analysis of reality and the problems of the environment itself, teachers lack confidence in their knowledge and understanding of how mathematics can be taught for social justice and reality.

It can be assumed that there is a small amount of published research evidence available that directs to working in school context with children who face social exclusion and have different cultural experiences with the aim to provide a culturally-oriented mathematics curriculum able to overcome existing obstacles of the education of the minority groups. It is argued that the present thesis has the potential to generate a valuable and considerable contribution to the field, providing except from the theoretical background, a detailed handbook that can be used in schools to make the bridging of the division between theory and practice a reality and remove the social exclusions resulting from mathematical education, thus, promoting the restoration of social justice.

1.4 Synopsis

The relation between mathematics, cultural diversity and social justice is usually ignored. Chapter 1 of this thesis focuses on the current practice related to the teaching of mathematics and how this is affected by and based on the prevailing social norms and beliefs. The role of government stands as well as the established approaches of teaching mathematics through collecting mathematical relationships or rules expressed in symbols and calculations are also reviewed in the attempt to shed light on the rationale behind the widespread belief that only talented students perform while studying mathematics.

The idea of curriculum reconceptualisation as a tool for social reform and development of a pioneering approach to encourage cultural integration and comprehension and acknowledgement of alternative viewpoints in mathematics is promoted and linked to research findings.

Relevant literature about student-centric education and its relation to the provision of opportunities for students to share their experiences and knowledge through collaboration of ideas with their peers is presented in detail to support the belief of ethnomathematics in the educational process and promote the role of the teacher as the principal agent mediating between the objects of learning of mathematics and the students.

Finally, the aims of the present research are discussed and linked to the contemporary trends and challenges in the teaching of mathematics in the current environment and how the structure of the curriculum should be a reflection and a connector between knowledge and society to support education within minorities.

Chapter 2: The pedagogy of mathematics

2.0 Summary

In this chapter, an educational framework relating to teaching mathematics and reconceptualising curriculum for social justice will be developed. In the beginning, epistemological issues in the teaching of mathematics will be presented while at a later time relate these issues to the idiosyncrasy of school mathematics. Further on, the purpose of mathematics education will be analysed in terms of reproducing social injustice in mathematics classrooms and finally there will be an analysis of critical mathematics education.

2.1 Epistemological issues in the teaching of mathematics

Epistemological inquiries concerning mathematics are researched and developed by both expert mathematicians and philosophers, with the former generally being occupied with the fundamental research and the latter adding to the philosophy of mathematics (Horsten, 2016). These inquiries are not new as they go back to the fourth century BC and are credited to Plato and Aristotle (Dossey, 1992). For Plato, mathematical objects had their existence, where clear lines characterised the ideas of the mind and their representations as discerned by the human senses. On the other hand, Aristotle, who was a student of Plato, considered unique mathematical ideas as idealisations performed by the mathematician, because of the involvement with objects. These two different points of view helped develop two separate schools of thought that later moved towards becoming related to absolutism and fallibilism angles (Ernest, 1991).

Absolutism sees mathematical comprehension as a group of knowledge which contains outright, confident, and unchallengeable certainties while fallibilism, on the other hand, sees mathematics knowledge and truth as capable of being corrected or reformed (Xenofontos, 2018). The ‘absolutism versus fallibilism’ banter was aggravated by the research of contemporary philosophers of mathematics, like Lakatos (1976) and Tymoczko (1986) both members of the fallibilism school emerging, thus, a number of paradigms (for

example logicism, formalism, intuitionism[7] etc.) to secure the nature of mathematics (Handal, 2003).

Dossey (1992) mentions that this mixture of conceptions about the nature of mathematics has influenced the ways researchers, teachers and the general public see the teaching and learning procedure of mathematics. However, numerous researchers feature that there are outstanding contrasts between expert mathematicians' and school teachers' methods for doing mathematics (Beswick, 2012; Boaler, 2008). Boaler (2008) points out that "the erroneous thinking behind many school approaches is that students should spend years being drilled in a set of methods that they can use later" (p. 31), while for professional mathematicians, "mathematics is all about illuminating relationships such as those found in shapes and in nature and constitute a powerful way of expressing relationships and ideas in numerical, graphical, symbolic, verbal and pictorial forms" (p.19). Such variations could be ascribed to the distinctive ways epistemological convictions and practices created by the two networks of experts (mathematicians and teachers), just as to the curricular focus on procedural or conceptual knowledge, as set by policymakers (Garagae, 2016).

Ernest (1989, 1991) portrays three kinds of epistemological beliefs: the platonist view where mathematics is seen as a static but unified set of knowledge whose structure and connections between various aspects are significant, the instrumentalist view where mathematics is a useful and essentially unrelated collection of facts, rules and skills and finally the problem-solving view where mathematics is a dynamic and innovative human creation and a problem-oriented field of inquiry.

7 Logicism, intuitionism and formalism are three traditional views about the nature of mathematics. Formalism was introduced by the German mathematician David Hilbert, and it holds that all mathematics can be reduced to rules for manipulating formulas without any reference to the meanings of the formulas. Thus, according to formalism, it is the mathematical symbols themselves and not any meaning that might be ascribed to them that are the basic objects of mathematics. Logicism was introduced by the German mathematician Gottlob Frege and the British mathematician Bertrand Russell. It holds that mathematics is actually logic. According to Logicism, all of mathematics can be deduced from pure logic without the use of any specifically mathematical concepts (such as numbers). Intuitionism was introduced by the Dutch mathematician L.E.J. Brouwer. It holds that the primary objects of mathematics are mental constructions governed by self-evident laws. Intuitionism has challenged many of the principles of mathematics as being non constructive and hence mathematically meaningless.

Similar to the above, Lerman (1990) depicts a bipolar system wherein the fallibilism paradigm; teachers offer students critical thinking opportunities, through which the procedures of mathematics may be created through social construction of mathematical knowledge, and in the absolutism paradigm; mathematics is seen as "an immutable body of knowledge, where creativity occurs only at the cutting edge of research, and teachers transmit their knowledge in the well-defined and replicable ways that their teachers used before them" (Andrews & Hatch, 1999, p. 206).

Drawing on Ernest and Lerman, different analysts propose refined structures which rise up out of praxis, like Andrews and Hatch (1999, 2000) and their investigation on English and Hungarian secondary teachers, and Goos (2006), who thinks about her own experiences as a mathematics teacher educator, and on the epistemological beliefs of her Australian student-teachers. The particular species of epistemological beliefs are described briefly in Table 1, as proposed by Xenofontos (2018).

Table 1: Various epistemological beliefs about mathematics held by teachers, as described by Andrews and Hatch (1999, 2000) and Goos (2006).

Andrews and Hatch (1999, 2000)

Mathematics as a personal economic tool: Mathematics might facilitate a person's managing his or her household accounts.

Mathematics as a diverse and pleasurable activity: People engage with mathematics and, more importantly, its processes in various ways and, in so doing, gain pleasure.

Mathematics as an essential life-tool: An understanding of mathematics allows people to comprehend the world and make informed decisions.

Mathematics as a service provider: Mathematics is essential for other areas of human activity such as science, commerce, industry and technology and, as such, was seen as a collection of results to be used rather than understood.

Mathematics as a curricular determination: Mathematics is the prerogative of teachers rather than governments.

Goos (2006)

Mathematics as a number: Mathematics is about understanding and working with numbers and symbols, or rules that apply to numbers.

Mathematics as a tool: Mathematics is essential in our everyday and working lives, a skill needed for many jobs: the base for science, accounting, engineering, and provides the fundamentals for everyday living.

Mathematics as logical thinking: Mathematics involves learning how to think logically and is a way to think and solve real-life problems.

Mathematics as a language: Mathematics is a creative language or a language of numbers and symbols that provides a means of communication.

Mathematics as patterns: Mathematics is the science of patterns and relationships or is about numbers and patterns.

Mathematics as a way of interpreting the world: Mathematics is a daily life experience (you see it everywhere) or a way of describing everything in life.

Mathematics as beauty: Mathematics is inescapable, fun, exciting, awe-inspiring.

The results of much comparative research (Applebaum, Freiman, & Leikin, 2011; Xenofontos & Andrews, 2012, 2014) have established that mathematics teachers' beliefs are culturally defined. Mathematics has parts beneath their basic functionality related to arithmetic and simple algebra. It is an all-powerful language for the dissemination and systematisation of knowledge as part of human culture. Mathematics is a field with its own historical and cultural heritage, and it is used to be synonymous with math or number, and will soon be taught in several countries by people who no longer know what mathematics is (Freudenthal, 1973). This circumstance emerges since mathematics is thought to be not just complicated but distant, obscured and murky, without a human face. An absolutist view of mathematics is inadequate to explain the social, cultural and political nature of mathematics.

Notwithstanding, there is a necessity to perceive in what way the cultural significance is often connected to mathematical understandings in a specific way which gives value to both. One issue is to identify a way to give value to

both cultural and mathematical information in modern school settings especially when these are isolated from traditional contexts, while also recognising that culture is not static but changes to meet contemporary challenges. Bishop (1990) used the expression "cultural imperialism[8]" in describing how "western mathematics has been one of the most powerful weapons in the imposition of western culture". This is because, from the Māori perspective, obtaining European knowledge, in particular, the knowledge associated with technology and trade, could enhance their traditional ways of life (Spolsky, 2005).

Bishop (1988) argues that mathematics is a cultural product arising from participation in various activities such as locating, designing and measuring. Bishop's work highlights the culturally specific nature of mathematics and the danger of assuming it is based on a universal language which can be understood across different cultures. The political nature of mathematics is apparent in the way that dominant groups which define goals and results have the financial resources necessary to fund research in areas which serve their interests such as business and commerce (Wright, 2013).

On the other hand, various mathematicians, like Thomas (1996), powerfully argued that the contextualising of mathematics should have been opposed with the goal that it did not turn into a watered-down adaptation of mathematics as to what it ought to be considered as. Boaler (2009) illustrates that students' experiences of school mathematics are poor because curriculum content is remarkably removed from the work of mathematicians

[8] **Cultural imperialism**, in anthropology, sociology, and ethics, the imposition by one usually politically or economically dominant community of various aspects of its own culture onto another non-dominant community. It is cultural in that the customs, traditions, religion, language, social and moral norms, and other aspects of the imposing community are distinct from, though often closely related to, the economic and political systems that shape the other community. It is a form of imperialism in that the imposing community forcefully extends the authority of its way of life over the other population by either transforming or replacing aspects of the non-dominant community's culture. Later, cultural imperialism became one of the primary instruments of colonization. While colonization was almost always initiated by some kind of military intervention, its full effects were achieved through practices of cultural imperialism. Fueled by a belief in the superiority of their own way of life, colonizers used law, education, and/or military force to impose various aspects of their own culture onto the target population. Motivated, in part, by a desire to purge local populations of allegedly barbaric, uncivilized customs and mores, colonizers also knew that the best way to mitigate resistance by the colonized was to eradicate as far as possible all traces of their former way of life (The Editors of Encyclopaedia Britannica, 2021).

who apply their knowledge in real life and employment. This is the reason why mathematics is thought to be learned through school education. According to Mazana et al. (2019), the factors influencing the students' liking or disliking of mathematics constituted the student's aptitude attribute and include several instructional, social, psychological and environmental factors. Furthermore, the results show that failure in examinations is attributed to teacher didactic strategies, institutional resources, poor learning and examination strategies, and failure to understand instructions.

D'Ambrosio (2006) contends that a type of mathematics, dominant in Europe in the 16th and 17th century, was forced upon the world through the process of colonisation. Schools were established within the colonies, with the aim of subordinating indigenous cultures, and this 'academic mathematics' displaced alternative types of mathematics antecedently practised by indigenous populations. D'Ambrosio (2008; p. 38) claims that, in this way, mathematics has contributed towards "the technological, industrial, military, economic and political complexes" which are responsible for "the growing crisis threatening humanity".

An absolutist view of mathematics fails to take account of the differences in achievement in and engagement with school mathematics amongst different groups within the society (Wright, 2013). Social turn in mathematics education was developed in order for researchers to understand differences in achievement and engagement using social rather than cognitive theories (Kaiser, 2020; Lerman, 2000). This recontextualisation of mathematics education aims at addressing issues of equity in the educational process.

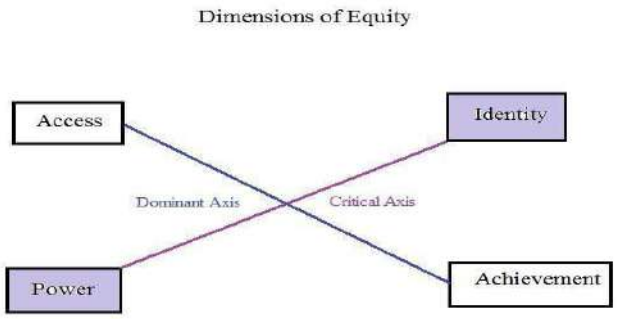
Despite the developing consideration of equity in mathematics, education has been proved to promote 'talk' of equity getting to be more standard within the mathematics education process (Gutiérrez and Dixon-Roman 2011), with the term regularly having distinctive meanings to individuals. When alluding to educational equity, the term equality is often used as well. It is evident that the terms have near similitudes although they have essential distinctions. Zhu (2018) mentions that according to the Oxford English Dictionary, equity is

defined as “the quality of being fair and impartial” while equality as “the state of being equal, especially in status, rights, or opportunities”.

Based on these two definitions, the former appears to be more around being fair-minded, and the latter being approximately the same. In this sense, contrasts related to personal needs and necessities are recognised and treated within the idea of equity; oppositely, everybody will be respected and treated within the same way without focusing on particular needs and necessities within the notion of equality.

While most equity-based mathematics education studies seem to focus on inspection of the existing gap between theory and practice, Lubienski and Gutiérrez (2008) have proposed a broader awareness to cope with equity troubles such as identity and experience issues. Referring to Gutiérrez’s (2009) four-dimension model of equity (see Table 2), equity-based research in mathematics education should move beyond the “dominant axis -access and achievement- and include the “critical axis” -identity and power- so as to allow students not only to cope with mathematics but also to change mathematics (Zhu, 2018).

Table 2: Four-dimension model of equity (Gutiérrez, 2009)



The notion of Ethnomathematics bridges this epistemological gap that has developed since the 1980s to express the connection between science and culture (D’Ambrosio, 1999). Ethnomathematics research examines a diverse range of ideas, including numeric traditions and patterns, as well as education policy and pedagogy in mathematics education. “One of the goals of ethnomathematics is to contribute both to the understanding of culture and the

understanding of mathematics as a science subject, and mainly to lead to an appreciation of the connections between the two" (D'Ambrosio, 1999, p. 146).

Either teachers with mathematics or mathematics-related degrees, or some with significant prior experience in mathematics-related employment, had not given serious consideration to the nature of mathematics (Wright, 2013). Relevant research findings pointed out teachers should increase their awareness of how their knowledge, practices and beliefs about mathematics learning development because they might affect students to improve their future practices. Teachers' beliefs about mathematics learning development could be related to their beliefs about the nature of mathematical knowledge and indicators of high performance in mathematics (Hamukwaya & Haser, 2021).

2.2 Idiosyncrasy of school mathematics

Mathematics has long been seen as 'difficult' and overwhelming as it has been for intelligent people. Cockfort (1982) reported that it is 'a difficult subject both to teach and to learn' and Dowkey (2004) mentioned that 'many children have difficulties with mathematics'. For many adults, remembrances of complex mathematical procedures and activities provoke math anxiety and feelings of inadequacy in this subject while they describe their memories of mathematics in terms of fear, terror and horror (Haylock, 2010). According to Putri et al. (2020) high mathematical anxiety has an impact on mathematics learning achievement. Longitudinal research indicates that low attainment in mathematics can have significant long-term consequences, affecting later school achievement, employment, criminality, mental health, and future earnings. In many countries, underachievement in mathematics is strongly associated with social, cultural, and economic disadvantages.

These negative opinions about school mathematics are consolidated in the consciousness of the wider society and are transferred from one generation to the next sharpening the existing problem of mathematics education. Indeed, it is noted that the majority of parents prefer to help their children in language teaching rather than in mathematics because they feel inadequate and unable

to cope with school activities. They very often articulate the phrase that “mathematics and their teaching has changed since they were taught at school” leaving it to be understood that in fact they did not understand embedding essential pieces of mathematical knowledge. Such a reaction can be interpreted in the context of students neither feeling comfortable nor enjoying learning mathematics, instead of feeling afraid or anxious. Anxiety is included in the realm of attitude in mathematics that must be well developed (Putri et al., 2020).

Relevant research (Enderson & Mann, 2018) shows that mathematics work as a ‘critical filter’ in striving towards scientific and technical careers. Mathematical skills are essential in most professions including the fields of business and social sciences (Luzzo et al., 1999). In particular, knowledge of basic mathematical concepts is critical for the successful performance of a wide range of roles across finance, purchasing, management and sales professions. Moreover, students lacking trust in mathematics, regularly, avoid interpreting recently learned mathematical ideas to new settings (Boaler, 1993). Mathematical learning means a learner is making reorganizations, or accommodations, in her schemes in on-going interaction in her experiential world. When students interiorize, or re-process of the results of their schemes so that they are available prior to activity, they abstract concepts (Hackenberg et al., 2020)

Significant research concludes that in improving students’ performance in mathematical subjects, an effort should be made by raising motivation and self-esteem of the students. Efforts to improve mathematics performance in education require continuous and constant actions. Practically it is necessary to diversify the method of learning mathematics to attract weak students to love mathematics courses. Real-life activities need to be prepared to show that mathematical knowledge is not just limited to doing quizzes, tests and final exams. More attention should be given to the students who have lower performance in mathematical results (Wahid et al., 2018).

The fact that low mathematics certainty and accomplishment can limit students’ capacity to explore career opportunities that require quantitative

skills highlights the need to address the absence of mathematical certainty and accomplishment among non-mathematics and non-science students (Flynn and Sandberg, 1993; House, 1995; Enderson & Mann, 2018). On the other hand, it is observed in several countries that an increased percentage of students choose study directions that have as their main corps advanced mathematics modules concerning those who choose language and theoretical directions. This fact may indicate that study directions containing mathematics provide a larger range of options for bachelor degrees and professional development, verifying the fact that mathematics very often acts as a critical filter even for students' future lives.

A significant study by Parsons and Bynner (2005) entitled 'Does Numeracy matter more?' showed that people with poor numeracy tended to leave full-time education at the earliest opportunity and usually without qualifications, followed by patchy employment with periods of casual work and unemployment. Most of their jobs were low skilled and poorly paid and offered few chances of training or promotion. Overall, poor numeracy rather than poor literacy was associated with low economic well-being.

Lerman (2000, p. 21) argues that the unique position of mathematics in the educational modules can be ascribed to the historical adherence to the obsolete thought of absolutism in the sense that "Mathematics has stood as exemplar of truth and rationality since ancient times, giving it a unique status in most world cultures and intellectual communities. That status may account for mathematics being seen as a marker of general intellectual capacity rather than simple aptitude in mathematics".

A critique often made in such research is its propensity to use conceptual structures that are internal to the individual such as self-efficacy and anxiety and thereby separate the environment in which these feelings are born and reproduced. In a match to the social turn-in mathematics (Lerman, 2000), mentions that notions like 'identity' and 'positioning' are used to establish students' beliefs about mathematics as produced through the engagement in social, cultural and educational practices which mediate the ideas we construct about ourselves (Black & Radovic, 2018; Solomon, 2008). This

construct is based on the method of reasoning that the personality we move towards becoming (in connection to mathematics) is unpredictably associated with what we do at the time (our being), and that what we do is socially arranged and characterized (Black & Radovic, 2018).

This approach to study students' effective relationships with school mathematics is related to how identities are created in practice through participation in specific forms of pedagogical and educational practice mediated by culture and ethnicity. For example, as the research of Boaler and Greeno (2000) in two different classes where algebra is taught either by teacher ‘telling’ method or collaborative discussion demonstrates, the teaching approach in the classroom made students able to co-modify different identities as passive receivers of knowledge and active learners respectively. More recently, Eisenhart & Aller (2016) show how neo-liberal educational practice promotes weak mathematics identities in schools as they focus on the performance rather than the value of mathematics. They studied two schools in the United States with students who had low math performance and came from low social and economic backgrounds, where both schools apply strategies to improve students’ performance in mathematics. Their findings show that encouraging students to focus on getting good grades has as a side effect little or even absent recognition of what mathematics is outside of this context.

D’ Ambrosio (2008) argues that the belief that success in mathematics can be used as a valid measure of general student intelligence is dangerous and detrimental to the students themselves. The correlation of success in mathematics with intelligence guides to a false mathematical identity that is static rather than dynamic and adapting to the challenges of the learning process. It is common to divide students into levels based on their mathematical skills, which reproduces issues of inequity, discrimination and enforces the culture of power and dominance even inside school context. Students are taught maths into different performance groups leading them from an early age to consider themselves as capable or incapable to meet the curriculum standards (Brooks, 2021). In fact what happens has two sides; on the one hand, ‘weak’ learners are treated by offering them a wide range of

exercises to become strong in mathematics, while on the other hand ‘capable’ students become passive acquirers of knowledge in order to learn more demanding tasks.

The fruitful interaction between students who are considered to be experiencing difficulties in mathematics and high-quality teachers who can respond to the challenges is critical for effective mathematics education (Averill, Anderson, & Drake, 2015). Teachers need to be able to implement a curriculum suited to the learning needs of their students while allowing them to experience positive emotions such as success. The structure of the mathematics class should include appropriate peer interactions. These interactions help develop self-efficacy and engagement vital to improving achievement (Barth, Dunlap, & Dane, 2004). Understanding these contributors (teacher, curriculum, and peers) could help teachers meet the students’ needs in mathematics and affect a potential change of their self-efficacy and identity beliefs as well as engagement (Burton, 2018).

Many studies carried out in different countries identify some factors influencing students' performance in mathematics. The attitude of students towards mathematics is the most important among these factors that has emerged (Addae & Agyei, 2018). Moreover, studies emphasise the relationship between students’ beliefs and their academic performance, showing a positive correlation. Teachers’, also, positive attitude towards mathematics for good performance plays unquestionably a key role in the shaping of the future of students. Consequently, their teaching practices may be identified as one of the predominant factors influencing the formation of students’ attitudes towards their learning of mathematics (Jordan, 2018; Bawuah et al., 2014).

Nardi & Steward (2003) describe the ‘quiet disaffection’ of a large group of students as a result of the teaching of mathematics, which is characterised as boring, irrelevant and ignoring individual needs. Brown et al. (2008) mention that main factors deterring students are the perceived difficulty of mathematics-based either on their previous experience as learners or through the sharing of common thoughts with members of their families (like older

siblings) and teachers. Teacher enjoyment of teaching mathematics is positively associated with a number of valued outcomes, such as a willingness to spend more time teaching mathematics and to encourage productive struggle with more cognitively demanding tasks (Russo et al., 2020),

In a culture where mathematics is perceived to be 'hard' and only for 'clever' people and mathematical incompetence is socially acceptable, we need to consider how we, as teachers and researchers, can address this (Mc Ateer, 2012). Possible strategies that can respond to the removal of the structural barriers to mathematics mainly concern the reduction of the hierarchies in curriculum and taking initiatives so that schools try to tackle rather than close their eyes to the difficulties that students face. Another group of strategies involves resolving personal barriers to mathematics which has to do with the increase of self-confidence and self-efficacy, encouraging students' positive identities concerning the subject of mathematics. This can be realised through integrating cultural and social peculiarities into the mathematics curriculum for the students to be able to understand the use of the individual school knowledge.

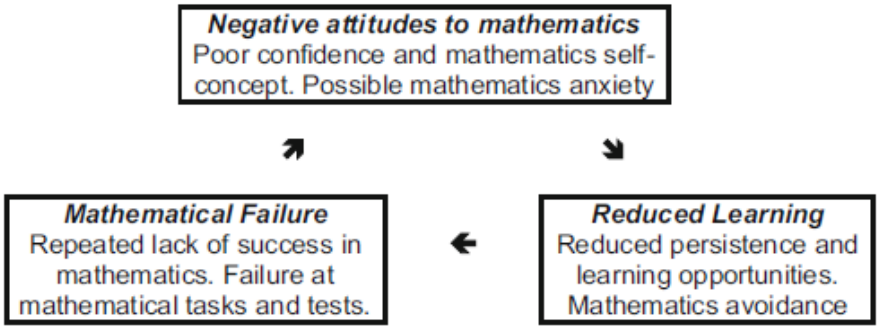


Table 3: The failure cycle (adapted from Ernest, 2013)

2.3 The purpose of mathematics education

Napoleon once said that mathematics is 'intimately connected with the prosperity of the state' (cited by Boyer & Merzbach, 2011, p. 466). Cockfort (1982) wrote 'Few subjects are as important to the future of the nation as mathematics'. The US National Research Council (2009) noted that 'The new demands of international competition in the twenty-first century require a

workforce that is competent in and comfortable with mathematics'; and to that end 'The committee [of experts] was charged with examining existing research in order to develop appropriate mathematics learning objectives for preschool children; providing evidence-based insights related to curriculum, instruction and teacher education for achieving these learning objectives' (p. 1).

This concern is understandable and has encouraged in recent decades amongst the members of the mathematical community, the belief that there is a need to create a relevant and engaging mathematics curriculum with a greater focus on culturally situated tasks, problem-solving, and conceptual understanding (Cockfort, 1982). Nevertheless, there are several cases where school mathematics continues to be taught as transmission of procedural methodologies alienating learners. This fact creates tensions and opposition between teachers and the policy-makers, leading to constant reforms in the classroom training. A frequent question that concerns both mathematics teachers and those wishing to engage in teaching mathematics concerns the fundamental goal of mathematics education. It is a common assumption that several hours of conferences and debates are spent about the curriculum of mathematics[9] without, however, creating exceptional knowledge capable of changing practices in the classroom (Baird & Clark, 2017).

Examination of the fundamental goals of mathematics education, according to Wright (2013) often receives a wide range of responses including developing financial literacy, numeracy and problem-solving skills required in everyday

[9] The documentational approach to didactics focuses on the interactions between teachers and different kinds of resources, and on the consequences of these interactions in terms of professional development and professional growth (as defined by Perrin-Glorian, Deblois, & Robert, 2010). 'Resources' in this approach takes on a broad meaning as proposed by Adler (2000): everything likely to resource the teacher's practice, hence to contribute to the teacher's professional growth. This includes curriculum materials, but also cultural resources like language, discussions with students or colleagues. This perspective invites attention to be given to the multiple forms of resources that come into play in teachers' work. A teacher might sometimes look for new resources for a precise teaching objective, discover new resources during a discussion with colleagues or when visiting a website (outside of any precise teaching objective). He/she can use these resources immediately or keep them for later potential use. When preparing a lesson, the teacher will also look through resources that he/she has already used before; he/she will combine different resources, modify them, use them in class and can also share them with colleagues. All this activity constitutes the documentation work of the teacher; it holds a central place in the teacher's professional activity, in and out of the classroom (Gueudet & Poisard, 2018).

life, other subject areas and in employment, appreciating the beauty of mathematics, and acquiring logical thinking and deductive reasoning. This wide range of aims is reflected in the introductory statement from the recently introduced ‘mathematics programs of study’ in England (DFE, 2013).

A large part of the literature on student engagement in mathematics is complicated by numerous and nuanced definitions (Hilton, 2016). An attempt to synthesise the bibliography is problematic since it contains a proliferation of constructs, definitions, and measures of concepts, which differ slightly, thus doing little to improve conceptual clarity (Fredricks et al., 2004). Attard (2014) makes a difference defining the engagement in mathematics in a sound way as the ‘coming together’ of cognitive, emotional, and behavioural engagement that leads to students’ enjoyment and valuing of mathematics (p. 3). According to Attard (2011), classroom engagement involves active participation and involvement in classroom activities.

Since 1992 it has been acknowledged that emotional issues are at the core of mathematical teaching and learning (McLeod, 1992). Relevant research shows that students will have increased levels of engagement in mathematics if they have positive attitudes and experiences to mathematics such as high mathematical self-perceptions and enjoyment of mathematics. The students’ experience of success when learning mathematics is also found to be positively associated with students’ engagement, thus, highlighting the imperative need to find ways to actively promote favourable learning of mathematics (Barkatsas, Kasimatis & Gialamas, 2009; Commonwealth of Australia, 2008; Dowker, Bennett & Smith, 2012).

Unfortunately, research shows that students already in the middle classes of elementary school have developed and consolidated their attitudes towards mathematics (Dowker et al., 2012), which affects both their future engagement and achievement in mathematics. At the same time, it is revealed that negative behaviours are often related to female gender and low participation rates in school attendance. It is also an inherent inefficiency of mathematics education that many times students experience negative feelings

for mathematics education even before coming in contact with the school modules as this is cultivated through their families and social milieu.

Minimum psychometric studies are used to measure the attitude of primary school students in mathematics while some authors have defined mathematical self-perceptions as ‘a person’s perceptions of self as a mathematical learner, including beliefs about his or her ability to learn and to perform well in mathematics’ (Adelson & McCoach, 2011, p. 226). They have defined the enjoyment of mathematics as ‘the degree to which a person takes pleasure in doing and learning mathematics’ (Adelson & McCoach, 2011, p. 44). Their decision to focus on mathematical self-perceptions and enjoyment of mathematics stems from the fact that these aspects have not been widely researched and yet they are known to have a strong influence on students’ engagement and achievement in mathematics.

Policy-makers around the world are actively involved in curriculum review processes to respond to global and local emerging research into the socio-economic and political dynamics of education; these include the transfer of theory and ideas to new educational practices (Pietarinen, Pyhältö & Soini, 2017), standardization of content and outcome of education (Porter, Fusarelli & Fusarelli, 2015), the renewal of educational content and experiences, and the introduction of curricula with pedagogical approach which brings into center the student. Several statements concerning the creation of mathematical curricula focus on opposing and conflicting views about the nature of mathematics as they are imprinted between the notions of mathematical ‘processes and applications’ and ‘content and procedures’ (Dowling & Noss, 1990).

Teachers are the key people in the implementation of the recontextualisation of the mathematics curriculum. Teachers are confronted as powerful agents of curriculum change and their readiness to adopt curriculum reforms is significant in shaping the success or failure of curriculum change (Lee, Yin, Zhang & Jin, 2011). Therefore, it is vitally important for teachers to be involved in the development of curricula. Otherwise, teachers are burdened with

learning how to manage a structured curriculum and how to adopt the proposed program in the school reality.

In this case, teachers limit their effectiveness which can lead to inefficient and low-quality education. Pre-service and in-service teacher training programs tend to focus both on pedagogical content knowledge and ideologies which inform curricula rather than on curriculum theory (Mnguni, 2013). Kelchtermans (2005) argues that underlying teaching philosophies, teachers' emotions and normative beliefs, which are grounded on the structural condition of the teaching job, are often ignored in the process of curriculum recontextualisation. Moreover, Ajzen (1991) claims that behaviour such as teaching is associated with normative beliefs. Consequently, if curriculum reforms impose different normative beliefs, they may trigger intense resistance (Mnguni, 2018; Bantwini & King-McKenzie, 2011).

A curriculum ideology refers to “the overarching aims or purposes of education, the nature of the child or student, the way learning must take place, the role of the teacher during instruction, the most important kind of knowledge that the curriculum is concerned with and the nature of this kind of knowledge, and the nature of assessment” (Schiro, 2008; p. 7).

Schiro (2008) has developed a framework for school curriculum ideologies. He provides a cogent summary of four specific curriculum ideologies documented in the literature. These are defined as a discipline-centred ideology, service-centred ideology, student-centred ideology and citizenship-centred ideology. Each ideology is based on the view that there are six components of the curriculum through which a curriculum ideology could be understood. These are the purpose of the subject, the nature of knowledge, the educational process (including teaching and learning), the role of the teachers, the role of the students and the assessment.

Curriculum features		Discipline-centred ideology	Service-centred ideology	Student-centred ideology	Citizenship-centred ideology
Aim of the subject	Purpose for knowledge	Understanding	Doing / action	Actualizing oneself	Interpret and reconstruct society
Content knowledge	Nature of knowledge	Didactic statements	Capabilities for action	Personal meanings	Intelligence and a moral stance
	Source of knowledge	Objective reality as interpreted by academic disciplines	Normative objective reality as socially interpreted	Individuals' personal creative response to experience	Individuals' interpretation of society's past, present and future
Instructional Process	Learning viewed from	Transmitter	Transmitter	Receiver	Transmitter
	Primary function of learning	Social transmission	Social transmission	Growth	Social transmission
	Result of learning	Changed mindset	Changed behaviour	Changed mindset	Changed behaviour
	Primary actor during learning	Agent	Agent/student	Student	Agent/student
	Student readiness	Simplification of difficult topics	Providing prerequisite behavioural capabilities	Stages of growth	Gestalt of prior experience
The student	Role during learning	Passive	Active	Active	Active
	Teachers focuses on	Student's mind	Student's behaviour	Student's mind	Student's behaviour
	Teachers concerned with children	As they ought to be	As they ought to be	As they are	As they ought to be
	Viewing children	In relation to standardized norms	In relation to standardized norms	As individuals	In relation to standardized norms
Teaching	Role of teacher	Transmitter	Supervisor	Facilitator	Colleague
	Standards used to measure teacher effectiveness	Accurate presentation of discipline	Efficiency of student learning	Facilitation of growth	Effective transference of the vision
	Teachers stimulate	Uniformity	Uniformity	Diversity	Uniformity
	Teachers	Directly implement curriculum	Directly implement curriculum	Adapt curriculum (according to children's needs)	Adapt curriculum (according to social concerns)
	Media used during learning	Didactic discourse	Programmed instruction	Child-environment interaction	Group dynamics
	Intent of teaching	To advance students in a discipline	To prepare students to perform skills	To stimulate child growth	To acculturate students into educators' vision
Assessment	Purpose of evaluation to the evaluator	Rank students for a future in the discipline	Certify that students have the skills	Diagnose students' abilities to facilitate growth	Measure student progress with respect to ability
	Nature of assessment tools	Norm reinforced	Criterion reinforced	Informal subjective diagnosis	Informal subjective diagnosis
	Assessments are	Objective	Objective	Subjective	Subjective
	Point of assessment	After instruction	After instruction	During instruction	During instruction

Table 4: A comparison of curriculum ideologies (adapted by Shiro, 2008)

The primary objective of discipline-centred ideology is the transfer of discipline-specific knowledge by teaching students epistemological and ontological principles of this subject, aiming at the autonomy of different teaching subjects and the associated knowledge. The curriculum is considered hard and rigid with no need for reform.

The service-centred ideology focuses on society and especially the services the student must be offered (Schiro, 2008). According to this ideology, the school is responsible for identifying social problems and developing curricula which will help students acquire the necessary skills needed to provide service to the society. The curriculum, in this case, is derived from a particular task considered essential to do a particular job (Mnguni, 2018). Curriculum creators in this respect translate knowledge into learning goals, which in turn are orchestrated into learning encounters.

In the student-centred ideology, teaching and learning are focused on the student, his interests and abilities and students are allowed to construct their knowledge and develop appropriate skills (Schiro, 2008). Teaching, in that sense, is a nurturing process where teachers are facilitators and mentors. The

student-centred ideology is founded on the idea that “artisans learn to forge by forging, to carve by carving, to paint by painting...let children learn to write by writing, to sing by singing, and to reason by reasoning” (Schiro, 2008, p. 112). It is based on the idea that students’ standard capacities and interface ought to be central to instructing to encourage the development of students by improving their aptitudes and skills.

Citizenship-centred ideology is seen as the ideology which promotes principles of citizenship in education (Mnguni, 2017). In this philosophy, students are seen as individuals of the community in which they live, who can impact and at the same time be affected by the standards, the values and the practices of their social groups through insights and knowledge (Cotti & Schiro, 2004). At the central core of a citizenship-centred ideology we find the view that students develop their knowledge and skills which will enable them to identify social skills and should be able to reconstruct these into social benefits. This approach, in any case, implies that instruction and learning must happen inside community settings, instead of disconnected school classrooms that are separated from the community, so that natural elements of the society are an indispensable portion of the educational curriculum. It is this shape of education which seems to cultivate citizenship.

Mathematics has an intrinsic value and as Ernest (2016) mentions the expansion of mathematics for its own sake is an ethical good for humankind. Some of the aspects of mathematics have as positive consequence the enhancement of real thinking, the compelling exploration of real life truth and ideas, and application of intellectual power in real-life. Another feature of school mathematics is that they use symbols and their mathematical language.

Mathematics although it often appears through mathematical representations, it is commonly accepted that it uses imperative mood and imperative orders which instruct or direct actions either inclusively such as “let us consider etc.” or exclusively, such as “add, count, solve, prove etc.” (Ernest, 2018). More frequently imperatives are present in mathematics than in any other school subject (Ernest, 1998). School mathematics includes strict rules leaving little

room for differentiation so students need to learn to use their language and follow the rules with high precision. There is no objection that mathematics is one of the most critical ways in which social training in obedience and apprenticeship is achieved.

Ernest (2018) mentions characteristically that “One of the most important ways that social training in obedience is achieved is through the universal teaching and learning of mathematics from a very early age and throughout the school years. The central and universal role of arithmetic in schooling provides the symbolic tools for quantified thought, including not only the ability to conceptualise situations quantitatively but a compulsion to do so. This compulsion first comes from the without but is appropriated, internalized and elaborated as part of the postmodern citizen’s identity. We cannot stop calculating and assigning quantified values to everything in a society in which what matters is what counts or is counted.” Specific objectives of development of a mathematical identity in schools are presented in the table below adapted by Ernest (2018).

Development of a mathematical identity in schools

Students should:

1. Acquire an object-oriented language of objects and processes,

2. Learn to conduct operations on and with them without any intrinsic reasons or sense of value, thus operating with deferred meaning,

3. Decontextualise their world of experience and replace it by a deliberately unrealistic and very stylized model composed of simplified static objects and reversible processes,

4. Suppress subjectivity, experiential being and feelings in their mathematical operations on objects, processes and models,

5. Learn to prioritise and value the outcomes of such modelling above any personal or connected values and feelings, and apply these outcomes irrespective of such subjective dimensions to domains including the human “for [your] their good” (Miller, 1983).

Table 5: Development of a mathematical identity in schools

Source: The ethics of Mathematics: Is Mathematics harmful? (Ernest, 2018)

Potari and Stouratis (2017) mention that mathematics teachers often face tensions in their professional life and especially in teaching mathematics in the school context. These tensions include pedagogical conflicts emerging in teaching-learning processes (Jaworski & Potari, 2009); cognitive and emotional tensions revealed in the process of self-reflection(Chapman & Heater, 2010); tensions between different identities in relating to different professional obligations (Potari, Sakonidis, Chatzigoula, & Manaridis, 2010), conflicts related to teachers' expectations and perspectives regarding professional development (Yamagata-Lynch & Haudenschild, 2009). Tensions and conflicts often emerge in the context of classroom interaction (Barab, Barnett, Yamagata-Lynch, Squire, & Keating, 2002; Jaworski & Potari, 2009) or in collaborative teacher contexts (Goodchild & Jaworski, 2005; Sakonidis & Potari, 2014). They are most apparent when teachers are engaged in educational reform, for instance when working with a newly prescribed curriculum (Remillard & Bryans, 2004).

The primary goal of mathematics education for us is to provide students with the ability to describe and interpret the real world and the world of mathematics with mathematical terms, touching the structural and functional perception of mathematical concepts and processes. Through the procedure of teaching mathematics students gradually develop their ways of thinking into more complex and more integrated forms of mathematical reasoning, depending on their age.

At the same time, teaching mathematics aims to provide the opportunity for the students to discover mathematics through real-life processes that come from their everyday life and their cultural context. This presupposes students in schools face real mathematical situations about which they will ask questions and seek answers in the process of discovery of their reality in mathematics (Clark & Roche, 2018). What we aim to teach as concepts acts as a tool for dealing with the situation.

Mathematical reasoning is for students a form of logical approach that will help them organise their thinking while they will realise that mathematics can become a useful and powerful tool for organising the phenomena of both the real world and the world of mathematics. Contextualized tasks serve the twin purposes of showing how mathematics is used to solve real problems and motivating students to solve the task. Teachers should also realise that mathematics as a human creation is under constant negotiation (Radovic et al., 2018). Making students understand that mathematics is a typical inflexible system, which does not accept adjustments, often has unpleasant consequences both in the understanding and the shaping of their attitudes and perceptions of this object as described in the previous section.

2.4 Reproduction of inequity and school mathematics

Standards for mathematics education pose extraordinary challenges for the preparation and lifelong learning of mathematics teachers in mathematics classes (Kramarski, 2018; NCTM[10], 2000; Program for International Student Assessment [PISA], 2003). Teaching focuses on solving problems in mathematical reasoning, and communication as integral parts of a coherent curriculum.

In these objectives' framework teachers should cope with the complex and dynamic process of teaching mathematics with pedagogical content knowledge[11] (PCK) methods that create opportunities for challenges and lead students to take advantage of mathematical ideas (NCTM, 2000). It is suggested that important teaching may challenge students to act in a learner-centered process of acquiring knowledge, by building knowledge through self-regulated learning (SRL[12]). Students are self-regulated only when they are

[10] Founded in 1920, the National Council of Teachers of Mathematics (NCTM) is the world's largest mathematics education organization and advocates for high-quality mathematics teaching and learning for each and every student.

[11] This model introduced by Barnett (2001), called *pedagogical context knowledge*, suggests that in discussion of their classroom practice, exemplary science teachers utilize four kinds of knowledge: academic and research knowledge, pedagogical content knowledge, professional knowledge, and classroom knowledge.

[12] Self-regulated learning (SRL) is one of the domains of self-regulation, and is aligned most closely with educational aims (Panadero, 2017). Broadly speaking, it refers to learning that is guided by metacognition (thinking about one's thinking), strategic action (planning, monitoring, and evaluating personal progress against a standard), and motivation to learn. 'Self-regulated ''

actively involved in their learning process (Kramarski, 2018; Zimmerman, 2000). Despite the ever-growing social and political view of school mathematics as well as the trend observed for the creation of a more appropriate and engaging mathematics curriculum, a large part of teachers remains obsolete in their teaching methods with procedural and deficient teaching in terms of relevance.

Active engagement in mathematics during secondary school is necessary in order for students to succeed in reaching attainment and expectations to pursue science, technology, engineering, and mathematics college majors and professional positions (Wang & Degol, 2017). Trying to focus on the main factors which limit mathematical achievement, it is highlighted that students' engagement in mathematics decreases remarkably since year six in primary school (Wang & Degol, 2014).

Ethnic differences in mathematics achievement tend to be sharpened in secondary education which creates the need for both educators and policymakers to aim to improve equity in educational opportunities, quality and outcomes, to focus on the operating causes found in primary school mathematics education. In Greece, it is often observed that the majority of students belonging to minorities, such as Roma students, even if they choose to study in the first grade of secondary education usually fail to complete due to their poor performance in mathematics classes. This happens for two reasons, on the one hand because students experience negative feelings by failing to attend and participate in the mathematics classroom and on the other because they fail to perform in the written examinations at the end of the school year.

Student-centred practices should be now a central and integral part of the educational process in order to promote student engagement in mathematics (Common Core State Standards Initiative[13], 2015). Emphasis is given to

describes a process of taking control of and evaluating (Buttler & Winne, 1995) one's own learning and behavior. (Ellis, Essentials of Educational Psychology, page 105, Pearson Education Inc., 2009).

[13] States led the development of the Common Core State Standards. In 2009, state leaders, including governors and state commissioners of education from 48 states, two territories and the

supporting students to develop their learning strategies to solve challenging cognitive tasks and constructing their understanding of mathematics concepts (Slavich & Zimbardo, 2012). Hypothetically, making students accountable for their learning contributes to mathematics achievement by cultivating a profound engagement in mathematics coursework. Such practices in education are emerging as a mechanism that promotes equity in mathematical education and provides high-quality opportunities for students to interact with the particular subject actively.

However, according to Steele (1997), there are reasons to believe that student-centred education may have mixed results on how African-American students engage in their mathematics coursework. This is why student-centred pedagogy requires students to actively participate in the classroom. Such a fact is able to cause anxiety and fear activating peers' negative stereotypes about their mathematics ability. According to the Stereotype Threat Theory (Steele, 1997), stereotypes loudly affect the behaviour of the individuals towards whom prejudices are directed.

Later research mentions that operative and active people –like students in a student-centred classroom- are profoundly influenced by stereotypes—being extremely sensitive to the impressions others have of them (Dutton et al. 1997; Crant 2000; Gupta & Bhawe 2007; Muntoni et al., 2020). According to Daprati (2019) "although different problems require different mental operations, all solutions benefit from the drive motivating whoever embarks on a task. In this view, variability in attitudes towards cognitive engagement is likely to affect optimal performance as well as consistency across time, introducing a relatively undetermined source of variability".

The threat of the stereotype can explain why and how student-centred education may impose different effects on the involvement of minority students. The term stereotype refers to triggering a series of negative perceptions about a particular social group such as African Americans or Roma students. Student-centred education has the potential to reduce

District of Columbia, came together and decided to develop common, college- and career-ready standards in mathematics and English language arts.

stereotypes by providing pathways through the classroom so that minority students develop a positive academic self-identity in mathematics (Talbert et al., 2018).

A student can share with the rest of the class his strategic steps used to solve a problem while reflecting the teacher's respect and offering him an intellectual authority contributing to others' learning on equal terms. Such participation will help the student overcome his fears about the threat of stereotypes. The decrease in the stress of stereotypes allows at the same time for a decrease in the negative feelings which are an obstacle to learning. On the other hand, student-centred education can worsen the experience of students belonging to minorities; when a student is asked to answer and explain his way of thinking, he is exposed to the rest of the class and is likely to be commented negatively on the way of speaking and thinking.

Analysing what “the way of speaking and thinking” means, it should be assumed that cultural realities of each school characterise the needs of students which in turn must determine the curriculum so as to meet the needs of their cultural reality in general (Entremont, 2014). These differences in culture must be taken into account in the process of learning. Culture is determined by beliefs, values, attitudes, customs, and social relationships. It is already mentioned in a previous section that numerous mathematics teachers are convinced that mathematics is a culture-free subject although it is clear that mathematics involves concepts of culture.

Gajardo & Dasen (2006, p. 125) insist “…upon the necessity to consider the social and cultural contexts with which students evolve daily in the teaching of mathematics … Each carries mathematical baggage about competencies acquired at school as well as the mathematical competencies acquired via the cultural traditions particular to each student(translation)”. Because the teacher is responsible for organising learning activities and teaching materials, he/she must consider the ethnic and cultural background of the students when planning these activities (Lafortune & Gaudet, 2000). According to Ladson-Billings (1995, p. 128), "content integration refers to how teachers “include and infuse data and examples from diverse cultural groups into their work".

Unfortunately, many primary school teachers continue to enter the field of education unprepared to teach mathematics in the way that the NCTM standards envision. (Kramarski, 2018; Hill et al., 2005). Many teachers instrumentally face mathematics because they have not experienced them the way described above. Even today they face mathematics as an independent form of rules and facts rather than a process of ‘reasoning and generalising’ (Ernest, 1989). Studies suggest that these pre-existing teachers' beliefs often work as a lens through which teachers see the new pedagogical knowledge being taught and also the processes of teaching and learning involved.

Changing classroom practice and adopting a more student-centered pedagogy are remarkably problematic in developed countries where the central government introduces student-centred learning as part of educational reform. Relevant studies show that student-centred learning is a distant dream instead of a reality when confronted with contextual issues rigid and strong enough to hinder the use of student-centred learning in classroom practices (Zacharia, Gracious, & Nicholas, 2012; Chiu & Whitebread, 2011).

A critical contextual issue is the traditional education teachers receive which is based on individual seminars presenting both theoretical evidence and modern studies outcomes without however linking them to educational practice. These seminars need to be replaced by “extensive clinical work, intensive supervision and expert modelling of practice’ (Darling-Hammond, 2006; p. 307) combined with reflective methods in order for teachers to be able to translate theory into actual teaching practice.

In order to make reform successful, it needs to be systemic (Elmore, 2007) while approaching independent parts of the education system, among which the most important are curriculum, professional development, and school culture. It is necessary to understand that approaches to only one of these elements will end up in failure if they are not accompanied by corresponding changes in the other areas (Fullan, 2009). Each of the elements mentioned above supports the other and brings the state of equilibrium to the educational system. Reform should affect both the visible components of the educational

system and the people embedded in it, their values, expectations, beliefs and everyday practices (Onurkan et al., 2016).

Counts (1932) asked whether or not schools should “dare to build a new social order”. The timeless query about the functioning of schools either as socialising agents or as a place where ‘transmission or transformation’ actually takes place is pivotal to this question (Stanley, 2005). Some scholars, such as Wade (2007), see possibilities for both socialising children and youth in the norms of society while also attempting to counter-socialise them against certain aspects of the status quo. On the other hand, critical theorists, for example, trace how public education instills the dominant ideology through the selection, distribution and legitimisation of certain kinds of privileged knowledge (Muller & Young, 2019; Apple, 2004).

The outcome of this educational enterprise ensures the reproduction of the political, social, and economic structures in society that maintain social inequity (Anyon, 1979; Bourdieu & Passeron, 1990; Apple, 2004). Transmission has been the predominant mode for civic education (Castro & Knowles, 2017) and was developed by a perceived need to “Americanize” the immigrants entering the public education in the start of the 20th century (Spring, 2010) in the sense that “there are values which inhere in our historical tradition; teaching students to become good citizens is largely a matter of teaching them to repose loyalty to these values” (Barr et al., 1977; p. 89). This version of citizenship aligns with a conservative ideology that manifests through teacher-centred instruction and curricular materials imbued with master narratives that reinforce dominant groups in society (Knowles & Castro, 2019; Castro, 2013; Barton & Levstik, 2004).

Among the functions of the school, one specific function is to reproduce social inequality which implements concealing the power relations that exist between different groups and mistakenly attribute it to the academic success of the gifted students. Such concepts of mathematical abilities leading to false prejudices, as described in the previous section, must be decisively excluded from the educational process so as for the school to give equal opportunities to both middle and working class students.

Teaching is a challenge characterised by an unusually large number of decisions, making the profession very demanding. These decisions are usually taken under the pressure of time and in the light of teachers' thoughts, beliefs, and motivations resulting in knowledge to be practically relevant (Hyry-Beihammer, 2018). According to Gess-Newsome (2015) beliefs are made of biographically gained ideas which are not evidence-based, but they act as a filter which allows only information compatible with the existing system of beliefs. These ideas have power in judging what kind of teaching is valid and as a result, they determine everyday practice in the classroom (Mayrhofer, 2019).

Ashton (2014) argues that beliefs and attitudes are biographically gained, “idiosyncratic and personally derived from experience,” and concedes that current research still lacks “sufficient understanding of the nature of beliefs, how they develop”. Korthagen (2017, with reference to Lave and Wenger, 1991) also expresses that “all knowledge is grounded in personal encounters” with concrete situations” The French sociologist and philosopher Pierre Bourdieu’s theory mediates between student’s social origin and learning in social contexts, showing how practice is influenced by dispositions and preconceptions rooted in student’s prior experiences.

Bourdieu (1984) highlights the notion of “habitus”, which is a setting of an individual’s “view of the world and of one’s place in it” that produces “deeply embedded attitudes, or dispositions”. Habitus is based on influences “from the earliest days of life” and contains one’s “world-view.” Bourdieu refers to this as “early, imperceptible learning, performed within the family” and “extended by scholastic learning which presupposes and completes fundamental values.” So the individual is “charged with the group’s deepest values, its most fundamental ‘beliefs’” (Bourdieu, 1984). Korthagen (2017, concerning Lave and Wenger, 1991) also expresses that “all knowledge is grounded in personal encounters with concrete situations and is influenced by social values, the behaviour of others, and implicit perspectives embedded in practice.” For Bourdieu, these encounters take place in “fields”.

Through socialisation in the “fields”, “cultural capital” is assembled during the education process and encounters from school later shape a person’s habits and beliefs. As any field contains a strong inclination to preserve and reproduce itself, an individual’s habitus is moulded by the fields’ structures and can itself have forming impacts on the field. This fact clarifies the corresponding relationship towards systems and how people act in specific ways in relevant areas – either adjusting to it or attempting to adjust the framework to their claim thoughts. Teachers’ engagement in school development is a case for this. Habitus, at that point, is where the beginning of teachers’ convictions and states of mind can be found. The social environment shapes an individual's specific habitus, which people were born into and developed up in, their life involvement from social fields as well as local culture (Mayrhofer, 2019; Tubin, 2004).

Bourdieu's theory of habitus as a source of beliefs and practical knowledge of teachers deserves to be credibly related to the context of teaching and learning. Habitus, as defined by Bourdieu, suggests that socio-cultural determined patterns shape human behaviour and thought. This view underestimates the opportunities and possibilities that a person has to change himself and the environment in which he lives as well as the importance of human knowledge and the process of evolution (Akrivou & Di San Giorgio, 2014). The freedom of the human being consists precisely in the fact that he can critically interpret his experiences and transform them through education to something superior.

2.4.1 Introducing epistemological violence in teaching mathematics

Bourdieu argues that a person’s habitus underlies the “reproduction of the most durable academic and social differences” (Bourdieu & Passeron, 1990, p. 16). The above phrase explains why members of an oppressed and marginalised group develop behaviours and make choices which in the end lead to the reproduction and perpetuation of their oppression. This process, according to Bourdieu, is referred to as ‘symbolic violence’. Those behaviours attribute the absence of academic success as well as the failure to follow mathematics courses in school to personal deficits.

Approaching the term violence, it is worth mentioning that there are several efforts in the field of mathematical research education focusing on subjective and objective violence. The concepts of violence differ and we can see with certainty that even research itself plays an essential role in the reproduction of violence. D' Ambrosio (2009, 2015) mentions that education plays an important role in overcoming the forms of violence that exist and this role is the trigger for change in educational practices: "violence comes from fear, fear comes from incomprehension, incomprehension comes from ignorance […] ignorance is eliminated by education" (Leah Wells, cited in D'Ambrosio, 2009, p.242)

D' Ambrosio (2015) states strongly the negative effects of mathematics education and proposes peaceful practices that lead to a 'non-killing' mathematics education that respects human existence instead of imposing violence on human beings. He extends the concept of violence more by mentioning that all people exercise violence against nature. Contemporary education promotes violence against nature as well as against individual groups of human beings while identifying that responsibility lies within the realm of education including mathematics education research to end the practices that support violence and its reproduction (Ruge, 2018).

Different forms of symbolic violence have been identified in the field of mathematics education and research. Specifically, Jorgensen et al. (2014) described symbolic violence in the process where students are grouped by their abilities (ability grouping) since the working-class students often are restricted to access to high-quality mathematics education. This practice is characterised as one of the numerous which marginalise groups and make them victims of existing educational practices. In this process, undoubtedly the role of the teacher as well as the role of the researcher holds an important part as they both have the potential and the responsibility to break the cycle of reproduction of symbolic violence in mathematics classrooms by valuing the individual culture, challenging misrecognition and offering equal opportunities to all students.

Modern research faces a critical attitude to existing approaches to mathematics education, and at the same time, is looking for an insight about the production of knowledge in mathematical education and its relation to capitalism and the reproduction of inequalities. In the book “The Disorder of Mathematics Education”, The notion that methodologies which provide concrete steps on how to realise research might be aligned with the “operating modes of global capitalism” (Straehler-Pohl, Bohlmann, & Pais 2017,p. 4) is introduced.

Pais (2017, p.70) highlights the necessity for alternative perspectives in mathematics education and research because students’ systematic failure and increased testing are “violent expressions of the disavowed part of itself”. The negative aspects of mathematical education are not the only ones responsible for enforcing and reproducing different forms of violence in schools but as Pais (2017) mentions mathematics acts as a replicator that produces violence itself.

Ruge (2018) introduces the concept of epistemological violence in order to precisely focus on forms of violence that are reproduced in academic contexts. Epistemological violence is apparent to empirical research and the publication of research outcomes. This term is introduced to characterise interpretations of data which construct the ‘other’ as problematic or inferior, with strong negative consequences for the ‘Other’ even when empirical results are open to different interpretations (Teo, 2008, p. 47). Relevant research (Teo, 2008; Darling-Hammond et al., 2020) states that interpretations of empirical data that express negative consequences for marginalised groups such as mathematics students belonging to minority cultural groups should be treated as acts of violence highlighting thus the positive implications for school and classroom practices of an emerging consensus about the science of learning and development as well as for the social equity.

A striking example of epistemological violence is shown in the following fact: The newly elected New Zealand government (November 2017) through the Ministry of Education chooses to address social justice issues in the field of education through the ‘Ka Hikitia’ strategic project. “‘Ka Hikitia’ means to step

up, to lift or to lengthen one's stride. A Māori potential approach underpins the policy, that is, the policy explicitly avoids discussion of deficits and disparities and focuses on Māori advantage rather than a disadvantage.

A potential approach for Māori in education has three fundamental underlying principles:

- ✔ Māori Potential: all Māori learners have unlimited potential.
- ✔ Cultural Advantage: all Māori have a cultural advantage by virtue of who they are, being Māori is an asset; not a problem.
- ✔ Inherent Capability: all Māori are inherently capable of achieving success.

(New Zealand Ministry of Education, 2009, p. 19)

According to Pomeroy (2018) within this framework, 'gap talk' is transformed so that the gap in educational attainment between students categorised into different ethnic groups remains unspoken. Instead, the gap is recast as a gap between the inherent strengths of Māori students on the one hand, and the pedagogies and success criteria of the mainstream education system on the other. One aspect of this 'gap' is a culturally generated rift between school and home, and schools are encouraged to develop stronger and more reciprocal relationships with students' families. A second and strongly emphasised gap exists between how Māori students learn and culturally inappropriate teaching methods although the Ministry of Education (2009, p. 20) suggests that "Culture and education are inextricably interwoven, in the education system as well as in the learning setting. Māori children and students are more likely to achieve when they see themselves, their whānau [extended family], hapū [clan] and iwi [tribe] reflected in the teaching content and environment, and can be 'Māori' in all learning contexts".

The epistemological violence reproduced by the New Zealand government's program lies in the fact that the objectives of educational reform are just as confident and beneficial to all students and not just to those belonging to culturally diverse groups as Maori students. This practically means that

educational reform tries to meet ‘equality’ but not ‘equity’ in terms of the difference of the notions as mentioned in the previous chapter. There is no mention of how to take into account the cultural specificities and the different experiences of the students to be transformed from a subject of ethnographic research into learning goals and a strategic plan of teaching mathematics towards social justice. Children from culturally diverse backgrounds experience difficulty in responding to the mathematics tasks which are often rather contrived and contain little relation to the real-life context; they find it difficult to interpret a task about the real-life context (Cooper & Dune, 2000).

2.4.2 Cultural meanings of numeracy and educational context

If we focus on pedagogical structures and curricula of school education which sees the Roma people as part of the wider group called the working-class, then we are dealing with Bernstein's research on language, knowledge, and pedagogy and how working classes can draw on a restricted language code that necessitates an implicit understanding of context, as opposed to the elaborate code of the middle classes which is ‘universal’ and explicit (Payne, 2019). Bernstein argues that middle-class children are exposed to this most complex context as their home acts as a second area of education that converges with the language and behaviour that a student is expected to have at school.

Researchers in mathematics education have conceptualised numeracy in a range of ways: mathematical basics, mathematics for citizenship, literacy with mathematics, mathematics for informed decision-making, the mathematics of social life and the social practice of mathematics (Craig, 2018). Lerman & Zevenbergen (2004, p. 27), however, highlighted the problem that “numeracy is a key feature of the reforms, and hence serious considerations are made of what it is to be numerate” but there is little consideration of the social context within which judgments about levels of numeracy are being made. Thus, to be considered numerate, it is expected that students will need to know some mathematics, and be able to apply that mathematics within a real-world context (Tout, 2020).

Influential people conceptualised and prescribed numeracy within a competency model of knowledge (Tsatsaroni & Evans, 2014; Evans, 2021). Their research revealed that the formation of numeracy was a political decision that involved reverting from more complex models of human reasoning. Tsatsaroni and Evans (2014; 2021) claimed that education policy on numeracy could reproduce simple and weak mathematical curricula and pedagogies in the light of educational reforms.

The ways that policymakers conceptualise and use the thought of numeracy to coordinate arrangement are vital because they have an impact both on educational discourses and educational practices. We ought to scrutinise the social settings of the numeracy-oriented decisions embedded into arrangement archives, as they are forces of control that extrude possibilities in mathematics education (Craig & Guzmán, 2018). In no way do we posit that this social dimension of numeracy is neither correct nor finished. As a contribution to the scholarly dialogue, we aim to illustrate how a social theory of literacy may be transformed into a reconceptualized, vivid and emerging mathematics curriculum.

Numeracy emerged linked closely to educational reform arguing that it is crucial but underachieved. Why numeracy is crucial, however, is answered with at least three different promises about numeracy which are consequently reasons for recontextualisation of mathematics education. A moderate perspective claims that numeracy represents a natural educational response to a changing world; a progressive perspective claims that numeracy represents a liberating potential for mathematics education, and a conservative perspective claims that innumeracy represents a slippage away from the principles that made modernity possible.

The first promise of numeracy is that it is crucial to living in modern societies as it is considered as a response to technological change. In a social environment where “numbers surround us [and] no important aspect of life is beyond their reach” (Porter, 1997, p. 2), mathematics education should be adapted to these new realities. Numeracy is essential because it helps people to live appropriately now and continue participating in society. The first

promise embedded in the numeracy discourse is that numeracy is a reflection of changes in modern life. Beyond participation, however, mathematics education scholars have also positioned numeracy as an empowering force for social transformation, framing the second promise of numeracy.

The second promise attributed to numeracy is that it contributes to the evolution of the future of humans as it liberates them and transfers them from the world of nature to the social world. Broad references are made to the relationship of mathematics and control and emancipation, and even a hundred twenty years back the National Education Association (1985; p.52) mentioned that “The key to the outer world insofar as the objects of the latter are a matter of direct enumeration capable of being counted, it is the first great step in the conquest of nature. It is the first tool of thought that man invests in the work of emancipating himself from thralldom, to external forces. For by the command of the number he learns to divide and conquer”.

Once mathematics is connected with the real world and acquires practical applications, it brings change and helps to solve social problems by empowering citizens and enabling them to engage in their world. Critical mathematics education has focused on how mathematics interacts with the social environment and how it deals with issues of social justice (Skovsmose, 2020). Numeracy, in that sense, is politically important in the fight for justice because the dominance of mathematics in all areas of everyday life creates vulnerability.

The third promise of numeracy is that innumeracy has personal, social and cultural costs. The logical system is similar to the literate-illiterate one, but now the innumerate person is “profoundly disabled in every sphere of human endeavour” (Craig, 2018; Orrill, 2001). The social cost of innumeracy lies in the fact that these people are excluded from participation in the activities of the wider society and the labour market and are excluded from the democratic way of living. Finally, the cultural costs are equally weighty, since cultural experiences and authentic forms of knowledge are underestimated, mocked, and disappear over time, flattened by the dominant culture.

In the field of education, it is observed that teachers significantly determine the educational process with their choices. Often students belonging to cultural and social groups are experiencing increased pedagogical control at school, rote learning, closed-ended questions and activities, while students of the other groups are experiencing more positive learning environments and rich experiences of problem-solving.

It is also observed that teachers who have low expectations from their students end up reproducing social stereotypes, while teachers who have expectations based on the mainstream of students usually lack understanding of how students' identity and responses may depend on their social and cultural background. Consequently, the need to make teachers more sensitive to cultural factors influencing student education is emerging. Such a strategy may help students achieve mathematics by providing a meaningful and engaging reconceptualised curriculum.

2.5 Critical mathematics education and social justice

School mathematics today removes students, especially those who do not have the required 'cultural capital' from successfully participating in the educational process in schools. Students belonging to lower sociocultural groups receive practical mathematics education. Skovsmose (2011) states that during the teaching of mathematics in school students are very often faced with an 'exercise paradigm'. This paradigm has a profound effect on mathematical education and refers to the organisation of individual lessons, ways of communication between teacher and students, as well as the social role mathematics plays in society. For example, mathematics works as a gatekeeper since their learning processes and assessments are in full agreement with standardised tests and assessment of knowledge and performance that fail to identify the essential comprehension and the level of numeracy of students.

Although mathematics is structured and takes place outside the school classroom, teachers and students come into contact unreservedly with a textbook which is structured by a writer who is the external factor of the

educational process. According to Skovsmose (2011; p.9) in school mathematics is characterized by “prescription readiness, which prepares the students for participating in work processes where a careful following of step by step instructions without any question is essential”.

Mathematics activities of solving exercises are restrictive for the students, demanding one single answer, and they do not promote student involvement in research. As it is implied in previous sections, this status of school mathematics reproduces weak students, with low self-esteem and problematic learning identities who develop a passive and repellent attitude towards democratic society. This fact does not seem to be accidental but seems to obey the needs of the capitalist economy to create a class of people who are weakened in mathematics and lack the necessary resources to resist and bring change to the broader political system (Apple, 1992; Ladson-Billings & Tate, 2016).

In order to become more explicit about what ‘exercise paradigm’ means in practice the following example is mentioned:

“There is one grocery which sells one kilogram of oranges for 0.90 cents, while another grocery sells one and a half kilograms of oranges for 1.40 cent. A) Which grocery has a cheaper offer? B) What is the difference in prices if somebody buys 20 kilograms of oranges from the two groceries?”

This example deals clearly with quantities and purchase prices. The person who has constructed such an exercise has neither empirically examined how oranges are sold in real-life contexts nor has considered under what circumstances a family will need to buy 20 whole kilos of oranges. This situation is artificial, and we could say that it is a problem belonging to semi-reality. Semi-reality is a mathematics skill, and it is based on the agreement between teachers and students who say that we need to apply problem-solving strategies even in a problem that does not seem so real.

This exercise solution needs to measure quantities and match prices while never thinking about ethic concepts inherent in population groups such as Roma students dealing with price negotiation or buying a smaller quantity of

oranges. Ethics is often linked to notions of fairness and social justice in mathematics education (Boylan, 2016; Register et al., 2021) but is a very murky term used and taken up in a wide variety of ways. The term ethics is used here to mean a set of philosophical or moral values that people use to make decisions about others, their communities, and the world in general.

As the use of mathematics is increasingly entering all aspects of people's everyday life, it is essential for students to be able to critically interpret such forms of knowledge that are integrated into their environment and society. Critical mathematics education is used here not within the meaning of the critical thinking that education requires in general, but in the sense of a revolutionary and emancipated pedagogy which has the potential to help students explore reflection and reconstitute discourses that are dehumanizing, unjust, and position groups as others (Freire 1970; Gutstein 2003; Giroux 2011; Darder 2014).

Gutstein et al. (1997) raise an intriguing point about critical mathematics thinking and how it has two implications in this case. On the one hand there is the mathematical sense of comprehending problems, making contentions, making guesses, investigating the thinking of others, thoughts that are described by the term critical thinking. On the other hand we identify the importance for critical thinking using different points of view, questioning educational standards, curriculum and practices. It is this second importance of critical mathematics education that contributes to mathematics (Jablonka, 2020; Weiland, 2018).

Gutstein (2006) draws heavily from Paulo Freire's work, which was done mainly in Brazil to help the marginalised population of that nation to become literate, to make sense of their world and in turn influence and improve their reality and position in society.

Critical education in the field of mathematics implies the use of real elements to investigate underlying structures and hidden assumptions in society but also to the critical understanding of everyday things from the perspective of mathematics education and it is relevant to Freire's notion of 'critical education' which encompasses raising consciousness, the emancipation of

learners, and the development of critical citizenship (Guilherme, 2020; Skovsmose, 2011).

Skovsmose (2011) makes it clear that mathematics education can be so empowering in a pragmatic sense, and at the same time disempowering in a socio-political sense. Mathematics education allows students to see mathematics as an analytic tool to understand and influence issues important to them and their communities(Yeh & Otis, 2019). The individual is not merely agent but importantly subject to and constituted by social processes that transform the world including the self (Roth & Walshaw, 2020).

The modern world faces multiple challenges arising from economic problems, poverty, climate change, sharpening differences between social classes, and immigration. This results in an increasing number of researchers wanting to use the classroom as a vehicle for pumping existing differences. Researchers in mathematics education also argue for similar efforts in mathematical education where they call for the use of critical and culturally oriented pedagogy. Cotton (2013a, p. 74) describes mathematics education in a 'socially just' world as one in which "you would be happy for a child you love to learn in any classroom in any school and to exchange places with any child in any classroom in any school". Gutstein (2006, p. 22) argues that mathematics educators have tended to focus too much on addressing issues of equity within mathematics, rather than on the need to restructure schools and society and that the fundamental aim of teaching mathematics for 'social justice' should be "liberation from oppression".

To address the need to create a mathematical classroom where students will learn how to understand the social-cultural and political environment of society and how to integrate these elements of the environment into the curriculum of mathematics, many researchers highlight problem solving issues as ideal for linking mathematical content to areas critical to mathematical education while excluding focus on neutral and semi-reality problems (Lumandi, 2019).

This is what is observed in mathematical education between two different ideas concerning the invisibility of mathematics as well as the concept of the power of mathematics. The correlation of these two concepts creates the

paradoxical, on the one hand, that mathematics has a siding social influence and on the other, that students are unable to recognise the importance of mathematics for the real world (Durrani & Nawani, 2020). Students need opportunities to see and experience the influences of mathematics in the real world in order to address social justice issues.

Social equity is both a goal and a process within the society in which there exists equal participation among groups, equitable distribution of resources, and psychologically safe members and it requires democratic, participatory, inclusive, and collaborative actions to effect change (Styslinger, 2019; Bell, 2007). The way towards achieving social equity is complicated, frustrating, and lengthy (Mthethwa-Sommers 2014). As indicated by Freire (2013), we can start to educate for social equity by raising critical consciousness. Critical education is the centre of social justice teaching.

Our critical awareness increments as we come to see logical inconsistencies and mistreatments in society. Teachers for social justice structure learning experiences which improve their students' critical consciousness. These teachers try to foster in students a sense of agency and capacity to interrupt and change oppressive patterns in themselves and their social context. Teaching by raising student consciousness and then trusting that students "will feel increasingly challenged and obliged to respond" to the inequities and injustices they come to recognise and realise (Freire, 2014, p.81) is the key element of critical mathematics education. Agency and engagement are intrinsic to social justice teaching in a democracy because as learners challenge individual and systemic forms of injustice, they also learn how to be active and engaged citizens (Styslinger, 2019). Freire argued that the process of education begins with the teacher coming to understand the students' world (Freire, 2013).

2.6 Synopsis

The ideas of Plato and Aristotle regarding mathematical objects and ideas are compared to explain the process towards the development of the schools of absolutism and fallibilism. More specifically, absolutism considers

mathematical comprehension as a group of knowledge which contains outright, confident, and unchallengeable certainties while fallibilism views mathematics knowledge and truth as capable of being corrected or reformed.

Analysing the role of these conceptions in the way the teaching and learning procedure of mathematics is approached by both scientists and the general public allows for further insights in the striking differences between the teaching methodologies adopted by expert mathematicians and school teachers.

In the attempt to explain the reasons behind the prevalent differences, we should bear in mind the three kinds of epistemological beliefs that is the platonist view where mathematics is seen as a static but unified set of knowledge whose structure and connections between various aspects are significant, the instrumentalist view where mathematics is a useful and essentially unrelated collection of facts, rules and skills and finally the problem-solving view where mathematics is a dynamic and innovative human creation and a problem-oriented field of inquiry.

In addition, the extensive analysis and consideration of the epistemological beliefs about mathematics as discussed by Andrew, Hatch (2000) and Goos (2006) allow for better understanding of the necessity for accepting that the teacher's beliefs around mathematics are culturally dependent and should be seen as part of human culture. Mathematics carries historical value and is instrumental in systemising and disseminating knowledge.

Consequently, mathematics cannot be viewed in isolation from society if we are to understand the evolution in society and also the teaching practices which are influenced by and influence the educational osmosis taking place in the modern school environment. At the same time, it is pivotal to acknowledge the influence of the established status quo and the role mathematics has played in the way western societies have imposed themselves upon minorities through the way of teaching as an expression of coloniality (Appelbaum & Stathopoulou, 2020).

It is this role and how teaching of mathematics affects the student's attitude towards the learning and understanding of mathematics that are also discussed to provide further insights in the wider influence of mathematics and their teaching might have on students' career choices, self-esteem, personal and professional success.

The perspectives presented in this chapter also implie that there is a link between the conception of the relation between the student's success and the methodology applied in the teaching of mathematics as a result of the gap between the theory of teaching and the established practice.

The failure of absolutism to consider the impact of social inequality or cultural difference on the performance of students at mathematics is also reviewed to show the importance of incorporating the influence of the cultural background and socioeconomic parameters in the curriculum design to reflect social reform. These ideas are the main objectives of ethnomathematics which clearly articulate and justify the challenges faced by students and how these hinder or facilitate the understanding of people's attitude towards mathematics.

Extensive reference to literature that analyses the role of performance in mathematics education process in the lifetime success at all levels, professional, educational and personal is made and supports the understanding of the mental and psychological impact of failure related to mathematics education.

These findings are the arguments of the idea in favour of the development of a curriculum that promotes participation in specific forms of pedagogical and educational practice mediated by culture and ethnicity. They also highlight the importance of the teacher in the student's success and the necessity for quality and exceptionally trained teachers to ensure maximum performance and delivery of quality teaching.

The development of a mathematical identity in schools is also discussed as part of the student-centric approach to teaching that places the student and their life experiences in the centre of the educational process as the basis for

relating knowledge to society. The relation should also be the benchmark against which all political decisions and reforms in education should be measured against.

Chapter 3: Theoretical principles

3.0 Summary

In chapter 3, the main theoretical principles around mathematics and mathematics education will be presented. More specifically the relationship between the Platonist school and mathematics and its influence in the development of Western mathematics will be examined. In addition, the anthropological and sociological aspects of mathematics and their application in the teaching methodology and how these have influenced the development of mathematics education and the curriculum development for minorities will be presented and analysed.

3.1 Platonist school and Mathematics

The recent definition of mathematics is based on a historical framework, what we nowadays call ‘mathematics’ evolved over the centuries by different cultures. European mathematicians looked at the mathematics elements of individual cultures and chose to deal with and develop those elements which had an exact mechanism. Focusing on this evolutionary conception of mathematics conveys how a concept can have worldview pressure positions implicitly attached to it.

A sound example of this effect is described by the Aikenhead (2018) and has to do with the concept of a circle in school mathematics which is framed by concepts such as point and level as well as by the objectivity of the Euclidean geometry related to the circle. When a mathematics textbook refers to “indigenous medicine wheels and their circle properties", then the phrase “circle properties' ' refers to a decontextualised meaning of the term “circle” with its cluster of peripheral Eurocentric concepts.

It is clear that the textbook's author has not understood, or has purposefully ignored, the contextualised subjective, holistic and spiritual peripheral concepts connected to the 'indigenous' meaning of circle. Culture-based peripheral concepts get lost in the process of evolution of mathematics knowledge. At this point we ought to consider the conflict experienced by students belonging to separate minority groups when they bring their mathematical concepts (such as peripheral concepts about cycle) to school at a time when the school itself has built a curricular program based on ignorance and leveling or often relying on the belief that students are a whiteboard on which inspired teachers to have to record new knowledge (Rodriguez & Blaney, 2020).

Plato's faculty, as we have already mentioned in a previous section, is philosophically associated with absolutist philosophers. Absolutists avoid practical utility and marginalise human characteristics of mathematics such as their values, their ideologies, and the role and feasibility of mathematics in everyday life of students, while at the same time they are interested in concepts such as the generalisation of the developed mathematical concepts.

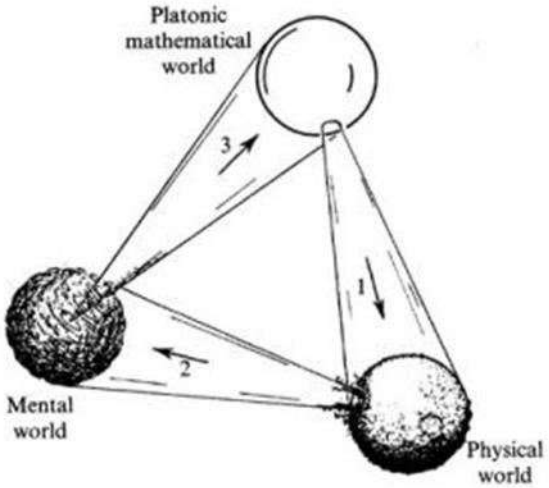


Figure 1: Three 'worlds': the platonic mathematical, the physical and the mental and the three profound mysteries in the connections between them.

Roger Penrose[14] in his book The Road to Reality: A Complete Guide to the Laws of the Universe (2016, p.18) presents the figure above as an effort to present the Platonist view of mathematics. Initially, he explains that going clockwise, the figure that:

- A small part of Platonic mathematics is relevant to the physical.
- A small part of the physical induces the mental.
- A small part of the mind is concerned with the Platonic.

Instead of this, Penrose gives emphasis that is going counterclockwise, and the figure reads these three prejudices:

- The entire Platonic mathematics is within the scope of reason (in principle).
- The entire mental is dependent on the physical.
- The Platonic governs the entire physical.

Ernest (1991) described livelily: “The values of the absolutists smuggled into mathematics, either consciously or unconsciously, through the definition of the field” (p. 259). It is a fact that Plato's faculty established its views on mathematics by extinguishing the practicality of the knowledge acquired by the students. This point of view has being perpetuated and incorporated into the official curriculum of school mathematics which is struggling for intelligence and epistemology in the learning process.

Hall (1976, p. 213) describes the dipole “logical versus irrational,” invented by “Western culture dating back to Socrates, Plato, and Aristotle”. This dipole was developed as a base for the dipole “formal mathematical discourse versus informal”. Secondly, they used the official form which should be the language of mathematics and which should be learned from the students exclusively in the school context. This strategy is consistent with the ancient Greek philosophy which explicitly states that mathematical content must be

[14] Sir Roger Penrose OM FRS (born 8 August 1931) is an English mathematical physicist, mathematician and philosopher of science. He is Emeritus Rouse Ball Professor of Mathematics in the University of Oxford and Emeritus Fellow of Wadham College, Oxford. Penrose has made contributions to the mathematical physics of general relativity and cosmology. He has received several prizes and awards, including the 1988 Wolf Prize for physics, which he shared with Stephen Hawking for the Penrose–Hawking singularity theorems.

discovered as an abstract object because it has universal application and power rather than being invented by humans (Aikenhead, 2017a, b). The informal discourse category includes everything school mathematics would do for human existence, such as the benefits that students will gain by applying mathematics to political, social and economic contexts (Skovsmose, 2016).

Ernest (1991) characterised the Platonists strategy as illusionary: “at the heart of the absolutist neutral view of mathematics is a set of values and a cultural perspective, as well as an ideology which renders them invisible” (p. 260). Incorporating the ideas of Plato's philosophy into mathematics and relating them to political, social, and economic power is the reason which has given these ideas validity. This practically happens for three reasons: school mathematics is treated as superior to the rest of the school courses and allow ‘elite’ students only to deal with them successfully, schools as vital parts of the education system use students’ success in mathematics as an indisputable and obvious indicator for their subsequent personal, professional, and social success (Breinholt & Jæger, 2020; Rodríguez et al., 2020). Finally, viewing mathematics as a ‘gatekeeper’ guarantees that “the knower gains prestige, control, authority, and power” (Russell 2016, p. 75). Russell and Chernoff (2013) described this social screening function as “unethical” (p. 109).

3.2 Western mathematics

Eurocentrism as a political movement effortlessly combines an essentialist[15] perspective in mathematics with education context. Practitioners and researchers highlight the significance of Euclidean elements to define the framework for thinking in mathematics. The term ‘western mathematics’ is often used to emphasise the position that mathematics is not universal but

[15] The Essentialist movement (Bagley, 1905) first began in the United States in the year 1938 Essentialists believe that there is a common core of knowledge that needs to be transmitted to students in a systematic, disciplined way. From the Essentialist point of view, the aim of education is to equip students with common core or the “basic” of information and skills needed for the promotion of citizenship. According to the Essentialist, the role of education is the transition of a common body of knowledge, skills, concepts and traditions from generation to learners in order to transform them to meaningfully and constructively contribute democratically to the society. The essentialist focus on intellectual training in the areas of grammar, literature and writing, mathematics, sciences, history and modern foreign language.

that it is culturally situated and has its roots in the West and the industrial revolution(Hardman, 2021).

Skovsmose (2019) summarises the four points of the official presentation of the history of mathematics. First, it emphasises that real mathematics started with the Greeks. Indeed, one finds mathematics before this period in areas such as Mesopotamia. However, this is seen as a form of pre-mathematical activity since it appears to be empirical-based and not to be unified in axiomatic deductive patterns. Second, it is emphasised that Greek philosophy, culture and mathematics is Western. This Westernization of the Greeks is highly problematic, as we have seen through Bernal's work. Greek culture was, in fact, intimately linked to the East and Egypt, as pointed out by Plato for instance. The reconfiguration of the Greek as a "Western" philosophy appeared much later.

Third, it is stipulated that mathematics was not profoundly developed again until the Ancient contributions were rediscovered during the Renaissance. Fourth, a range of mathematical activities often get ignored. What has taken place in India, China and Japan is hardly mentioned in the official presentation of the history of mathematics. The vast variety of cultural practices of mathematics is ignored as well. Such practices have been identified and described within the overall ethnomathematical approaches (Roth, 2020).

The perception of mathematics as a human activity influenced by social and cultural factors is confronted with the formalistic views of mathematics origin (Hooley, 2020). Good social studies teachers encourage debate and discussion; good literature teachers promote unique and insightful interpretations; good science teachers nurture close observation of nature and careful experimentation. But “good” math teachers—well, they want right answers and high scores on standardized tests (Stemhagen & Henney, 2021; p. 9). Formalism[16] is based on the argumentation of the complete consistency

[16]Formalism, in mathematics, is a school of thought introduced by the 20th-century German mathematician David Hilbert, which holds that all mathematics can be reduced to rules for manipulating formulas without any reference to the meanings of the formulas. Formalists contend that it is the mathematical symbols themselves, and not any meaning that might be ascribed to them, that are the basic objects of mathematical thought.

of mathematical concepts and theories, and a joint and absolute agreement between the mathematics researchers.

There is a common argument for the objectivity and consistency of formal mathematics since it is pointed out that mathematics is a coherent ‘whole’ in contrast to other areas in which we meet distinctly disagreeable and partly contradictory theories. If one takes into account the enormous specialties that there are in the scientific mathematics field, this consistency is not reasonable because although mathematicians work independently, in particular subjects a significant number of links and relationships between regions that have developed separately is discovered (Fayzullaev, 2020; Prediger, 2002).

As far as the agreement between mathematicians is concerned, it is argued that there is no room for doubt in mathematics and that even if there is a doubt, it is easy for someone to judge. In contrast to the other sciences, mathematics does not provide flexibility in interpretation as whoever follows the rules of the method of mathematics always arrives at the same result. Heintz (2000) concludes that modern mathematics is characterised by properties that hardly leave room for sociological analyses. She clearly distinguishes the difference between the route towards mathematical content (concepts of theorems, axioms and so on) and the mathematical content itself. Social and cultural factors that are studied interact with the route towards mathematical content but not with the content itself. Social and cultural factors demarcate mathematics by limiting them to the focus on ‘the final product’ of the educational process and degrading the process leading to the mathematical product (Dowling, 2020).

Hersh (1997) refers to the false distinction between process and final ‘product’ through an extensive analysis of the prevailing myths around mathematics using the terms “forehead” and “Backstreet”. A similar distinction is also found in the work of Lakatos (1976) who distinguishes between “context discovery” and “frame of justification”. In the same spirit, Freudenthal (1991), defines mathematics as a process of mathematisation. The difference between the views of Heintz (2000) and a large part of researchers lies in the definition of mathematics. Heintz had chosen the epistemologically valuable definition

which relates mathematics to the logical result while other researchers stress the importance of the discovery process mentioning that "…apart from the reflection on what is right or acceptable, the question of looking for what is interesting, elegant and profound is equally important. These criteria vary in each person, in each cognitive domain, and change over time" (Hersh, 1997, p. 39).

Mathematics is a particular way of thinking which is exceptionally well structured and around it a particular community is formed. Among mathematicians, a discussion outcome is almost always an agreement on what it is true and why it is true. The source of mathematical agreement is a shared view of the structures that are built around the nature of that mathematical reasoning. Assumptions of people who have learned to think in the same way are giving mathematics its objective existence. The links under development within the community are not confined just to the cognitive level but extend to the post-cognitive. Prediger (2002) states that "when the community is convinced that inconsistencies cannot occur, its members do everything to eliminate them when they need."

The Westernisation of mathematics constitutes a part of much broader processes of "Westernisation." Such processes are not only part of the Renaissance conception of ancient Greece; they turned into an integral part of the racisms that accompanied the processes of colonisation and the growth of black slavery (Skovsmose, 2019).

3.3 The rise of social anthropology of Mathematics

D'Ambrosio uses 'mathematics' to document and understand diverse mathematical practices of the very cultures it seeks to empower and study (D' Ambrosio & Rosa, 2008). His focus on what the concept 'ethnomathematics' include, led him from particular cultural practices to the general concept of a research program in the history and philosophy "not only of mathematics but also of everything" (D'Ambrosio & Ascher, 1994, p43). He argues that every human activity includes mathematical aspects and that these aspects collectively form the way we understand the world that surrounds us. The

value of recognising this important fact is to stop mathematics from exercising social terrorism on different groups of people (D'Ambrosio, 1990; p. 23).

The study of mathematics as knowledge has been shifted from an anthropological task to a political act which involves growing awareness of the importance of who determines knowledge and who has a profit when mathematics is taught in this way in schools. A movement created by this political nature of mathematics is known as the Political Dimensions of Mathematics Education (PDME) (Julie et al., 1994).

Jurdak et al. (2016) in their book “Social and Political Dimensions of Mathematics Education: Current Thinking” mention that social and political dimensions of mathematics education, as it is shaped today, defines five distinct areas for research in the process of mathematics curriculum reconceptualisation:

- The first area referred to as equitable access and participation in quality mathematics education: ideology, policies, and perspectives examines the issue of equal access and participation in quality mathematics education in different contexts and from different ideological perspectives. Equity and quality are transformed into policies and practices which affect teachers of mathematics.
- The second area entitled ‘distributions of power and cultural origins of truth’ challenges the political view of mathematics and mathematics education. It argues on the systematic reproduction of socio-economic, ethnical and gender-based discrimination in achievement in mathematics leading to inequalities on students' future opportunities. It analyses the critical role of mathematics education research to provide new insights into the political bias of mathematics in schools.
- The third area is ‘mathematics identity, subjectivity and embodied (dis) ability’ and examines the present research on the political forces that affect issues of identity and subjectivity of the students of mathematics classroom emphasising on language issues and how the existing teaching materials form the students’ learning experiences in the classroom.

- ❖ The fourth, titled ‘activism and material conditions of inequality’ detects the need to develop a form of activism in mathematical education practice and research. It examines the relationship between activism and the teaching materials which reproduce inequality. Poverty is a factor that identifies ‘achievement gaps’ highlighting thus the need for curriculum reforms.
- ❖ Finally, the fifth area, called ‘economic factors behind mathematics achievement’, studies the data from Pisa's research programs and identifies failure factors in mathematics related to social inequity issues.

D’Ambrosio (1985) uses the term ethnomathematics for anthropological writing[17] and seems to wish to claim a universal human effort which draws our attention to the idea that everyone within their cultural framework can identify what they think as global. Within a European framework of knowledge, there is a set of values that have to do with logic, relationships, design and other mathematics universals. People through different cultures can recognise the universal language of mathematics relating their cultural diversity to global values without damaging the content of mathematics.

3.3.1 Anthropological perspectives in mathematics education

Anthropological perspectives in mathematics education are apparent in a wide range of research which is part of a humanistic mathematics movement. Zaslavsky in the USA (1991a &b, 1993) provides one of the most critical and pioneering research. Zaslavsky seeks to improve access to mathematics for cultural groups that have been alienated from school, and she believes that mathematics can be used for intercultural understanding and elimination of inequities.

A second direction of the anthropological view of mathematics is the work of Bishop (1988) who aims to elaborate a more appropriate way to capture

[17] D’Ambrosio (1990), who coined the term, takes it to mean a general anthropology of mathematical thought and practice. In that sense, the word applies to the connections between mathematics and culture in every geographic area, every human group, and in every historical moment on earth. D'Ambrosio defines ethnomathematics in terms of the mathematical practices of any cultural group, rather than specifically indigenous societies, was an outcome of this context (Eglash, 2000).

mathematics education. Since mathematics is a cultural phenomenon, Bishop uses detailed anthropological constructs to suggest ways in which these constructs have the potential to associate people and in particular children with their mathematical culture. Bishop focuses on the culture of mathematics and how it can be taught or acquired through the process of education and the six universal mathematical activities proposed in his research[18].

Stigler et al. (1990) then pursue another direction using anthropological concepts to highlight how mathematical education takes place in different cultures. In an early work with Baranes (1988), they describe these foundations and the research on mathematical learning that occurs both within the framework of the school and out of school, in everyday life of people belonging to different cultures. Stigler & Baranes (1988) support that the benefit of intercultural studies in mathematics education is the fact that cultural practices appear implicitly to those who participate in them. In that sense, recognition of certain aspects of our mathematics education will only occur when we examine them in the light of the people living in those cultures (Pramudita & Rosnawati, 2019).

The most important work of Stigler is that he compares American mathematical education to that of the Asian countries focusing neither on cognitive differences nor on the influence of different practices on the class, but on the impact of these differences on the institution of school education. His research emphasises intercultural psychology and attempts to highlight the cultural differences that exist in learning modes or whether culturally

[18] Enculturation and acculturation refer broadly to the processes whereby newcomers come to participate in the normative practices of a cultural community. In relation to each other, enculturation generally signals the case in which the newcomer is an immature member of the cultural community into which she or he is being socialized (e.g., a child); acculturation signals the case in which the newcomer is not a member of the cultural community (e.g., an immigrant). These processes variously include instruction by agents of the culture (e.g., parental scolding), conscious emulation, and unconscious adaptation. Whereas typically the focus of interest is the changing newcomer, enculturation and acculturation have been recognized as involving "reciprocal accommodation" (Simons 1901) which both newcomer and cultural community adapt to one another. Change in the cultural community is particularly evident when the newcomer is part of a community of newcomers sharing a common cultural background. Indeed, acculturation is summarized in Rudmin's (2003) extensive review as "the processes by which individuals, families, communities, and societies react to inter-cultural contact," thereby enabling a focus on the individual, the society, or on intermediate levels of social organization (Kirshner & Meng, 2012).

different cognitive styles can be identified and used to improve mathematical learning.

Finally, the fourth direction for anthropological writing provided by Lerman et al. (1994), uses anthropological structures to examine the culture of the mathematics classroom.

3.3.2 History and Historiography of mathematics

In this section we will try to highlight the difference between the ethnomathematical approach from an anthropological, historical approach to mathematics. One important difference is that the ethnomathematical approach may have as its object the study of the aspects of a culture that are not accepted as mathematics content. On the other hand, the history of mathematics examines those ideas which have been legalised as mathematics, and these ideas are considered as mathematics throughout their history. History of mathematics may also consider the development of ideas that were later accepted as mathematics such as Aristotle's logic[19].

However, the ethnomathematical approach involves studying ideas explicitly excluded from mathematics. Among the most explicit objectives of the curriculum as suggested by D'Ambrosio's Programme in the History of Mathematics (1985c, p.47) is to broaden the definition of mathematics to include some previously excluded practices as legitimate mathematics. Ethnomathematics is proactive by creating mathematics reviewing historical practices for their mathematical characteristics. Another way of expressing this idea is to say that the ethnomathematics approach is in a different time frame from the general chronological concept of the history of mathematics (Burton, 1996; Fauvel, 1995).

[19] Aristotle's logical works contain the earliest formal study of logic that we have. It is therefore all the more remarkable that together they comprise a highly developed logical theory, one that was able to command immense respect for many centuries: Kant, who was ten times more distant from Aristotle than we are from him, even held that nothing significant had been added to Aristotle's views in the intervening two millennia (Stanford encyclopedia of philosophy, 2017).

In order to clarify this idea, we remark Gerdes' examination of Angolan sand drawings[20]. It is not known how old this art is: 4000 years or 400 years. However, for ethnomathematics, age is not the prime concern, rather what the quality of evidence and its uses are in the present (Burton, 1996).

These ideas can be related to Foucault's Archaeology of Knowledge and his attitude to historical discourse inspired by Lotringer, (1989)

"...not only a set of events which would have taken place once and for all and which would remain in abeyance, ... however, also as a set that continues to function, to be transformed through history, and to provide the possibility of appearing in other discourses (p.45)".

An implication of Foucault's analysis is that mathematics may be re-written by examining history and not just by developing into the future. Although the Foucault accepts the value of history in the transformation of mathematics, he tries to untie history from the search of beginning of everything mentioning that "It's always the relative beginnings that I am searching for, more the institutionalizations or the transformations than the foundings or foundations" (Lotringer, 1989, p. 46).The way Foucault approaches the historical study of mathematics is that history as it touches a particular field like mathematics is branched into sections which are not necessarily parallel to each other but are very often intersected. These are not histories of different aspects of the subject (the social history, the technical history, the political history, the history of applications); these histories present mathematics (and therefore create mathematics) as a different field. It may be that this is what is happening with

[20] The Tchokwe people (or Quiocos), with a population of about one million, predominantly inhabit the northeast of Angola, the Lunda region. The Tchokwe are well known for their beautiful decorative art, ranging from the ornamentation of plaited mats and baskets, iron work, ceramics, engraved calabash fruits and tattooings, to paintings on house walls and sand drawings. The designs have to be executed smoothly and continuously as any hesitation or stopping on the part of the drawer is interpreted by the audience as an imperfection and lack of knowledge, and assented to with an ironic smile (Fontinha, 1983). In order to facilitate the memorisation of their standardised picto- and ideograms, the "akwa kuta sona"--drawing experts--invented an interesting mnemonic device. After cleaning and smoothing the ground, they first set out with their fingertips an orthogonal net of equidistant points. The number of rows and columns depends on the motif to be represented.

ethnomathematics: the subject being created by the ethnomathematical study is not the same one as that of the mathematicians (Burton, 1996).

Finally, some of Foucault's comments on the role of history relate specifically to D' Ambrosio's encompassing concept of ethnomathematics as a historical programme (Lotringer, 1989, p9, 29)

"[Considering] the history of philosophy, ... the history of ideas, [and] ... the histories of the sciences, one cannot fail to be struck by the impossibility of our culture to pose the problem of the history of its thought. It is why I have tried to make ... the history not of thought in general but of all that "contains thought" in a culture..... For there is thought in philosophy, but also a novel, in jurisprudence, in law, in an administrative system, in prison. If history holds a privilege, it would be rather to the extent to which it would play the role of internal ethnology of our culture and our rationality, and would consequently incarnate the very possibility of every ethnology."

For Foucault, it can be assumed that ethnomathematics would be the attitude that there are alternative histories of mathematics, and, in so far as mathematics embodies rationality, ethnomathematics would be 'the history and philosophy, not just of mathematics, but of everything' (Burton, 1996).

3.3.3 Sociology of mathematics education

Ivan Illich is one of the most controversial philosophers in the educational theory field. He criticizes modern economic development which is described as a process in which people who were self-sufficient in the past, lose their traditional skills and end up dependent on doctors for their health, on teachers for their education, on television for their entertainment and on their employers for their survival. Illich (1973) argues that the concept of compulsory education that is globally accepted today should be brought into question. Emphasising on the relationship of educational development and economic demands for discipline and social hierarchy, he suggests that schools have been developed to meet four basic needs of people. These needs are supervision of people, distribution of people in professional roles, learning sovereign values, and acquiring socially acceptable skills and knowledge. The school has become a supervising organisation because supervision is mandatory

and children are kept off the streets in the age between their childhood and their entry at work.

A large group of knowledge acquired at schools has nothing to do with the formal content of the modules. More specifically, in the field of mathematics, schools tend to reproduce what Illich calls as ‘passive consumption’; an embarrassed acceptance of the existing social organisation because of the compelling nature of discipline and control that are occupied by school organisations. Mathematics is not taught consciously. In general, mathematics is inherent in school processes and school organisation. If we consider what a curriculum includes for students in any educational framework, then the most central module will be thought to be mathematics; proof that the teaching of mathematics is vitally and structurally related to formal education. The hidden curriculum in schools teaches children that their role in life is to passively accept their place in the classroom society and not react to predetermined learning objectives and procedures (Yeh & Otis, 2019).

Illich (1971) suggests the deschooling of society. School education is a recent discovery and there is no reason to be considered as inevitable since schools do not promote equity or the development of individual creative skills. Illich did not propose all forms of school education be abandoned, but he proposed everyone who wants to learn, to have access to the available resources at every moment of his life, not just during childhood or teenage years. Such a system should provide the possibility of widespread dissemination and participation in knowledge. Students should not be required to follow a fixed and rigid curriculum, and it is necessary to have a personal choice of modules taught.

Among the most enlightening ways to combine some of the themes of theoretical approaches to education is through the concept of cultural reproduction. Cultural reproduction refers to how schools in reaction with other institutions contribute to the perpetuation of social and economic inequalities from generation to generation. This concept focuses on how schools, through the hidden curriculum, influence the teaching of the values and attitudes and habits of children. Schools strengthen the differences in cultural values and

perceptions acquired in the early years of their life and, as a result, when children finish school, these differences have the effect of restricting the opportunities of some and widening the opportunities of some others.

The differences between the ways of using the language pointed out by Bernstein, are undoubtedly associated with such cultural differences that lie behind the differences of interests and preferences. Children from low class, especially when they are members of some social minorities such as Roma children, develop ways of speech and behaviour that conflict with those who dominate school. Schools impose discipline rules to students as the power of teachers is oriented towards academic education.

Children belonging to minorities face a much more intense cultural conflict when they enter the school in comparison to the conflict faced by children from more favoured social environments because they should deal with an unknown cultural environment (Trumbull, 2020). Children belonging to minorities do not have fewer incentives for high academic performance, but the usual ways of speaking and acting in school do not correspond to those of their teachers even when both sides make every effort to communicate effectively.

Davis (1993b, p.189) argues that mathematics constitutes a way of thinking which is different from other ways and that different ways of thinking need to be balanced in our society. For Davis, the balance of mathematical versus other types of thinking is to be achieved through education, but can only be done if public debate about mathematics education rises above content topics or instructional techniques and begins to consider "awareness of the applications of mathematics that affect society and of the consequences of these applications" (1993b, p. 191). He sums up that “If mathematics is a language, it is time to put an end to overconcentration on its grammar and to study the "literature" that mathematics has created and to interpret that literature”.

3.4 The rise of politics of mathematics education

Many students find mathematics difficult, and some scholars have argued that mathematics serves as a form of gatekeeper by determining social mobility, and is influenced by family socioeconomic status (Douglas & Attewell, 2017). Trying to reveal the historical background of the belief that mathematics is a "gatekeeper", we identify that French sociologists such as Bourdieu[21] (in the 1970s introduced terms such as 'cultural capital' while studying the way in which society is structured, in order to be able to describe how a society can continue to exist instead of the existence of significant inequalities among its members. They argue that organisations such as schools are vital parts of social reproduction.

Among the most profound proofs which support that mathematics education is a political act and it affects social reproduction is that although the amount of mathematics performed by people at home or work is very small, mathematical knowledge is one of the significant determinants of professional and educational progress studies. Mathematics required in non-specialized professions and everyday life has revealed that there is minimal mathematical content that is necessary to perform the work of most people adequately. Very often we hear our students solve a secondary equation or face exercises with trigonometric identities and wonder how this knowledge relates to real life and whether the school mathematical knowledge makes sense because they will never use it in a framework outside of the classroom.

The gatekeeping function of mathematics is based on the preservation and continuation of social status through education (Burton, 1996). The learning environment that exists through the history of mathematics education is characterized by a dichotomy between the subsidized intellectual pursuit of knowledge by an elite and the need for commercial and administrative mathematics from commerce and government, resulting in trade being the

[21] Pierre Bourdieu and Jean-Claude Passeron coined and defined the term *cultural capital* in the essay "Cultural Reproduction and Social Reproduction" (1977). Bourdieu then developed the concept in the essay "The Forms of Capital" (1985) and in the book *The State Nobility: Élite Schools in the Field of Power* (1996) to explain that the education (knowledge and intellectual skills) of a person provides social mobility in achieving a higher social status in society

vehicle with which the science of mathematics evolved in Europe through the interaction with the Arab empire after the Dark Ages (Swetz, 1987).

Briefly, it should be mentioned that mathematical knowledge was widely applied during the period of the industrial revolution in the post-Middle Ages. Although this fact was important enough, it was not able to bring about change because according to Hardy (1941) the view of top mathematicians called “Cambridge wranglers” who represented another kind of mathematics education standing away from any use of mathematics in real life prevailed. In America, the equality society tried to overcome such discrimination in education and make mathematics education equal and accessible to all people.

America developed an elite mathematical training and the reason for it was according to Burton (1996) the failure of launching the Sputnik spacecraft in 1958. Mathematics was then charged with the responsibility for the disappointment of the American public for the launch of the Russian Sputnik spacecraft and this event was the reason for introducing a new mathematics curriculum that gradually created an elite group of people who understood mathematics. Consequently, in the field of compulsory education, all students were taught a wide range of knowledge although a tiny percentage of students would practically use this mathematics in their everyday life. It is clear that the school mathematics curriculum was determined by university mathematics (Thompson & Senk, 2020).

In addition to these historical factors which have contributed to the thought of mathematics as a gatekeeper, it is still worth mentioning that a psychological cause exists and derives from the relationship between mathematics and intelligence. The educational theory was heavily influenced by psychometric tools, with the result that it turned the interest to measuring students' abilities. Mathematics is an easily measurable cognitive object and was used extensively to evaluate students' cognitive abilities. Therefore, being good at mathematics has become synonymous with being smart (Steinig, 2016). Parents, thus, became more aware of the impact of mathematics on the

acquisition of future jobs while teachers and professionals were involved in the struggle to locate class talents.

After detecting the historical and psychological factors that mathematics has shown as a gatekeeper, we must note that this approach has created a closed culture for mathematics and mathematics education which needs to be emancipated in order to bring mathematics into line with the immediate needs of society. Mathematics acts as a system within the systems (Moutsios-Rentzios & Kalabasis, 2012). Cultural capital of mathematics today is defined by a small group that benefits from the continuation of the existing situation where mathematics has power and refers to students with specific abilities.

D'Ambrosio (1990, p.23) refers to this as the 'social terrorism' of mathematics education and links it to the production of negative self-esteem among minority students.

3.4.1 Towards a cultural orientation

Numerous researchers and teachers have started to change the Platonist view of mathematics promoting a cultural-based understanding of mathematics in order to promote students' interest and understanding. Although there is willingness to ground mathematics education on a cultural basis, the content, the structure and the language used has not entirely moved from the Platonist belief. In fact, they use the Platonist language in cultural activities and they incorrectly believe that students belonging to different cultural groups, either share the same worldview with the rest of students or their minds are a tabula rasa because of the poor educational opportunities offered by their social environment. Usually a poor environment is considered as stupidity.

Mathematics researchers and teachers often report that mathematics is found in the world around us (Hube & Karaali, 2020). This opinion supposes that everybody sees the same thing and this language is not harmonized with their culturally oriented plans giving, thus, mixed and confusing messages that impede the quality and the effectiveness of the teaching process. According to Ernest (1991) mathematics is rooted in the culture of individuals who created

the knowledge system and should be related meaningfully to their cultural identities (Abdulrahim & Orosco, 2020; Ishimaru et al., 2015). Bishop (1988b, p. 155) acknowledged this double function when he stated that mathematics is a product of its developer's culture; and "as a cultural product, [it] is now strongly shaping Western culture as a whole."

Unlike the Platonist belief, a cultural understanding of school mathematics aims to position students so that they experience mathematics as a human endeavour (Ernest et al., 2016; François & Van Kerkhove, 2010; Russell, 2016; Skovsmose, 1985, 2005). "[W]e take it as self-evident that mathematics must be understood as a human activity, a social phenomenon, part of human culture, historically evolved, and intelligible only in a social context" (Skovsmose & Greer, 2012, p. 379). To experience mathematics as a human endeavour is to engage in a repertoire of its sense-making cultural practices (Boylan, 2016).

The cultural product of mathematics is interwoven with students' cultural activities. Linking mathematics to culturally approved activities is a way to make students express their way of living (Vos, 2018). According to Bishop, "Mathematics, as an example of a cultural phenomenon, has an important 'technological' component," Bishop argued (1988b, p. 146). He then mentioned that all mathematical cultural activities "relate to the physical and social environment in some way and…the functions of this symbolic technology called mathematics are concerned with relating [humankind] to [the] environment in a particular way" (p. 147). Bishop's general characterization of mathematics can be distilled into the following definition: "In any culture (including Euro-American cultures), their mathematics is a symbolic technology for building a relationship between humans and their social and physical environments."

Every major culture has created a mathematics knowledge system making mathematics culturally pluralist, but not relativist. Platonists value binaries really highly, for instance, universalist or relativist, and almost nothing in-between. But pluralism rests comfortably in-between. Pluralism is simply a logical implication of Bishop's (1988) characterization of mathematics.

Mathematical pluralism directly relates to epistemological pluralism in general, and it could serve as an anti-hegemonic movement in the field of educational reforms for social justice. (Aikenhead, 2017).

3.4.2 Mathematics education and curriculum development for minorities

Gutiérrez (2018) believes that we are in an interesting historical moment in mathematics teacher education. There is a greater realisation within our field of the connections between systems of power and mathematics (O'Neil, 2016). We are starting to acknowledge how mathematics education can be viewed as dehumanising for both students and teachers as well as what might constitute re-humanising practices (Gutiérrez, in press). Our professional organisations are calling for teachers to move beyond simplistic notions of equity to understand these power dimensions and challenge the system on behalf of students belonging to minorities.

The intense concern in contemporary literature on developing the structure, the content and the approach of modern mathematics curricula is expected if we consider that the role of mathematics in schools as social reproduction vehicles is politically essential. How the mathematics curriculum is developed is undoubtedly a dimension of the mathematics education policy.

Gutiérrez (2015, 2016, 2017b) argues that mathematics as a school practice is resonant with a white supremacist agenda when the contributions of all cultures are not acknowledged, and mathematics is simultaneously seen as a standard by which we judge intelligence in society. This is not the first time researchers have directly linked the supremacist capitalist patriarchy and mathematics (Battey, 2013; Battey & Leyva, 2016; Bullock, 2017; Harron, 2017; Joseph, Haynes, & Cobb, 2015; Leyva, 2017; Martin, 2013, 2015; Stinson, 2013; Warburton, 2015, 2017).

Mathematics education was late to the backlash party since mathematics educators have not been seen as making genuine changes in terms of institutions or structures in society. The agendas have been aligned too closely with the status quo, with a system of education that is not meant to

support students who are Black, Indigenous, or Latin, and as such we are not seen as a threat (Gutiérrez, 2017c). There are unquestionably a group of researchers and educators who point out how the framework is set up to protect the benefits of the elite as described in the previous section. These analysts request that we re-humanise mathematics instruction and learning for students who historically have been marginalised and persecuted, putting their needs in the first place when reconceptualising the mathematics curriculum.

A good mathematics education within the terms of a dominant culture is vital if students' belonging to minority endemic culture are to achieve the world since these are the terms on which success is presently measured. However, good mathematics education in an ethno mathematical sense is vital if there is to be an amendment in society towards the culture of the minority group (Wachira, & Mburu, 2020). The role of mathematics in passing on the worth system of the minority group should be understood and shared. Considering the extent to which both are possible together, who professionally defines each of these curricula, and who decides which is to be taught and at what time, are all contentious issues (Burton, 1996).

The status of the professional is not to faithfully follow the commands of the ideologies presented by others and to follow the way of work established in the past years as a soldier. Being professional means that you can degrade the messages you get from the professional societies, the professional development and the practice, and in continuing to decide what is the interest of the individual students in order to make the required decisions for the teaching practice. Reconceptualising mathematics curriculum, professionals look beyond social justice to find other ways of disconnecting mathematical teaching and learning from sovereignty, compliance and supremacy (Gutiérrez, 2017c).

3.5 Synopsis

Analysis of the theoretical principles around mathematics has made prominent the differences among the various views regarding mathematics.

Absolutists tend to oversee the role and feasibility of mathematics in everyday life of students, while at the same time they are interested in concepts such as the generalisation of the developed mathematical concepts. At the same time Penrose in his analysis coincides with the ancient Greek philosophy which explicitly states that mathematical content must be discovered as an abstract object because it has universal application and power rather than being invented by humans.

Looking into the status of mathematics it is obvious that it has a prominent position in how it is viewed as superior to the rest of the school courses and students that present exceptional performance in its study are considered as particularly intelligent and gifted with the prospects of successful development and career ahead of them and consequently prominent social status.

Historically, mathematics was associated with the Greeks and there has been a continuous tendency to link their philosophy with a western mentality and approach. s that real mathematics started with the Greeks. At this point, the link between Greek culture and the East and Egypt as well as any pre-mathematical activity should be taken into consideration as they should be viewed as the stimuli of further growth and development.

What we view as a holistic approach to mathematics is the extensive application of mathematics in every aspect of human activity in accordance with the numerous specialities in the scientific mathematics field which although is not easily justifiable, it is resulting from the unified thinking among scientists.

Mathematics is a particular way of thinking which is thoroughly structured and contributes to the formation of a particular community. The source of mathematical agreement is a shared view of the structures that are built around the nature of mathematical reasoning.

During the process of mathematics curriculum reconceptualization certain areas are being reviewed and analysed to support the framework upon which the principles of the new curriculum are based. The areas of equitable access and participation in quality mathematics education, distributions of power and

cultural origins of truth, mathematics identity, subjectivity and embodied (dis) ability, activism and material conditions of inequality, economic factors behind mathematics achievement are the five main areas that are analysed in depth in the efforts to identify their influence in the learning process, the impact on how mathematics is viewed by society and how the new curriculum should approach them to ensure effectiveness of the curriculum, facilitation of the educational policies and acceptance from society and the educational community.

What is prominent is the cultural impact mathematics has and how this is depicted in anthropological and social studies that attempt to define the approaches towards assessment in education which tend to create a universal standard ignoring cultural differences and characteristics.

Ethnomathematics at the same time considers historical practices for their mathematical characteristics as pivotal and views its role as a representation of society. It is evident that the educational establishment is compelled to accept the existing social organisation as mathematics is inherent in school processes and school organisation which links it to formal education.

Historical factors have contributed to the thought of mathematics as a gatekeeper due to breakthroughs in science and technology and the rivalry between superpowers. This explains the tendency to develop a mathematics curriculum that aligns with the mathematics education policy. Nonetheless, it is of prominent importance that to support knowledge growth and participation of minorities in the learning of mathematics and ethno mathematical sense should be applied in order to provide equal opportunity in the educational process.

Chapter 4: Social exclusion

4.0 Summary

The phenomenon of social exclusion is the focus of chapter 4 of this research paper. The underlying reasons and their impact on the different social layers and classes are presented to provide theoretical insight in Roma people social exclusion. In section two of this chapter, the way social exclusion is evident in Roma societies along with the different forms experienced by Roma people are analysed in an effort to facilitate the understanding of the challenges faced by Roma people in relation to their education and the obstacles that have to be overcome. Finally, the school's role in the formation of racist perceptions, attitudes and behaviours are presented and compared to the existing culture in education and its impact on the teaching of mathematics

4.1 Social exclusion as a social phenomenon

Social exclusion is a rupturing of the social bond. It is a process of declining participation, access, and solidarity. At the societal level, it reflects low social cohesion or integration. At the individual level, it refers to the incapacity to participate in normatively expected social activities and to build meaningful social relations (Hämäläinen & Matikainen, 2018; Silver, 2007).The term social exclusion was used for the first time in 1974 by Rene Lenoir to describe the socially excluded such as the handicapped, substance abusers, juvenile delinquents, and deviant groups (Silver, 2007). Since then it has become a point of reference until today, by referring to a settlement of society in a distinction to those who are inside and those outside society. The term social exclusion is useful in everyday speech, in politics, and science, with a different dimension and connotation for each one of the above-mentioned cases.

Social exclusion is usually synonymous to other phenomena which affect human dignity and make everyday life harder such as unemployment, poverty, racism, and so on. Social exclusion is generally characterised as a living condition in conditions of poverty on the margins of society. Winston and Kennedy (2019) mention that aspects of severe housing deprivation, such as

poor dwelling quality, unaffordability and insecurity, have been linked to a range of problems including lower quality of life and well-being (Burgard et al., 2012; Cannuscio et al., 2012; Barnes et al., 2011; Mulder, 2007); poor physical and mental health, especially among those living in accommodation which is damp and/or mouldy (Bentley et al, 2011; Clark & Kearns, 2012; Marmot, 2015; Mendell, 2015; Reeves et al, 2016; Rollins et al, 2012; Webb et al, 2013) ; and more inadequate access to jobs, schools, amenities and social networks (Mulder, 2007; Acolin & Wachter, 2017). There is a growing body of research indicating that residents of poor housing frequently suffer from energy poverty, which is likely to result in, or exacerbate, health challenges (Healy 2003; 2016; Liddel & Morris, 2010). The effects of living in poor residential environments on morbidity and life expectancy are a particular concern (Baciu et al. 2017; Kim et al., 2018; Woolf & Purnell, 2016).

For the European Union, the concept of social exclusion means not only inadequate income but includes areas of life that are excluded from the marginalised people such as housing, education, health and a lack of access to opportunities due to the particular circumstances existing in areas where problems arise or where vulnerable social groups live. Usually, socially excluded people live in rural areas or on the margins of the urban areas of the big cities. The European Union then attempts to justify the phenomenon as a result of both industrial change, the evolution of its traditional family structures and change of traditional solidarity structures (European Committee, 1994, p. 20-21).

Studies of poverty and material deprivation highlight its multidimensional nature, including both monetary and non-monetary indicators (Alkire & Foster, 2008; Nolan & Whelan, 2011). Increasing efforts have been made to collate data on non-monetary indicators in the EU to help identify the poor and capture the multidimensionality of poverty (Walker & Smith, 2018, p. 249; Nolan & Whelan, 2007, p. 162).

Social exclusion is seen as a state of affairs but also as a process in an effort to understand more precisely what causes it and what causal relationships of social complexity can be included in this specific term (Vandekinderen et al.,

2018). Causes and consequences of social exclusion that create a vicious circle and lead to the perpetuation of this dangerous social phenomenon are bound to be related to wealth, permanent and adequate housing, access to education and health, and access to the labour market, in general, to all those factors which contribute to peaceful living (Delgado-Baena et al, 2021) .

The whole process of hindering access to public goods and at a time when so many goods are produced in Europe, the existence of the phenomenon of social exclusion is a scandal. The fact is that while goods in favour are sufficient for all people in Europe, there is a high percentage of people living in the borders or below poverty. Social exclusion as a social problem creates situations that cause discomfort to a substantial part of society, especially to those who experience it as such because their status does not coincide with the desired one.

Social exclusion is a problem which creates unpleasant situations, as a direct result of the formation of relations of subordination between the dominant culture and the persons experiencing social exclusion. Among researchers who examine policy and social sustainability, particularly pertinent issues include the satisfaction of basic material needs and self-fulfilment (Littig & Griessler, 2005); provision of facilities which address the need and the capacity for participation (Cuthill, 2010) and promotion of inclusion by providing basic needs (Vavik & Keitsch, 2010). Murphy advances this by linking the social and environmental pillars with policy (Murphy, 2012) arguing that the three pre-eminent concepts of the social pillar include equity, participation, social cohesion which are all included in the concept of awareness for sustainability.

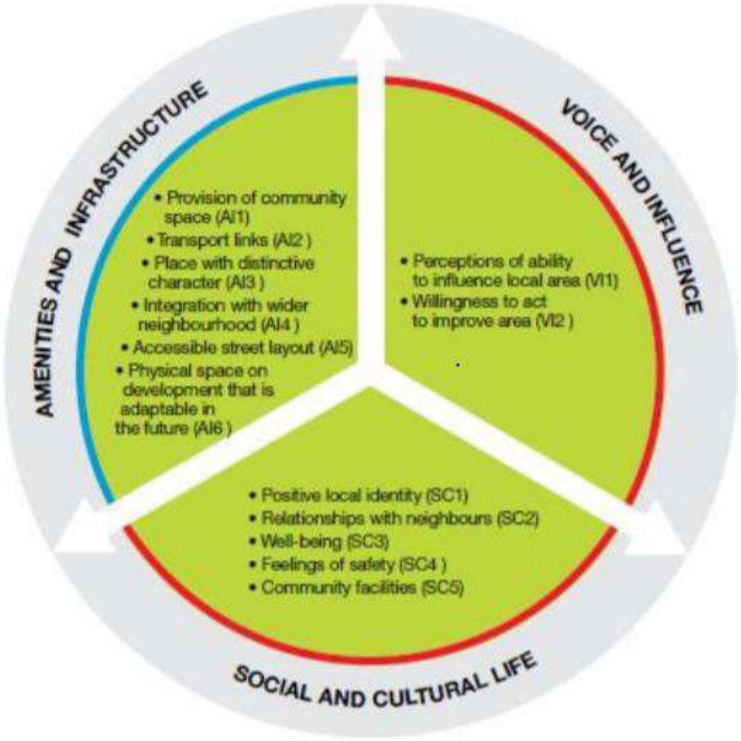


Figure 2: Indicators for the three different dimensions of the social sustainability framework.

(Bacon, Cochrane & Woodcraft, 2012, p.21)

For those who are responsible for their fate, the faces of people who are socially excluded are not admitted to society and have the stigma of guiltiness for anything negative, which happens to the rest of the society. Additionally, it becomes evident that the interest is directed not only to those who are socially excluded but also to the mechanisms and processes that create, maintain and generate social exclusion, mainly if we accept the view which is dominated by the incrimination of the victims identifying specific practices that allow or exclude members of a social group (Modi et al., 2021).

However, the action of the teams requires them to be involved in the evolution of society as well as the development of the group and the individuals themselves. This participation has to do with whether or not opportunities are provided for people to act. Usually all the groups affected by social exclusion against the absorption of public and social wealth are at the same time blocked to a greater extent and to the most critical asset of social wealth: that of equal participation in the political process (Hayden & Saunders, 2019). Considering social exclusion as a problem means an obligation by the

institutions and the state to take measures, and it is true that development attempts are being made strategies to address it. It is a fact that while efforts to develop both politically and theoretical strategies are made, minimally positive outcomes have an impact on the everyday life of people living in such social groups.

Trying to tackle the phenomenon of social exclusion at its base and to create the conditions that will allow change to become a reality in the long term, we should identify education as the primary concern. As long as discrimination and social exclusion find scope even within schools, then any hope for improving the living conditions of people belonging to different cultural and social groups is lost (Alan et al., 2020).

4.2 The Roma people and social exclusion

Mihai Surdu's book entitled 'Those Who Count: Expert Practices of Roma Classification', released by the CEU Press in 2016, is, according to the author, "not another book about Roma or Gypsy people". It is instead, a book about "the history of their classification and about their classifiers". Surdu seeks to expose multiple interests – scientific, political, and those of Roma entrepreneurs – in "constituting Roma groupness", a process which is "terribly mundane if one considers money, power, academic, and managerial positions that circulate in political and academic networks.

Who are the Gypsies/Roma (in an ontological context)? How are they constituted as an object of political and scientific research (in an epistemological context)? These appear to be the main issues in Surdu's book. Surdu addresses these questions with scepticism and incredibility that the concept of ethnicity expresses a distinct social reality. In contrast, he chooses nominalist and constructivist approaches against realist and essentialist ones, making it clear that Roma is, in fact, "a fiction" brought into existence merely by "concepts", "classifications" or "categories" by those who researched or counted them.

Moreover, he believes that the present Roma ethnicity is a result of classification and categorisation or– a construction – by those who have had

interests in doing so, be they scholars, policy experts or entrepreneurs, among them Roma entrepreneurs. He further states that in the case of Roma, this method has not been “principally driven by the Roma political community but by external or academic experts and political community”. He asserts his position clearly: “I do not affirm that Roma people do not exist, but I assert that the Roma population exists as a negative and opponent structure created by dominant groups and self-internalised by many of those labelled as Roma”.

There are many other theories about ethnicity that could better serve to explain the condition of the Roma for all of us interested in ethnicity, particularly in the context of ethnic identity in a globalised world. To make it clear, Aronoff & Kubik mention that, “Although some scholars consider ethnicity to be primordial or at least perennial, it is neither wholly chosen nor assigned. […] The acquisition of ethnic identity is generally associated with the growing sense of self-consciousness linked with so-called modernity” and in this process, identity is “deliberately politicized, especially, when it is threatened by forces of domination and /or assimilation (like colonialism or globalization)” (Aronoff & Kubik, 2013, p. 158).

In Surdu’s view, there is an “epistemic community” (p.72–81) and a particular form of policy community (i.e. state institutions), and the expertise of both is used in producing knowledge about Roma. However, the prevailing political field or type of regime that constitutes Gypsies/Roma as a political entity and generates a “Roma issue which afterwards is objectified by various academic disciplines is predominant”.

In other words, Surdu argues that the academic construction of Roma as a research field depends on the political context or type of system. In this regard, awareness of the Roma is a by-product of political will-power and what is being said about Roma is authoritative, since it is related to people holding power, thereby granting a reality.

For Surdu, categorisation of Gypsies and later of Roma should be essentially seen in its historical context in order to understand the epistemic claims made by authorities that lead to the social formation of the group. Literature review on general classificatory practices related to ethnicity or minority identity and

those tied explicitly to Roma leads Surdu to the conclusion that “those labelled as Roma (in the process of the standardisation of Roma identity) internalise the scientifically connected with stereotypes”.

Ethnicity, as a process of social construction, consists of a set of constitutive factors. The experience of being Roma is determined by the convergence of factors such as ancestry, mother tongue, neighbourhood, and social bonds. However, in the absence of the entirety of these factors, it still is possible to be categorised, by the outgroup, as Roma (Parnell-Berry & Lawton, 2019; Csepeli et al., 2004).

In comparative studies of Roma and other youth, ethnic identity has been associated with wellbeing and school success (Dimitrova et al., 2017); this multinational study by Dimitrova et al. (2017) found that national identity was unrelated to well-being among Roma in some countries but not others, demonstrating that the relationship is susceptible to context.

Evidence also supports the influence of ethnic socialisation on ethnic identity and psychological and academic outcomes among ethnic minority youth. Hughes, Witherspoon, Rivas-Drake, and West-Bey (2009) report that youth who reported cultural pride messages also reported higher ethnic identity and self-esteem; ethnic socialisation messages, focusing on cultural pride development and preparation for bias, were associated with more positive beliefs about their ability to master academic work. Similarly, Murry et al., (2009), showed that youth who reported receiving a combination of these two message types had higher self-esteem and racial identity and were less likely to devalue their academic achievements. Roma youth live under discrimination regularly in communities and schools. Messaging around pride reinforcement or cultural socialisation (historical legacy or group pride) may enhance school success, whereas the recognition of bias may inhibit school success or promote skills to overcome adversity.

The determined segregation of Roma minorities over Europe has, in later years, prompted the issue on the beat of the European Union’s motivation. Later occurrences, ranging from constrained removals within the United Kingdom and France to anti-Roma demonstrations in the Czech Republic,

caused diverse international personalities to repeatedly highlight the criticality of the issue (Stewart, 2012). Since Roma make up Europe's most prominent minority group, Western and Eastern European nations confront a collective challenge in stemming the tide of their rising social and financial exclusion (Kroon et al., 2016). Although over the past decades, several European nations have endeavoured to ameliorate Roma's social position (Sigona & Trehan, 2009) later reports demonstrate that both West and East European countries keep coming up short to progress the circumstance (Absolution Worldwide, 2014, p. 30). To clarify open states of mind and convictions towards minorities, news scope is contended to matter (Boomgaarden & Vliegenthart, 2009; Vergeer et al., 2000).

News media are a powerful tool which assesses foreigners and minorities impacts people's eagerness to categorise others (Hatton, 2016; Boomgaarden, 2007) and may contribute to the generation of preference and racism and the upkeep of ethnic dominance and imbalance in society (Richardson, 2014). Notably, the more adverse news outlets cover minorities, the more problematic people see these bunches (Boomgaarden & Vliegenthart, 2009). Such assertions flag the significance of news representations for our understanding of how Roma are seen within European dialogue.

Kroon's et al. (2016) research has highlighted that discriminatory behaviours are established in partiality (Cuddy et al., 2008), and anti-minority attitudes can be fortified by news scope (Boomgaarden & Vliegenthart, 2009). Since news assessments impact how problematic people see minority issues, systematic associations between Roma, culpability and tricky conduct may strengthen adverse convictions and prejudices towards this bunch.

Lastikova and Findor (2016) mention that several books have been published to critically assess the current research on prejudice and stereotypes in social psychology and offer alternative conceptualisations, research methodologies and intervention strategies. The most relevant of these to our research are the edited volumes Beyond Prejudice (Dixon & Levine, 2012a) and Moving Beyond Prejudice Reduction (Tropp & Mallett, 2011a). The main criticisms

made by the authors that contributed to these volumes about the current prejudice and stereotypes include that:

- ❖ prejudice is a collaborative and social relationship-driven endeavour (Dixon & Levine, 2012b; Condor & Figgou, 2012; Durrheim, 2012);
- ❖ focuses on irrationality and biased information processing: exploring prejudiced personality, psychodynamic explanations of prejudice, misperception of social reality (Dixon & Levine, 2012b; Reicher, 2012);
- ❖ concentrates on negative attitudes and emotions although outgroup attitudes often have mixed valence (Dixon & Levine, 2012b; Reicher, 2012; Tropp & Mallett, 2011b; Gartner & Dovidio, 2011), the main criticism being that positive and negative attitudes differ in their ability to predict positive and negative behaviour (Pittinsky, Rosenthal, & Montoya, 2011);
- ❖ Prejudice reduction interventions are designed for historically advantaged social groups following the logic that prejudice reduction in majority members will solve the intergroup conflict, a logic that shifts the power to make social change happen even further away from the stigmatised minorities (Dixon et al., 2015).

Consequently, considering Roma people, racism is considered to be a set of attitudes, behaviours, and stances as well as all the statutory measures, which forces them into submissive living just because of belonging to a distinct group of people. The common excuse for this attitude is the diversity of the Roma group in which an alleged impairment, inferiority or danger for the dominant group is attributed. According to the results of surveys on attitudes, stereotypes, prejudices and social distance toward ethnic and religious minorities in all the countries of Central and Eastern Europe, the Roma are the most rejected of all minority groups (Csepeli et al. 2000, 2004).

The data also show that during the transitional period to a market economy, hostility against the Roma became even stronger and acts of overt discrimination and racism against this community became part of everyday life

in Central and Eastern Europe. Throughout the region the agreement response rates to statements such as ‘The Roma are genetically inclined to commit crimes’, ‘You cannot trust or rely on Gypsies’ and ‘The Gypsies are lazy and irresponsible’, have been conspicuously rising.

In the case of education, this specific dimension of racism is of particular importance for the reason that individual racist attitudes of students and teachers belonging to the dominant group are in a dialectical relationship with school curriculum development measures since they often predetermine the appearance of such behaviours during the educational process (Turner & Brown, 2008). While there are benefits associated with curricular recognition, including its capacity to potentially disrupt the reiterative reproduction of institutional racism at a formal curricular level, a significant body of literature highlights the shortcomings associated with additive curricular approaches. These include tokenism and a failure to challenge dominant mainstream-centric perspectives and wider systemic inequities (Kavanagh & Dupont, 2021)

Romani children while playing and interacting with the Greek students at schools, learn specific language terms, which are essential for the game. Generally, the level of Greek language use, which undoubtedly affects Roma students’ ability to participate effectively in mathematics courses, can be considered "poor" both in terms of understanding and expression (Stathopoulou & Kalabasis, 2007).

Generally, the level of Greek language use by Roma students —given that the use of other languages is not encouraged— undoubtedly affects Roma students’ ability to effectively participate in mathematics classroom, restricting their understanding and communication. This practice that is dominant in Greek schools results from monolingual ideologies which are influencing teaching practices for a long time, meaning that language is often taught separately during teaching (Cummins, 2008).

Implicit (or explicit) language hierarchies make teaching languages with a higher status be perceived as more urgent than focusing on languages with a lower status, such as migrant or regional languages (Makarova et al., 2021);

an expression of discrimination that leads to racist practices. Issues of interest in the approach of racism experienced by Roma children in schools are those presented below in a series of questions which struggle for valid answers such as examining the central stereotypes which are created and reproduced in the dominant school speech (for example excluded children are failed children who are hyperactive, dangerous to classroom regularity etc.) The first easy answers to be found will have simple content that they are children with violent personalities or divergent children, children with low mental levels as well as bad students. On a second level, they may be considered as children with no values.

A first perspective approaches the issue of creating, reproducing and perpetuating racist perceptions within the school area by teachers and students. This ideology raises the awareness for portraying which the real intentions that govern the whole school function are. This policy defines all the frameworks of the educational process through which it is shaped by a grid of perceptions, attitudes and behaviours and how these policies are implemented by the dominant socio-political ideology. It is unquestionable that both racism and acts of physical, mental and symbolic violence in schools are extreme and should be ostracized by both changing the attitude of the people involved in the learning process and by effectively redesigning the curriculum of the individual courses as a political action which addresses inequality issues that are at the heart of the educational process.

The phenomenon of racism is the result of the social crisis and therefore directly affects education, which acts as a feedback mechanism for this crisis in a cause and result cycle phenomenon. This opens the way for the implementation of policies of lesser evil or intimidation, namely persecution or assimilation. In an era of a universal economic crisis, racism is becoming clearer and has to do with the fact that it has been consolidated in modern times in two modern structures which directly determine the identity of citizens: the economy and nationality. Both are dominant components of shaping people's identity.

Education and school as a vital part of the social system, contribute to the formation of citizens as a model of the dominant ethnocentric identity. Detailed analysis of curricula makes it apparent that education struggles to shape a dominant identity (Rubel, 2017) based on which policymakers promote and impose the formation of a Greek ideal. It is a collective consciousness that the formation of this ideal type of Greek intervenes in schools and is, therefore, the result of a defined and unaltered educational policy as the exclusive responsibility of the government.

The organisation of school courses which, as a whole, is regulated up to the last detail by a specific course book in combination with the hidden curriculum leads to full control of all school life events. In this way, in the context of an ethnocentric model, social hierarchy replaces respect for each person's personality and culture. Modern nationalism, as promoted by schools, is characterised by aggression towards the beliefs and aspirations of the sovereign group, and it acquires the dimensions of progressive ideology[22]. It is certain that both racism and nationalism are mutually interrelated and mutually reinforcing each other.

This process can quickly be developed around any characteristic of the dominant group, which suggests differentiation, such as race and language. Modern racism, as an ideological phenomenon, has been expanded with cultural and psychosocial arguments and practices of social discrimination. Scholars relate this phenomenon to the extent that modern political sensitivities do not accept open-ended manifestations of racism in schools, however identifying new forms of racism, combining them with social exclusion, institutional exclusion or exclusion from education (Arneback & Jämte, 2021). Another dimension of racism seems to be cultivated between

[22] Ideology is a French philosophic movement of the late 18th and early 19th centuries, named by Destutt de Tracy, that reduced epistemological problems (concerning the nature or grounds of knowledge) to those of psychology (as in the work of Étienne Condillac), before advancing to ethical and political problems. The Idéologues, by analysis of ideas, viewed the simple sensory elements of Condillac's sensationalism as generating, by successive composition, the totality of the psychic and spiritual sentiments and, finally, of the social, moral, and political sentiments as well (The Editors of Encyclopaedia Britannica, 2019)

the dipole, either ethnocentric assimilation or exclusion. The sides of this dipole create intense discrimination against vulnerable Roma groups.

Summing up, the problem of racism cannot be seen independently of the structural, economic, political and ideological relations of capitalist society. According to this view, there is not a general theory of racism in schools, but the modern critical race theory[23] (CRT) may act as a theoretical and methodological framework. CRT has no canonical doctrines or methods. Instead, as Ladson-Billings (1998) explains, CRT research is unified by "two common interests: (1) understand white supremacy and subordination of people of color; (2) change the bond that exists between law and racial power" (p. 14). The range of critical and activist scholarship within the umbrella of critical race studies is anchored by what are commonly understood to be central tenets regarding the study of race and racism. Each case of racism, as well as racism in the educational context, needs its particular historical analysis and interpretation.

This section starts with racism and the way it is expressed, continues with how and why Roma children experience it at school and highlights that racism is involved at many levels of society by examining how we can respond to this phenomenon. In the next section the way in which racist perceptions and behaviors are cultivated and maintained within the schools and how this fact affects Roma students attendance will be analyzed.

4.3 School and the formation of racist perceptions, attitudes and behaviours

Among the groups enduring all the adverse effects of marginalization and prohibition related to their community ((İlik, 2016), the Roma people are argued to be the foremost socially excluded members of the society with a

[23] Critical race theory (CRT), the view that race, instead of being biologically grounded and natural, is socially constructed and that race, as a socially constructed concept, functions as a means to maintain the interests of the white population that constructed it. According to CRT, racial inequality emerges from the social, economic, and legal differences that white people create between "races" to maintain elite white interest in labor markets and politics and as such create the circumstances that give rise to poverty and criminality in many minority communities. Though the intellectual origins of the movement go back much further, the CRT movement officially organized itself in July 1989 (Curry, T., Britannica Encyclopaedia, 2019).

number of fifteen million all around the world, nearly 9 million of whom are located in Europe and 2.5 million in Turkey (İlik, 2016; Swamp, 2008). The history of Roma has mostly been characterised by experiences of rejection, exclusion, sterilisation, slavery, banishment and even genocide (Symeou, Luciak & Gobbo, 2009; Murray, 2012).

After centuries of abuse as slaves or migrants and mistreatment as a second value race, the Roma are still enduring remarkably high levels of poverty, poor lodging, unemployment and moo instruction (Bit & Rughinis, 2007). According to the report of the European Commission (European Commission, 2011, p.173-4), 'Roma in Europe confront prejudice, intolerance, separation and social prohibition in their everyday lives. They are marginalised and live in deplorable socio-economic conditions" and as a result of this "Roma children are vulnerable and exposed to poor health, poor housing, poor nutrition, exclusion, discrimination, racism and violence" (European Commission, 2013, p.8).

This exclusion is manifesting itself in educational practices and affects children's schooling encounters to a great extent (Kesik et al., 2018). The distraught status of Roma is reflected within the educational framework in numerous ways including the inadequate registration of Roma children in primary schools, their amazingly high drop-out rate in the compulsory school framework, the low number of Roma students going to non-compulsory education and university, the absence of Romani dialect classes due to their disadvantaged socio-economic conditions, the unwillingness of Roma families to make their children go to school due to specific educational practices of isolation carried out in numerous schools (Roth & Moisa, 2009; Greenberg, 2010; Kubaník, 2021).

In addition, most of the members of the dominant culture have stereotypes as "the disaffection with school among Roma is natural" (Flecha & Soler, 2013) and Roma individuals prohibit themselves from standard education to preserve their culture (İlik, 2016) which intensify the educational exclusion of Roma children to a remarkable extent. International organisations such as the United Nations (UN), Organisation for Economic Cooperation and

Development (OECD), United Nations International Children's Emergency Fund (UNICEF) and many others criticised the attitudes towards Roma people in Europe and attempted to offer various solutions.

There have been numerous initiatives to move forward the educational conditions of Roma children inside the standards of integration and inclusion in the last years. Notwithstanding, the total equity and participation of Roma children to education is still a dream, and the majority of Roma children continue to experience marginalisation and stay among the lowest academic achievers all around the world ((Kesik et al., 2018).

There is a gap between what is expressed in educational policy archives and the reality of schools regarding Roma children (Symeou et al., 2009). Several reports demonstrate that the inclusive approach is not fortified, integrated schools and classes cannot reach their objectives or maybe the educational practices turn out to support segregation (Roth & Moisa, 2011) and the methods applied to 'civilise' the Roma strengthen this isolation (Hellgren & Gabrielli, 2021). Inside this setting, a few practices tend to gather Roma children within the same classes offering, thus, lower instruction level (Roth & Moisa, 2011), enlisting Roma children into individual schools for children with mental retardation (Vincze & Harabula, 2008) replicate the existing prohibition of Roma.

Research, however, does not support the claim that current policies are reducing social exclusion. Whitty argued that these structural shifts are "policies that do nothing to challenge deeper social and cultural inequalities" (Whitty, 1997, p. 58). The shift towards a "free market" in education seems to have made little change at all to these inequalities (Poweret al., 1994, p. 39). The education system continues to favour those whom it has always favoured—those of higher socioeconomic status and those who know how to work the system and have a "feel for the game" (Bourdieu, 1990, p.9). We would argue that this stance of privilege does not happen through oversight or accident but is a result of some deliberate, though possibly covert, strategies.

Even if the Roma children get higher levels of education, they do not experience social sustainability, and negative emotions overwhelm their

school life (Mendes et al., 2021). The right of accessibility to education requires the disallowance of discriminations to the right of education and taking the vital safeguards to empower balance of opportunity for each member of the society (Karan, 2017). However, the schools where Roma people generally live are exposed to several disadvantages leading to the maintenance of grossly under-resourced schools with sometimes deplorable physical and instructional conditions since the essential prerequisites of the schools are not met by the government and the school stakeholders try to find out sources of funds (Bosman, 2016; Briscoe & Khalifa, 2015).

Taking the reality of poverty, Roma parents mention that the disadvantageous circumstances of schools duplicate the inequities and injustices once more. However, it is hardly impossible to develop an equality discourse without referring to justice issues as the basis of equity. Thus, inclusive educational practices, require not only “bringing together children with different levels of ability, cultural backgrounds and socio-economic status in the same schools and classrooms” (Roth & Moisa, 2011, p.511) but also a distributive, cultural and participative justice in education, a more broad perspective in the discourse of equality and democracy.

A plethora of research has shown that racial inequity is evident in just about every aspect of schooling. Studies suggest that Roma families often perceive schools as learning centres that overlook, diminish or deny their culture and strengths in part by not integrating multicultural or culturally relevant curriculum that addresses minority history, contributions, struggles, and broader lived experiences (Wilson et al., 2013).

School failure of Roma children is a result of the structure of the educational process as implemented in the curriculum material which promotes education through the lenses of dominant culture and language. The ability to use the Greek language depends on specific circumstances which cannot be familiar to all students because they are directly related to the primary socialisation process. For Roma children who are socialised through learning and interacting in their broader family framework using the Romani language, the ability to use the Greek language is a powerful tool because language skills

create classification between good and bad students in the school (Kassis, 2020).

Being in a state of alienation, they refuse to accept the knowledge offered by a dogmatic ideological system that falsifies and distorts reality in the hope that students will adapt to live in a lie. This is the reason why a considerable proportion of studentsstudents belonging to lower classes resist formal education, abandoning school. Dumas (2014, p.3) refers to schools as the site of “Black suffering”, and this parallelisation can very aptly be used for the case of Roma students. He explains that such suffering is deepened by “racial melancholia”, meaning a “heavy, deeply-felt awareness of the history and persistence of anti-Black disregard and subjugation” and adds “that black suffering is a kind of constant travelling between historical memory and current predicament”.

Restrictive power principles and rules hinder Roma, given the differential status and value that many educators ascribe to families’ cultural and social capital (Louque & Latunde, 2014; Vincent et al., 2012). Cultural capital in this context refers as described previously to Bourdieu's conception of the “dispositions and cultural goods” and social educational and professional qualifications that one can leverage to attain socioeconomic status and mobility, such as elite job status (Sheldon & Taylor-Vorbeck, 2019). Social capital refers to the resources, access, opportunities and privileges people can accumulate through their social ties and networks, such as communities of worship (Posey-Maddox, 2013).

Cultural and social capital is developed and deployed by families to secure educational access and advantages for their children, and sometimes in a competitive manner whereby parents knowingly disadvantage other children in their quest to elevate their own (Baquedano-Lopez, 2013). Race and socioeconomic status intersect to simultaneously influence one’s power and perceive cultural and social capital. Research shows that the development and wielding of social capital is vital among Roma students because it enables their families, youth, and communities to individually and collectively benefit from social networks and not only individually advance in similar ways

as other families, but also distinctly enact advocacy, activism, and political resistance for racial justice. Families develop and activate social capital in culturally relevant sites that educators should take into consideration (Torras-Gómez, 2021).

Occasionally, the characteristics of Roma are adopted by the school to justify the divisional choices around which a theory develops, articulating concepts about the peculiarity of the tribes. In other cases, Roma children themselves, in the context of assimilation models, are used to strengthen the ethnocentric outlook of the school and to demonstrate a robust national homogeneity towards the society that takes place within the institutions of education. These children themselves experience, within this assimilation model, the separation, as a risky one in particular classes of reception only for the Roma, without creating relationships with non-Roma children, as well as the total neglect in the standard classes where they are integrated. Moreover, the content of the school books reflects the life of the dominant group only. It becomes clear that the school is remote and distant to the lives of Roma children, their living conditions and the daily social exclusion they experience. Education outcomes can be improved more rapidly by taking aspirations into account when targeting education programmes, and through interventions that shape aspirations (Serneels & Dercon, 2021)

Juxtaposing the sense of "other" and "we", tries to transform the hard social environment experienced by socially excluded groups into milder, in everyday discourse. This, in turn, means that the ideology of co-responsibility is more naturally passed on to the socially excluded groups themselves and is justified in not taking adequate measures against school racism on the one hand, and on the other, the use of inferiority as a natural phenomenon. What is happening in reality, is that it is the disguise of economic and political inequalities that imparts a "natural inferiority" to those groups that are promoted as subordinates, legitimising the oppression of those who hold power through naturalism (Vincze, 2014). The racist manifestations and attitudes are also reinforced by the everyday arguments of journalistic discourse when it is pointed out that the explanations that overwhelming

understanding raise for a supposed threat from the "crime" as presented by the Roma.

In schools, racist ideologies are apparent in many cases. They derive not so much from the teachers' daily experience but the already formed and supported causes and interpretations of media that are embraced by teachers. They interpret their knowledge and not only contain unjustified charging discrepancies that appeal to those who are targets of the respective ideological and practical, but also hint at solutions that ultimately turn against the Roma, which are also embraced by the same teachers.

The racism manifested in schools as a grid of perceptions, attitudes and behaviours is the birth of the educational system itself, which leads to the margin of Roma children despising them, while at the same time contempt reveals messages of superiority to non-Roma children of the dominant group. In recent years there has been a change and active mobility around the inclusion of Roma children in school. It is important to emphasise that integration is based on the rationale of tolerance and not respecting the other’s right to diversity. This means that Roma children are admitted to the school under certain conditions (Ananiev, 2020).

Policymakers, although they have the power to bring change, they allow and await diversity. Indirect discrimination made in this way is conventional refined racism that seems to care much about "cultural" dignity, but education plays with these notions only in the context of folklore dimensions. In this way, it is challenging and complicated to detect racism because of its invasion of concepts like these and to escape from its traditional ways of identifying it through the appropriation of cultural boundaries through which limits between cultures are created. Roma inclusion policies both in the EU and Western Balkans contain considerable flaws and tend to ignore the variables of discrimination and antigypsyism. There is an obvious need to act more urgently to prevent the exclusion of Roma and to create strategies for better inclusion. Overall, gaps seem to remain between the strategies and implementation results (Balidemaj, 2021).

4.4 Synopsis

Defining social exclusion and its impact on society structure and education has been the focus of this chapter. It is crucial to understand what is meant by social exclusion as it refers to not only inadequate income but multiple aspects of life such as housing, education, health and a lack of access to what is considered as the norm by those categorised as privileged but lies outside the social and personal sphere of the disadvantaged and minorities. The European Union then attempts to justify the phenomenon as a result of both industrial change, the evolution of its traditional family structures and change of traditional solidarity structures. Equally interesting is to understand the root causes as well as the consequences of social exclusion as they create perpetuation of this social phenomenon which contributes to striking social segregation and deprives large groups of people of what is widely considered as standard, that is permanent and adequate housing, access to education and health, and access to the labour market.

It also affects policy formation and decision making by those in power which leads to inequalities and social unrest. Research of relevant literature shows that the present Roma ethnotic group is a result of such segregation that serves different purposes and intends related to politics, economic factors and academia as well as representatives of the Roma minority.

Researching the status of Roma from a cultural perspective, it becomes evident that acquisition of an ethnic identity facilitates the association of certain characteristics that define behaviours and performance within social, economic and educational environments. These characteristics along with ancestry, mother tongue, neighborhood, and social bonds are accepted as defining factors and are used to explain attitude and behaviour as well as cognitive aptitude. Ethnotic characteristics also define expected character development that lead to social exclusion and are associated with reluctance to adopt and assimilate within the wider society. They also support the creation of stereotypes in the attempt to justify and explain the approach and behaviour of the dominant cultures and groups against the minority of Roma which often leads to marginalisation and rejection. Racist actions are a common occurrence towards Romani groups and especially children within

the educational framework as children represent the social stance they have experienced and have come to consider a natural expression of behaviour. This prevents educational authorities from reviewing the curriculum on its own accord and analysing the cultural impact on the learning attitudes and tends to be influenced by the prevalent prejudice and assumptions related to the Roma ethnotic group.

More particularly, in the Greek educational system, Greek language aptitude is a factor that predominantly affects performance and understanding along with the ability to participate effectively in mathematics courses. Considering that monolingual ideologies have been influencing teaching practices for a long time, it is easy to understand that categorising language teaching based on the perceived status of the predominant language supports the development of racism and segregation in the school environment.

Undoubtedly, any expression of racism or acts of physical, mental and symbolic violence in schools should be condemned and should be the priority of the curriculum redesigning in the efforts to address inequality issues within the educational process.

What could be considered as disheartening at this point is that extensive research has shown that racial inequity is evident in almost every aspect of schooling. This explains why Roma families often perceive schools as an environment that attempts to overlook, diminish or deny their culture and strengths by not integrating culturally appropriate curriculum that includes minority history, contributions, struggles, and broader lived experiences.

Cultural and social capital is directly linked to educational access and advantages and contributes to the development of a competitive behaviour often to the expense of the weak or socially deprived. for their children, and sometimes in a competitive manner. Research shows that social capital is vital among Roma students because it enables their families and communities to benefit from social networks and resist racial injustice.

The current approach to social integration of Romani children in the school environment is one of tolerance and not respecting the other's right to

diversity which does not resolve the issue of social exclusion and racism but rather attempts to pacify objections and promote the efforts of modernisation of the educational system and promote multicultural approaches.

Chapter 5: Roma community

5.0 Summary

Chapter 5 of this research thesis uses elements from field research as they emerge through the researcher's many years of interaction and action in this field. It focuses on the Roma minority and specifically in the Roma community in which the present research is conducted, their attitude towards education and the wider influence this attitude has within the extended society outside the minority closed cast. In addition, the widely perceived understanding of the Roma minority, the reluctance in accepting the importance of considering the cultural diversity in the selection of the educational material and the educational process by the established norm will be presented and analysed in the attempt to shed light on the reasons why and how the school environment contributes to the exclusion of the Roma minority from the education system as a result of the minority academic performance. Finally, the policy approach within the international organisations will be analysed to provide the basis for understanding the approach different governments have towards mathematics, their role in education and their impact on minority approach to learning.

5.1 Socio-political dimensions of Roma education

In this section, a review is made of how Roma are constructed on the one hand as inferior and on the other as indifferent to education, how and what are the social representations for them as they emerge through observation in the context of research and its interaction. researcher with individuals and situations during his twelve-year stay in that context..

Amid the final decade numerous Roma families have ended up jobless, and the financial circumstances of most Roma have deteriorated further. Families

cannot afford to pay the expenses for kindergarten; to purchase books and clothes, or to supply their children with the financial support needed to lead a full and ordinary school life.

At the same time, it is known that traditional Roma education is a community-based educational process. Children learn to understand and read the verbal and non-verbal communication signals of adults in their community at a much earlier age than their non-Roma classroom mates. They take part in the community's daily activities, and their involvement becomes the context for learning by observing the economic, social, linguistic, political and moral codes of their society. Children will quickly learn the first words of the country's official language in this community environment.

When they start their formal schooling, the Roma child arrives in a non-Roma world where knowledge about life and society is displayed in a completely different way. Roma children usually have difficulties adapting to the educational processes that characterise an ordinary classroom. The teachers expect Roma children to know how to cope with the school rules. It is a typical pattern for teachers and non-Roma students to abstain from communicating with Roma children because they are dirty (Gana et al., 2020). The Roma children in the back of the room too often also lack textbooks and other resource materials required for classroom activities.

The negative perceptions and attitudes of teachers towards Roma are created by socio-cultural factors which penetrate the whole process of teaching as discrimination against Roma children. Such discriminations make Roma children suffer from all the people involved in the educational process. These discriminations should be mentioned among the factors of marginalisation and school failure for Roma students because they promote the formation of negative attitudes from the side of the educators towards the Roma children. The usual range of discrimination for Roma children includes the following: as children indifferent facing with difficulties for being disciplined and not interested in school learning, negligible as students, often as thieves, and dangerous to the balance of school. Most importantly, very often they are given responsibility for their school failure because 'they do not like learning'.

The negative attitude of the Roma to school as the foremost educational institution creates a series of problems in their self-esteem and is usually translated by themselves for their personality: as an inability to join the school. Such views are spread to all Roma as part of the formation of collective thinking, as is the case of many ‘closed’ societies, so many of them do not enter the educational process, or many parents do not try to enroll their children in school. Thus, it is necessary to analyse and identify what points of the mono-cultural and ethnocentric school prevent Roma from absorbing the educational wealth produced, and fail to achieve their vital social role and their mission. The crucial role of curricula is found at the top of this analysis since they very often determine the implementation of the educational process. Also, curricula, as the central component of the theoretical and practical mechanisms of schools, are necessary to be examined and analysed because they are identified to contribute to the exclusion of children from education.

These ‘failing’ schools are a product of the political system, and regularly, the reason they ‘fail’ is not due to poor teaching or leadership, but the structures of the education system. Rarely are ‘failing schools’ found in middle-to-affluent suburbs. Most regularly, they are located in poor, working-class and multicultural areas (Chime, 2003; Lupton, 2004). That is to say that we can absolve leaders and teachers from the responsibility for poor practices. Instead, we seek to understand the systemic failure of disadvantaged students and communities which becomes reified in curriculum and through testing and management processes.

By understanding how these practices are structured to marginalise particular social and cultural groups in ways that are coercive and invisible, we will be better able to change those practices. When the normalised practices within education are not challenged, and the status quo is preserved, then the most disadvantaged groups suffer through symbolic violence (Bourdieu, 1972) whereby they take on board the value-laden processes of education and become victims of those approaches through which they are effectively excluded and marginalised.

At the same time, education and literacy of the Roma are considered by the official state, by the scientific community and by Roma people themselves, the key to their integration into society. Usually, exclusion from education becomes exclusion from work, access to services and, more generally, smooth and uninterrupted integration into society (Vandekinderen et al., 2018). The factors of the educational process which lead to the exclusion of Roma children, although complementary and challenging to be separated can be divided into three major categories which include living conditions of the Roma, functioning of the school institution itself and formed historical perceptions about Roma by external social factors, which directly or indirectly affect education.

Education has a better chance of succeeding in this process if it is delivered through a national system and through schools which are genuinely inclusive in nature—welcoming difference and diversity; attempting to fulfil the rights for education of good quality; and targeting both out-of-school children and children in school but not learning. But many education systems still have large numbers of children who are not achieving minimum expected levels of learning—usually because of neglect, disinterest, discriminatory policies, and/or a lack of resources and data about who are excluded, where they live, and why they are not in school (Shaeffer, 2019).

The living conditions of the Roma in Europe are characterized as miserable. Usually, these people live without a home, electricity and access to clean water (Van Baar, 2018). When a child lives in such an environment, it is impossible to allow them to study. Living conditions of the sheds are assimilated to the main physical conditions and do not provide the equal protection of a typical home. The sheds usually do not have electricity, so studying which is valid in normal daily conditions in general, becomes impossible. If we also think about the humidity or the water during the days of winter, destroying Roma children's houses, then the role of living conditions in school failure becomes more apparent.

Overcrowding of many people in the family makes it impossible to study. Large families, coupled with the miserable economic conditions experienced

by the Roma, push them to give priority to looking for the essentials for survival. Decent student attendance at school assumes that families can spend a minimal amount of money for the purchase of stationery and clothes. It is easy to understand that this amount is multiplied in families with three or four children in the majority of Roma families, so it becomes even more challenging to meet the school requirements and children are forced to leave school because of financial hardship. Socio-economic reasons oblige the Roma not to develop a written culture, resulting in being considered illiterate.

Today it is estimated that 90% of the Roma in Europe are organically illiterate. The negative experiences of the Roma that went to school, which influenced the whole group in shaping collective memory, played a crucial role in their exclusion from education. If the above view also takes into account the plain predominant view prevailing in education and focusing on the logic that Roma do not go to school because education is not an element of their cultural identity, then any responsibility for their illiteracy is attributed to themselves.

The mental age of an average adult Gypsy is thought to be about that of a child of 10," said the 1959 edition of the Encyclopaedia Britannica, 14 years after the end of the Nazi genocide of Romani Gypsies. A characteristic feature of this predominant perspective is that school failure of Roma in education is based on the genetic factors under which Roma children fail at school as children with learning disabilities, so they require special education. This viewpoint is extremely dangerous because they attribute problems to their temper without considering the impact of historical-social and political factors.

As a consequence of the above it arises that the historical background of the Roma highlights that it is purely political, social and economic reasons that have determined both the formation of Roma attitudes towards schools and the formation of the schools' attitudes against them by creating a series of obstacles or persecutions. These political actors played a decisive role in 1979 since they were not considered to be a Greek citizen, which means that they were not registered in a municipality, so they did not have the necessary documentation to enrol in school. However, recognizing the dimensions of the

problem provides an opportunity to introduce a proposal that could tackle it effectively and radically.

For this, in addition to the factors of living conditions, several inter-institutional school factors are involved acting in the institution itself and play a vital role in the school failure of these children. These factors have to do with the mono-cultural structure of the school institution as it is reflected in the curricula and methods of their approach during the educational-didactic process.

The above structure often affects and determines the relations of the teachers with the Roma children, relationships that are regulated by stereotypes and diffuse throughout the educational process as negative discrimination against Roma children. In recent years there has been a strong mobility around the attendance of Roma children with particular interest from the Ministry. Despite initial benefits, many Roma children leave school or have long periods of absence, which has proved to be an academic failure factor (Rotaru & Grebeldinger, 2020)

From a Roma child's point of view, school life is boring, and classroom activities are neither engaging nor enjoyable. Teachers rarely realise that Roma children have much more knowledge about life than some of the other students and that their interests are associated with everyday life. The process of education should not be one-sided. Some steps can be taken, however, which can ensure the success of all students. The challenge for educators is to involve Roma children to a greater extent in the educational process by making it more exciting and productive for them (Khalfaoui et al., 2020).

5.2 Curriculum materials and Roma education

The typical functioning of the school is usually based on the factors: student, teacher and curriculum. Through the curricula, the intentions of the state, as well as the predominant ideology for the content and objectives of the educational process, are implemented. Regarding the relations of the three formal factors, it is observed that in the last years there has been a dominance of the curricula on the other two poles of the educational process,

and through this sovereignty, it is easier to impose the government's intentions (Schneuwly, 2021)

Consequently, at the level of the pedagogical intentions of the educational process, there is the dominance of some ideologies, approaches and perspectivesthat are directly implied or implicitly implicated both in the formulation of the purposes of education and in the individual objectives and purposes of curricula. Ideological issues then play a predominant role in the formulation and selection of teaching material in each lesson, and they are materialised with enforceability and obligation through the school textbooks (Koren, 2020). The way educational material is structured defines the teaching method in general, leaving little flexibility for technical adjustments to teachers.

Regarding the Greek reality, the monocultural and ethnocentric nature of education, which is influenced by the Greek political scene, seems to dominate the curriculum. Recent years, in the rhetoric of policymakers there have been observed the adoption of a more pluralistic approach to the educational process at a theoretical level (Baker et al., 2021). However, the ethnocentric and mono-cultural perspective of Greek education has led many minority children to the margins of the school system or their exclusion from education as a failure in schooling will always be at the pinnacle of the causes of school leakage for these students.

The educational system in an organised society beyond the transmission of knowledge seeks to alter the attitude of individuals to the benefit of society itself (Idris et al., 2012). According to the predominantly functionalist[24] view of the interpretation of education, it functions as a cultural transfer institution, and indeed it carries a kind of cultural critique, since by formal procedures it

[24] Functionalists view education as one of the more important social institutions in a society. They contend that education contributes two kinds of functions: manifest (or primary) functions, which are the intended and visible functions of education; and latent (or secondary) functions, which are the hidden and unintended functions. The French sociologist Émile Durkheim (1858–1917), who established the academic discipline of sociology, characterized schools as “socialization agencies that teach children how to get along with others and prepare them for adult economic roles” (Durkheim 1898). The educational setting introduces students to social networks that might last for years and can help people find jobs after their schooling is complete.

selects and evaluates cultural data at each level of its transmission and uses those that are deemed most necessary for non-disruption of the class of society (Gorard, 2019, p. 11; Blackledge & Hunt 1995, p. 93-96). These pursuits of the overturned transfer from generation to generation are an underlying intention of society, which based on this logic formulates the primary educational objectives, which are central to the whole educational process.

The curriculum includes the aims and objectives of the education, the content of the educational process, the teaching methods, the tools to be used and the evaluation standards. The aims set the philosophy and ideology of those who have the power as well as the needs of socio-economic development that education is called upon to serve. These are the basis of the education system because they determine the content of studies, which will be the building of knowledge of children (Zipin, 2020). The correspondence of educational purposes with national needs is an act of the school system and helps to prioritise educational goals, which are regarded as a natural consequence in order to serve changes in the political, economic and social spheres (Mølstad et al., 2021). This priority series is an essential element for curriculum authors because it determines the order and weight of the lessons that then determine the skills and attitudes that students should develop.

For the instructional designers of the Greek curriculum, these elements are a facet of living culture. They are all the primary elements identified in the dominant cultural tradition and are designed to prepare young people to effectively address social reality and thus to adopt young people to the dominant cultural tradition. However, the curriculum includes all activities and actions aimed at promoting learning to achieve educational goals. It includes all this material that represents the intentions of the dominant ideology, namely the central values and cultural assets that will be passed on to the citizens of each country.

Summarizing the above points, the strategic importance of the structure and organization of the curriculum is highlighted in order to promote the goals of the respective educational policy. Through the curriculum, the authorities now

determine the subject of the educational process as well as the way in which it should be taught to students. It is clear that such an approach in the case of Roma students lacks meaning and value as these students have different educational needs and the approach through the school educational process must be done through current research for curriculum reconceptualization which focuses on the fundamental matters of recognizing and interrupting dominant ideologies and hegemonic practices that have made their way into Roma students' classrooms by explicitly addressing how a teacher's ideology, sociocultural/linguistic funds of identity, and pedagogy announce or denounce Roma students' teachers' critical consciousness that leads to the creation of equitable teaching and learning spaces

According to these elements, the curricula are based on the fundamental question already mentioned in the introduction of the dissertation: What values, attitudes, skills, strategies, and knowledge must be acquired by modern students in order to be able to live creatively in the world of the future. Based on this specific question, the theoretical framework for curriculum development is related to the effort to identify the world and the most critical factors that will make a student an active and equal citizen of social life. This creates a framework of self-evident assumptions for the student and society that supports the main material selection options. The choices for meaningful knowledge seek to guarantee the validity of the general acceptance of the decisions of the dominant ideological-political group of society. Through a postcolonial approach to competency-based curriculum (re)design, we propose a framework that centers the knowledge and voices of Roma students as a way to dismantle oppressive systems in higher education (Parson & Weise, 2020).

The curriculum adopts the principles of reality that have been applied mainly by the pedagogical process of progressive education[25], whose theorists

[25] Emerging at the end of the nineteenth century, Progressive Education became a major international educational movement in the 1920s. Its advocates demanded profound educational reforms based on a scientific understanding of the child and on a reversal of educational logic. School, it was argued, should adapt to the child by respecting his or her

express the view that "true is any knowledge that is useful" Thus, it is no coincidence that the development of curricula takes into account psychology more, with the result that teaching is identical to the psychological theories of learning (Weinstein, 2018).

Also, curricula in both their development and their implementation in the teaching process use those trends of psychology that are considered to be dominant. Such are the psychological theories, the use of which is assessed as very efficient and effective for achieving the objectives of education. At the same time, their use in the theoretical support of curricula is considered as the only and most correct scientific approach. Learning is considered to be the permanent change in behaviour that results from experience and exercise, and that it must be accessible to any observation since it is subject to modifications based on the purposes (Elihami & Ibrahim, 2020).

In practice, most educational reforms will move more quickly into homogenization around a dominant culture that is a source of discrimination about which people will have opportunities to succeed in predetermined educational goals. Curricula are widely considered as indisputable monopolies or authorisations on the pretext that the state must provide all children with a consistent level of education so that there are no individuals or groups that do not have the right training opportunities. In essence, however, they seek to achieve consistent behaviour and articulate the learning objectives. Thus, curricula are the result of a political act with specific goals and interests (Gershon, 2021).

A school is a place that molds the individual in a very holistic manner. It is a training ground where students can develop, harness, and maximize their potential to be a responsive and excellent man as a product of their learning process (Tus, 2020). The teachers should focus not only on the fact that a

---

needs and interests and allowing him or her to learn through experience, activity and cooperation. It was therefore a question of rethinking the curricula, teaching methods and the respective roles of teachers and students so that the latter could appropriate knowledge for themselves. Those who promoted Progressive Education campaigned for coeducation, so that boys and girls could benefit from the same teaching in a shared environment. For them, education should be natural, close to life, and should prepare students for social life through an experience of community life in school. This is how they would learn tolerance and respect for others, both children and adults.

student will acquire knowledge but at the same time they should present why and how the dominant collective theory is regarded as a piece of objective knowledge and how the daily regularity of schools contributes to the learning of this ideology. At the same time, on a day-to-day basis, the teacher asks whether the view of knowledge as a ‘neutral product’ leads to the virtualisation of almost all of the culture in school. National historical ideology through curricula exploits both the "objectivity" of the knowledge provided by the school and the objectivity in order to present its principles as ideas indestructible over time.

When discussing the schooling of Roma children, the issue is almost always considered a “problem,” and what invariably follows is an account framed by negative associations and focused on the “difficulties of integration” of a group considered marginal (Liégeois, 2007, p. 11). The assimilation that is being attempted at the expense of the Roma is a result of society and is given the prestige of uniqueness, with the result that their school assimilation process seems to be one-way within the current educational framework.

School is a dominant ideological mechanism of the state, and the rigidity of the school curriculum is always under the direct or indirect supervision of the respective governing body, and for this reason, the corresponding teaching act is surrounded by the prestige of state power. School knowledge permits the search for the ideological and political choices it expresses, and thus, it permits the correlation of the curriculum with the dominant political aspirations of assimilation and homogenization, which are regarded as political acts of unsatisfactory commentary and criticism.

The organisation of school knowledge takes into account specific criteria, including the common origin of all children. The process of selecting school knowledge implies accepting its validity and evaluating all knowledge in order to respond to the ideology expressed by predominant purposes. This control of knowledge is identical to social control and depicts the dependencies and constraints imposed by dominant social groups on society as a whole. At the same time, the process of controlling knowledge leads to the exclusion of all those elements from the knowledge that may lead to a reversal in the

formation of the dominant ideology. For instance, the persecutions suffered by the Roma in the Second World War and their genocide by the Nazis is not mentioned to the history taught in elementary school, . This fact is not even cited in the Romani literacy books, which is not accidental since it helps to identify only the struggles of the actors of the dominant cultural ideology.

The curriculum development model dangerously disregards Indigenous studies and research paradigms, as development theory is positivist or post-positivist (Wilson, 2001), thinking of individuals as sources of data being in relation with the researcher and with the world. Indigenous inquiries about standards and epistemologies are understood to be fundamental for any frame of community advancement, which means working in relation with others, which is essential to cultural responsiveness. The modern curriculum should be criticized for the fact that it inadequately addresses issues of poverty, human-rights, violations or development (Hannum, 2016).

The critical theory focuses on social justice and offers a method for analysing systems of oppression, systems which limit the agency of individuals and non-dominant groups (Freire, 2000). The critical theory looks at how power, social class, and economic systems limit individuals' and groups' access to goods (Howell, 2018; Agger, 1991). The ultimate goal of critical theory is to uncover structures that maintain inequality and to make those who are oppressed by them aware of those structures. Once aware, the oppressed (Freire, 2000) can work together towards new systems that change the oppressive systems. The critical theory sees oppression as material and psychological (Watts & Hodgson, 2019). From the perspective of critical theory, the challenges that Roma students face in schools are the result of these unjust structures.

Critical theory points out that students are told an inherently unjust system meant to keep them within their class is a just system. So, policymakers who take a critical perspective teach about the ways the system in which the students find themselves is only one option of many, and that they need to change the system to make it more just. Taking a critical approach for understanding participant-voice data implies that students who seek forms of neoliberal advancement, such as a professional job, have a false

consciousness about the place they inhabit within the hierarchy of the system, which is engineered to keep them down (Levitan, 2019).

Apple (1993; 2012) takes the view that the ideological interests hidden behind the text can easily be found not in what the text contains, but in what is absent. This characteristic of the content of the curriculum is called "selective knowledge transfer" (Apple, 1993, p. 56). The character of knowledge is an absolute fact and that the existence of a defined form of knowledge and any attempt to modify it is within the framework of the respective guidelines of the specific educational policy. Consequently, it expresses all the social relations of reproduction of power that allow the exercise of this policy, and as it is clearly seen in the case of the Roma, knowledge itself has acquired social control itself, which evaluates behaviors according to the ethnocentric model, in order to place children in respective social strata (Apple, 1993, p. 41-43). Creating a uniform way of thinking aims at eliminating any different perspective that would jeopardise the conditions of social control and this uniformity also enshrines the centralised nature of the education system.

The attempt to modify the behaviour of Roma children based on the values of the dominant Greek past means that this past is the only acceptable functional value. The neglect and exclusion of Roma cultural elements is the exercise of social control by the dominant social group of Roma children in school. The Roma student should acquire schooling knowledge and learn to recognise and respect the existing organisation of sovereign knowledge. The school in the process of conquering this knowledge engraves everything that characterises this knowledge. Roma internalisation of conscious perceptions is the expected result of forced recognition and respect for these perceptions and the recognition of voluntary legitimacy towards them to be considered equal citizens, materialising in this way its assimilative political intentions education (Kalantzis & Cope, 2020).

If any child is familiar with the school system, the school experience is a source of social and symbolic development for the child. Roma children are not familiar with this system because of exclusion from it, so school experience is a symbolic and social change in which the ethnocentric and

homogenizing model creates a series of problems in the development of school identity (Singh, 2017) which will be seen in the assessment of these children in the school process. The ideological role of the perceptions of a society that dominates the curriculum consistently reveals the use of unclear theoretical constructs and a picture of a society where there are no opposing social interests, social conflicts and exclusions but only uniform visions.

It is argued that such segregation, while it may arise from a legitimate intention to address educational disadvantage, cannot achieve such a goal in a climate of separation and intolerance which permeates the wider society. Separate schooling for Roma students usually means lower educational standards and a reduced curriculum, which in turn reinforces the view that Roma students are educationally inferior. The typical reasons provided for segregation are lack of competence in the majority language, inadequate preparation for primary school or non-attendance in preschool classes (ERRC 2004, p. 22). Linguistic and socio-economic disadvantage combine to prevent Roma students from attending ordinary schools, with the result that many are after that unemployable.

Culturally insensitive IQ tests are often used to designate Roma students as having particular educational needs and, in some cases, financial incentives are offered to attract Roma students away from mainstream schools (Cahn 1998; Danova 2005, p. 5). No person shall be denied the right to education. In the exercise of any functions which it assumes concerning education and teaching, the State shall respect the right of parents to ensure such education and teaching in conformity with their own religious and philosophical convictions. (Council of Europe 1952, Protocol 1, Article 2)

Thus, the school system in a pluralist society needs to be both integrative and intercultural. In the past, international human rights provisions have focused on the availability of education, particularly at primary level, but they have avoided the issue of content and quality of such education. This has allowed states a wide margin of appreciation. Usually there is no account taken of the different values of the Roma students, and few teachers have any familiarity with their culture, interests and language: ‘All this prepares for and conditions

methodological, pedagogical and didactic assumptions which place Gypsy students in an inferior position, denigrate them and show contempt for them' (Gypsy Council for Education, Culture, Welfare & Civil Rights 1994).

The intercultural ideology requires that the curriculum respects the diversity of each child and that teachers are skilled and sensitive to the needs of minority cultures. An intercultural strategy would also facilitate the dialogue needed to address negative stereotypes and suspicion in the classroom (O'Nions, 2010; 2016, p. 175). Segregation and separation cannot be sustained. Racism needs to be challenged in the classroom in a climate of intercultural respect, in keeping with the United Nations' recently elaborated policies on human rights education.

In developing the multi-ethnic strategy, consultation and cooperation are essential prerequisites. As far as possible, Roma should be involved in the development of policy and the delivery of education programs. This not only serves to demonstrate legitimacy but also provides role models and understanding of particular problems which cannot be learnt from a teacher-training program. At present, the high level of illiteracy means that there is a shortage of Roma in a position to offer to teach. Therefore, it is desirable to develop the role of teaching assistants and mediators. Banks argue that excluded groups must be included in shaping educational policy in order that the necessary reforms become institutionalised in the education system (Banks 1981, p. 83).

Labeling Roma children as handicapped on account of their lifestyle has been a simplified approach in education policy. In keeping with the assimilation strategy, Roma students are perceived as belonging to a social group characterised by disadvantage which can be targeted for improvement by social initiatives that fail to appreciate the constitutive elements of collective identity or the effect of entrenched discriminatory attitudes. The cultural aspects of the students' identity are underplayed in a way that will inevitably stifle identity as it denies access to individual rights such as expression and association (Lauritzen, 2018, p. 5).

5.3 School performance and evaluation as an exclusion mechanism for Roma students

The breadth and complexity of the evaluation of the educational project lie in the importance of school performance both during school years and during professional life. School performance is closely related to a favorable outlook for progress and social development (González et al., 2021).

The use of this term in the school context takes the characteristics of school success or failure. In the first instance, school performance and school success revolve in a cognitive learning framework that contains information that students need to know. At the same time, the students check whether they can generalise their knowledge by applying what they have learned in their daily life. This knowledge application may include simple and complex skills, behaviours and obedience considered normal and acceptable (Gergen, 1973).

Assessing students' performance is important because students are primarily assessed not only based on their knowledge at school, but at the same time assessed through their personality and all those factors that directly or indirectly affect students, and especially their family environment. In many cases, students who achieve the assessment criteria are intelligent as opposed to students who fail, and this is considered a natural occurrence because learning for them is unsolicited. Positive attitudes and forms of reward are attributed to intelligent students, while negative consequences are attributed to students who fail (Herrera et al., 2020).

School classifications are directly influenced by broader social classifications since the student who achieves is a responsible personality, while the failing one is irresponsible, nonchalant and unconcerned. It is considered that successful students behave correctly, and the teacher can support them, while those who fail are the ones who are the source of problems for the smooth running of the learning process and they are often blamed for any malfunctioning event of school life (Zacharos, 2006). Also it is often considered that low-performance students are considered to be responsible for their reduced performance using these prejudices as predictions for their

future as professionals and as citizens (Ensher et al., 2001). As a result, it is already pre designed from the school environment who will be a competent citizen, and that this behaviour will also be combined with his general social success. Thus, the most straightforward dimension of the assessment is the rendering of particular value to a person based on specific, explicit and predetermined criteria as a result of comparison with other classmates.

Teachers' perceptions of Roma children are of particular importance as they rely on prejudices that have to do with more general social assumptions and social representation about the Roma group. The evaluation uses the measurement to obtain a quantitative character and usually results in numbers that are considered objective and comparable. The simultaneous qualitative description of the various aspects of students' performance used by teachers' evaluation and judgments determines their position in the school system. This process is similar to the process of classifying in society, allocating to each student a position which from a very early age children accept and sometimes consider unchangeable, resulting in giving up early on any attempt for change (Zhao et al., 2021). Students get acquainted with the assessment in schools so that they can more easily and unconditionally accept the social status as future citizens.

It is well known that a student's view of his / her abilities in Mathematics (self-assessment, self-assessment, self-perception) is positively correlated with his performance in this Mathematics (Fennema, 1989; Marsh et al., 1988; Shen & Pedulla, 2000). In general, the nature of the relationship between self-perception and school performance has been the subject of much research and it has been shown that there is a high degree of relevance between general self-perception and school performance, "which increases more when school performance is related to school self-perception." the child's perception of his / her abilities at school. It seems that whether one feels capable or not is a direct function of the image one has of oneself. In addition, modern theories agree with

multidimensional structure of self-perception, according to which the person perceives himself in relation to various areas of life, the importance of which varies according to the degree of importance of each area for his life.

Teachers and parents significantly influence the formation of the student's assessment, with their comments and behavior, feeding him with a positive or negative assessment. Therefore, they also affect his performance, resulting in the widening or convergence of the choice horizon in his life.

In classrooms where Roma students attend there is a close relationship between evaluation and performance, the teacher's insight is that in many cases, it is more important to evaluate performance than the education process itself.. The Roma student is in a continuous assessment that takes place alongside the development of teaching. Its purpose is to keep track of students' progress and is based on a logic that seems to be presented as a requirement of the students being aware of their performance. It is thus understood that assessment fails from the ground up because it is not possible to assess the performance of Roma students when the subject of the curriculum and the content of the teaching is something completely foreign to their particular cultural conditions and the context in which they have learn to live and shape their individual identity. The result is that assessment can not be static but can be dynamically adapted and evolving in parallel with a lively curriculum that will give meaning to their daily experiences without simplifying and limiting the mathematical knowledge taught to Roma students.

Relevant literature, which informs the development of current curriculum materials, supports that continuous assessment will certainly bring school success because it promotes learning and increases interest in the courses through promoting strengthening efforts to achieve the desired goal (Daka et al., 2020). Assessment’s operation facilitates the new members of society to adapt quickly and appropriately to the community and to respond more successfully to its demands. In this sense, school assessment is necessary, since it is inherent in the wider society. Consequently the student as a future citizen gets used to this punitive and stressful process at an early stage.

The pretext for integrating this anti-pedagogical process into education is that it supposedly helps reveal how the child learns. Exams help the teacher to understand the abilities and characteristics of children. The teacher assumes the role of an examiner is to check whether the student used all the information or part of it, the way they organised new knowledge and their involvement. The development of a student's critical thinking does not imply that they will write what they believe but will write their personal opinion which will result from the views they expressed and learned through the implementation process of a specific curriculum. Courses, exams, and everyday tests are organised to ensure that students learn and think appropriately.

It is reasonable for the school that student assessment aims at controlling their interaction with knowledge, which is an inexhaustible source of moral and spiritual culture as well as social reflection. Instructions which come from the governing bodies of the educational institutions stress that evaluation should not be an end in itself and that it must serve to learn and contribute continually, to the improvement of the quality of teaching through the feedback process. In recent years, ways of fostering effectiveness are being introduced in the educational field, and they are combined with productivity to support the socio-economic policies of the sovereign system (Molderez & Fonseca, 2018).

Performance is directly affecting almost all school activities and functions. Performing in the context of creative production as well as in the context of play and individual or collective work is one of the students' absolute satisfaction. Unfortunately, this does not mean such a quality characterises their performance at school. Major activities such as communicative completeness, teamwork and schoolwork, mutual appreciation, social offer, and solidarity are not included in the current curriculum. There is a direct relationship between the objectives of the courses and the assessment criteria. Usually, educational processes like the above, which do not directly or indirectly serve the applicable performance dimensions, are abolished and considered misplaced (Maba, 2017).

Performance theories move between two extremes: with the one being the dependency of reckoning and the recognition based on performance and the other being the identification of performance with the principle of a democratic society. At the same time, performance is seen as an oppressive method of a system of economic sovereignty, which directs efforts on profit. Ogbu[26] (1998) calls his explanation of minority school performance a cultural-ecological theory. This theory considers the broad societal and school factors as well as the dynamics within the minority communities. Ecology is the "setting," "environment," or "world" of people (minorities), and "cultural," broadly, refers to the way people (in this case the minorities) see their world and behave in it.

The theory has two major parts. One part is about the way minorities are treated or mistreated in education in terms of educational policies, pedagogy, and returns for their investment or school credentials. The second part is about the way minorities perceive and respond to schooling as a consequence of their treatment. Minority responses are also affected by how and why a group became a minority. This second set of factors is designated as community forces.

Understanding how the system affects minority school performance calls for an examination of the overall westernized treatment of minorities. These barriers are instrumental discrimination (e.g., in employment and wages), relational discrimination (such as social and residential segregation), and symbolic discrimination (e.g., denigration of the minority culture and language). Ogbu (1998) calls these discriminations joint problems faced by minorities. To explain the minorities' perceptions of and responses to education, the theory explores the impact of the white treatment of the minorities. This impact is expressed in their responses, or their "collective solutions," to the joint problems.

[26] John Uzo Ogbu (May 9, 1939 – 20 August 2003) was a Nigerian-American anthropologist and professor known for his theories on observed phenomena involving race and intelligence, especially how race and ethnic differences played out in educational and economic achievement. He suggested that being a "caste-like minority" affects motivation and achievement, depressing IQ scores. He also concluded that some students did poorly because high achievement was considered "acting white" among their peers.

School usually requires Roma children to ignore and revive their pre-existing experience at least for the time they are at school and to replace it with new, which certainly differs from their cultural environment. According to the constructivist learning theory, teaching and developing concepts and curriculum for the classroom have to take learners' pre-existing experience into account. Students' pre-existing experience is built through troubleshooting, where they frequently find and fix errors in their daily lives (Michaeli & Romeike, 2021).

Many non-Roma children from infancy use pencil and paper or write on the walls of their homes, an activity not so common among Roma children. For most Roma children and almost all camp children, contact for the first time with paper takes place at school. Incorrect use of stationery is one of the first variations identified by teachers, which is immediately assessed as incorrect. In this case, this assessment is considered a precursor to school failure of these children.

Many teachers who teach in the 1st grade of the elementary school make very new classifications such as intelligent, energetic, receptive classifications for children that accompany students throughout their schooling. They evaluate the help the children receive in their family context in order to be prepared to participate in school. Roma children who do not have family support for the development of writing skills are doomed from the very first days of school to experiencing failure. This failure will accompany them throughout their school career since it creates negative feelings to students and low expectations to teachers.

Thus, Roma children seem to be unadulterated or do not easily conform to the school's fundamental principles and claims, so this entails school failure. Failure leads to the child's non-participation in the teaching process, and any movement in the classroom is perceived as disruptive to discipline. In this case, the characterization does not merely describe the performance of a tag in an instantaneous action, but it refers to a continuous posture and sorting process. This is the analogous approach that accompanies these Roma children during their schooling.

The ideological engraving carried out through the descriptions is not accidental but serves to establish a status quo. When one realises that he is inferior, he submits more quickly to the upper one. So the choice of some words is not accidental, and it is not a normal function of the language, but for ideological construction. The regular schooling suits the bureaucratic school system to regard the student classifications as natural and not to react. Schools are organizations with a formal bureaucratic structure. Hoy and Sweetland (2001) applied the work of Gouldner[27], who viewed organizational structure as ranging from representative to punishment centered, and Adler and Borys (1996), who viewed bureaucracy as ranging from enabling to coercive, to schools. They coined the term “enabling school structures” (ESS), which they defined as “a hierarchy of authority and a system of rules and regulations that help rather than hinder the teaching learning mission of the school (Mitchell, 2020).

The labels in this case of Roma children include the negative labels accompanying them, which are a specific case of social bias and violence and are used to describe acts and traits. These qualities are integral elements of the dominant culture when it evaluates its subordinates. They are often involved in everyday social communication, while at the same time they are transferred to the school communication environment by continually attributing to Roma children the characteristics of bad students. Such a prejudice is often considered to be self-evident to Roma children, since according to the predominant conception it has to do with Roma cultural identity and more specifically with the alleged existence of differences between the educational aspirations of Roma parents than those of non- Roma for their children or the alleged position of education in the Roma values system (Popoviciu & Tileagă, 2021).

[27] **Gouldner, Alvin W.** (1920–81) An American sociologist who eventually became as much a critical intellectual as a sociologist. His early work was recognized as important within the then orthodox sociological framework, especially Patterns of Industrial Bureaucracy (1954), but even at that stage he adopted a critical attitude towards the dominant functionalist perspective. His essay ‘Anti-Minotaur: The Myth of a Value-Free Sociology’, published in 1964, was a controversial interpretation of Max Weber's work, arguing that Weber did not believe sociology was capable of simple objectivity, although his name was often erroneously used to support such a proposition.

Education among Roma community members depends on the broader exclusionary problems they are experiencing, and this seems to be the case if the whole issue is compared with non-Roma parents of upper or middle class. Typically, the latter show a particular interest in educating their children, the stimuli they give, the motivations they provide, and their encouragement for learning which affect their school performance accordingly. Unfortunately, these standards cannot apply to the Roma, and this seems to happen for two distinct reasons: parents had never had such experiences, and the survival needs often force them to give weight on other stimuli such as the one of work in order for their children to contribute to the family financials.

Thus, severe economic conditions regulate the Roma educational strategies that have a direct impact on school success since they are not directed towards investing and acquiring knowledge. Based on the above, it is noted that the absence of family strategies with an emphasis on Roma educational investment practices, which is not their voluntary choice but is the result of the more extensive exclusion and extreme poverty they experience, affects the school failure of these children.

The focus should be whether teachers during the daily educational process, and especially when assessing students, take into account the socio-economic situation of families as well as the hierarchy of their needs. It is also essential to prioritise the evaluation criteria in such a case giving teachers the ability to modify the predetermined criteria for the evaluation of school curricula. What appears to be is that the criteria used in schools for student assessment are related to their response to the goals and purposes of the curriculum defined by the state. Consequently, students who do not meet these criteria fall short of the other students.

If the ability to read, to understand texts and problems, to solve numerical acts, etc. is perceived as a criterion, it is evident that Roma children will have a number of problems in understanding the curriculum, since it is structured in a language as well as in a cultural context different from what they use at home on a daily basis. As a result, their performance and measurements do

not meet the current criteria, and these children are consistently considered to be failing or viewed as negligent students (Petrík & Popper, 2020)

At the same time, the school and the teacher as an educational framework mark the school program and crystallise the cognitive system. In this way, a part of knowledge that is not coded according to the dominant principles is underestimated and marginalised. Codifying sovereign knowledge and any other knowledge that brings children to pass through the criteria of the dominant ideology and assess it accordingly is recognised as something undeniable.

Assessment for learning (AfL) is an ongoing concern in the development of teaching practices. AfL is promoted as a means of developing subject achievement as well as sustainable competencies (Leong & Tan, 2014; Deneen & Boud, 2014; Bennett, 2011). Teachers' fluency in connecting AfL to the assessment of learning is, therefore, fundamental to modern definitions of assessment literacy (Deneen & Brown, 2016; Leong, 2016). Preparation for formalised examination competes with other priorities for time, attention and focus within curricula; the narrowing effect this can have on curricula is an issue of growing concern (Berry, 2011; Bonner, 2016; Taras, 2010). In affected curricula, the purposes and priorities of AfL often narrow from sustainable and subject competencies to the attainment of higher external examination marks (Deneen & Brown, 2016; Leong, 2016).

Assessment is based on specific pedagogical terms and psychological conditions. At the same time, it emphasises its conspicuous, feedback and paranoid character and, in many cases, it is identified with the notion of motivation. It is considered that the outcome of the assessment is the accurate self-assessment of children or the diagnosis of learning difficulties, which are usually based on psychological justifications. In other words, evaluating students is not seen as an element of competition in a social process but as an incentive to learn.

Through the assessment and evaluation of all aspects of the students' school life, reference is not made only to school knowledge, skills and abilities, but also to their attitudes, their particular psychological characteristics, their

emotional field and their social activities. This generalisation of the evaluation essentially means that the conditions for exercising social control over the overall presence and action of the students at school are favoured.

In this context, Roma children get the lowest score, as the school uses the same criteria for every student without taking their background into account. Thus, Roma children are easily characterised as inappropriate for school or children with learning difficulties that need special assistance and are often referred to particular classes. However, this help, as an educational process, is organised both as a philosophy and as a practice on the logic that governs the same purposes and objectives of curricula. In other words, participation in special classes or tutorials is intended to make Roma children meet the general aims of education, which are homogenization, uniformity and adaptation to the dominant ethnocentric reasonable.

It has been observed that negative remarks about work in the classroom are much easier addressed by "weak" students. They know that their teachers expect less from them. According to the theory of social representation[28], which is defined to be the product and process of a psychological and social process of reality, it is worthwhile to identify the ‘bad’ student as being a social construct playing a double role. On the one hand, it provokes and justifies the specific act of characterisation, while on the other, it provides a sense of belonging to a social group which in the case of the Roma is the group of weak students.

The social representation is at the same time based on the ideology of the students’ charisma, which is transformed into an ideology of meritocracy.

[28] As heir to a strong French sociological tradition, the theory of social representations, elaborated by Serge Moscovici in the beginning of the 1960s, has become one of the major theories in social psychology. Mainly European initially, it rapidly brought together a large number of researchers and practitioners worldwide, mainly in the field of social psychology, but also in all other social sciences. These researchers have seen this theory as a flexible conceptual framework that enables us to understand and explain the way individuals and groups elaborate, transform, and communicate their social reality. They have also found in this theory's different developments a vast set of methods and tools, directly applicable to the analysis of a wide range of social issues. Lending itself equally well to qualitative approaches as to experimental applications, studies have multiplied along different lines. Those aiming at making connections between socio representational processes and other processes classically studied in the field of social cognition seem to be the most promising in terms of the theory's future development (Rateau et al, 2012).

Consequently, success or failure in a school that is considered to provide equal opportunities to all children is interpreted as a lack of competence and a lack of effort on the part of the Roma students. This reasoning is also based on the effort to interpret the failure of these children in the ideology of the social and cultural deficit, which can be treated by compensatory measures.

In this case, school failure is transferred from the student to the family and the entire Roma group. Thus the social and cultural "disadvantage" of disadvantaged Roma towards school culture is the result of the arbitrary nature of the school culture itself, which is regulated and established as an assessor of all other cultural expressions. The evaluation becomes a culprit of the failure of Roma children in the school institution. From the above, it appears that the Roma child is always the focus of atypical forms of assessment, which are supposed to aim at the liberation of individual knowledge and qualities while suppressing it.

The questions that Roma children often experience in an unfamiliar language environment, and therefore, the perceptual assessment, are more intrusive techniques and are very painful for some students because they rank them directly as failed. In particular, in an informal communication framework, Roma children expose their "weaknesses" resulting in interpersonal comparisons becoming more precise and more painful for these students.

The educational system differentiates students based on an unprecedented scale of success and failure questioning the extent to which the student manages to respond to the subjective expectations of the teacher as a stakeholder of the school system and sovereign perceptions (Miguéis et al., 2018). At the same time, the school is the only institution that has the right through the assessment to certify the scale and the only one which has the competence to behaviours the knowledge in society instill. School knowledge is considered valid and worthwhile and useful for the broader socio political and economic system and leads safely to uniformity.

By examining in-depth the social origin of the students concerning their classification in school, it is clear that the performance gap between privileged and non-privileged increases during their school life. Thus, the school

exacerbates the differences between the students, because mainly their failure is not the result of their unequal skills but its meaning lies in the rules and choices of the school institution itself, which prepares people for the hierarchically structured society.

The whole evaluation process is involved in the concept of performance and gives the school the character of the production process. Dependence on the reputation of the child as well as the employee is judged based on the performance achieved. While each employee is remunerated according to the quality and quantity of his work, the Roma student is labelled as lazy and underperforming as learning is the product of school work. At the same time, performance concerning the individual is a repressive method of a system that unilaterally directs efforts to profit and competition. School becomes a field of competition and not joy and solidarity among children (Kim & Dorner, 2021).

The assessment in its existent form in schools exacerbates social discrimination against Roma children. It performs a diagnostic function to classify children. The school already characterises Roma children as harmful and dangerous to the schooling system. The rating used to characterise these children, which as a process is repeated at regular intervals every day, acts as a self-fulfilling prophecy and is used to establish the socially predetermined student identity of Roma children.

The apparent complexity of the evaluation process, its regulatory framework and its general criteria ensure that non-Roma parents from an early stage transfer it both as knowledge and as a culture to their children so that they are prepared to suffer as a process because it is considered to contribute to their progress. This self-evident process of evaluating functioning as an incentive for learning and improving performance is not offered to Roma children and their families. This is because it is assumed that the numerical rating, where it acts as an incentive, works as such for already good students and as a disincentive for the less "good" or "bad".

Such assessment certainly promotes competition and undermines willingness to cooperate, while at the same time promoting the mockery of "bad guys" like Roma children. Within this multi-grade ballot, Roma children are always

pushed to the margins of the teaching process. School interventions are such as to highlight the low position of Roma in school life. These children are usually ignored in the classroom, and where the burden on the situation is directed towards the students themselves, with attributes such as "indifferent" to school, are blamed for failure while schooling is what favours school failure and school leakage. Besides, if there is no acceptance and interest in any student, then what can be the incentive to continue their studies? The marginalisation of these children many times in the classroom reaches the view of these children as outcasts. In many cases, it appears that Romani children have accepted this characterisation imposed on them by the school implicitly and without reaction, according to Freire's theory of Freire's silence culture (Freire, 1976).

McDermott et al. (2017) mention that teachers' accounts reflected anxiety in teaching Roma children in multicultural classrooms. Teachers' anxiety was related to Roma children's high level of school absenteeism and their negative evaluation of Roma children's motivation, the lack of Roma parents' school involvement, language issues and bullying incidents, all leading to low expectations of teachers and the belief that Roma children are predestined for school failure. Interviewed Roma parents indicated concerns about the social as well as the academic role of the school, raising issues of bullying, language difficulties, cultural issues and social isolation. Similar needs were also expressed by Roma students who also shared their wish that their teachers knew more about their culture. Some of these findings are consistent with other research that reports on bullying and adjustment problems impacting Roma children in school, often not acknowledged by the school (Derrington 2007).

5.4 Policy recommendations

The role of education as a transformative tool to overcome inequality is well established (Apple, 2013). Education is one of the central core pillars set up by the UN to develop its 2030 Agenda for Sustainable Development, to coordinate countries' attempts to tackle all types of poverty and inequalities, while at the same time guaranteeing that nobody is left behind. The fourth

objective of this agenda is addressed to guarantee inclusive and quality education for everyone and encourage lifelong learning.

According to the UN, obtaining a quality education “is the foundation for improving people’s lives and sustainable development” (United Nations Goal 4, 2018). The growth of human capital relies on long-term sustainability, and education plays such an important role (Šlaus & Jacobs, 2011). Therefore, no one has to be left behind to attain the objective of establishing a sustainable world based on equity, inclusion, peace, social justice and cultural competence (Wulf, 2013). Data indicate that better job possibilities and more significant income are associated with more excellent rates of education (Eurostat Statistics Explained, 2018). A higher education in which critical thinking is created provides better possibilities and can impair living standards and may impact on personal behaviour for a more sustainable world.

Based on the existing literature, we understand that mathematical performance is a gatekeeper in schooling: learners who have a higher mathematical performance are more probable than learners who have less performance in this field to gain better results and to end in better academic trajectories (Martin et al., 2010). According to Parker et al. (2014), the statistically significant predictor of university entrance is mathematical self-efficacy. Balfanz, Herzog & Mac Iver (2007) warned that the failure of sixth-grade mathematics is an extremely reliable predictor of the number of learners who do not complete mandatory training. To overcome this situation, effective instructional action is required in order to achieve the UN objective of inclusive education for all members of society.

However, in order to fulfil this goal, many (social, gender and cultural) inequalities must be tackled. The discriminating situation of exclusion and oppression is based on socio-economic status, sexuality or cultural patrimony (Duque, 2016). Inequalities between socioeconomic groups are often linked to low school attainment and continuity in post-compulsory education, which cannot be separated with the segregation of students according to their cultural and social background, frequently observed in European schools Catarci, 2014). International statistics OECD, 2017; Unesco, 2018) indicate

that students with minority background perform lower than those belonging to the mainstream, especially in subjects such as mathematics or reading comprehension.

In all OECD countries, this is a general trend. Roma kids in Spain are more vulnerable and are more probable than the mainstream population to leave school earlier than the mainstream population: statistically, six Roma abandon the education scheme without finishing the mandatory level, against fewer than two non-Roma in the same situation. Achieving the UN objective of inclusive education and moving towards sustainable development involves not only ensuring equal opportunities according to individual, cultural, social or ethnic identities but also achievement in order to eventually promote social inclusiveness. In the case of students with a disadvantaged background, an education based on high expectations and culturally responsive curriculum becomes a lever to overcome educational inequalities (Girbés, 2015). This may be the case for Roma students.

Education can be defined as the art or process of imparting skill and knowledge. The word Education means “to educe”. The success of education lies in harnessing the latent potential of an individual. The present system of education does not serve the purpose for which it has started. In general, education itself has become so profitable a business that quality is lost in the increase of the number of professional institutions with the quota system and politicisation adding fuel to the fire of the spoil system, thereby increasing unemployment. The present-day education neither imparts actual knowledge of life nor improves the talent of a student by which one can achieve laurels in the field one is interested in. No doubt that the educational system is making engineers, doctors, lawyers and schools more stressed on completing the curriculum and helping the students to pass the exams instead of building their character and enhancing their personalities.

Critical findings on Roma education in central and southeast Europe (2012) demonstrate that:

1. Although Roma educational attainment rates have increased since 2004 in a few countries, attainment gaps between Roma and non-Roma remain large throughout Central and Southeast Europe.

2. Self-perceived literacy rates among young Roma have increased in several countries.

3. Gaps between Roma and non-Roma in self-perceived computer literacy are remarkable in all countries.

4. Low pre-school attendance rates actively contribute to the long-term disadvantages of Roma students.

5. A considerable share of young Roma has never been to school.

6. School attendance rates in several countries indicate late initial school entry of Roma and show that many Roma leave school early compared to their non-Roma peers.

7. In many countries, Roma, who attend school, indicate higher absences compared to their non-Roma peers.

8. Bi- and multilingualism are widespread phenomena among Roma families.

9. Large shares of Roma students attend ethnically segregated schools or classes.

10. In many countries, large shares of Roma attend individual schools.

12. Students from certain regions are more likely to end up in special schooling compared to students from other regions.

13. Acceptability of affirmative action in education is high among Roma and non-Roma alike.

14. On average (idealistic) aspirations of Roma are much higher than their educational outcomes.

Educational segregation in the context of Roma inclusion refers to two different sets of circumstances. The first occurs when Roma students, even

when being a minority within a given community, comprise the majority of the student body in (what would otherwise be) a “regular” school. The second occurs when Roma students are streamed into individual schools and classes, leading to their overrepresentation in these settings. When the two sets of circumstances overlap and mutually reinforce one another, special schooling becomes ethnically segregated education for Roma children. This outcome might be called twofold segregation (Brüggemann 2011, p. 201).

Universal access to education in early childhood should become the first concern for Roma students. Many studies highlight the critical connections between early childhood education and future progress in education. Not surprisingly, low attendance rates at a pre-school level have long-term disadvantages for Roma students. Removing barriers to early childhood education is what is needed now. These concern physical access (insufficient number of kindergartens, distance from Roma homes), income poverty (incapacity to meet basic needs and cover out-of-pocket costs associated with attendance at school), and prejudice- the unwillingness of non-Roma parents to have their children attend Roma children's kindergarten. As a long-term investment in reducing Roma exclusion and vulnerability, holistic efforts are needed to address these barriers. At the same time, steps must be taken to ensure that ethnic streaming is not facilitated or strengthened by pre-schools.

Promoting increased participation of Roma in primary, lower secondary and post-compulsory education is crucial for reducing the phenomenon of school dropout. To reduce the number of early school leavers and increase Roma participation in secondary and tertiary education, governments need to identify where early school leavers are most likely to drop out (Brüggemann, 2012; p. 38-45). In countries where large numbers of Roma students are not at all enrolled, special attention must be given to the initial enrolment of the school. In these countries, educational monitoring systems need to detect school absences better and enforce attendance if necessary. Regular primary schools must be obliged to enroll students in the relevant jurisdictions; non-enrolment tolerance should be sanctioned.

The right to education for each child with or without proper documents (e.g. resident permits, identity cards) must be enforced by law if not already established. Other countries may need to focus on preventing the absence and truancy of teenagers. Others should still look for mechanisms to keep students in school after the completion of compulsory education. It is crucial to make transitions from compulsory to post-compulsory education. Ensuring that all Roma complete compulsory education and support their transition to post-compulsory education should be key priorities in Roma education interventions (Nikolau, 2021). There should be an organized effort to reduce the cost of education, investment in the quality of schools (especially in poor regions), and the introduction of financial incentives to subsidise participation in post-compulsory education.

Nikolau (2021) refers to the research findings of Magano and Mendes (2016) that state that primary school teachers do not point out any major differences between Roma and non-Roma studentsstudents regarding school attainment. However, in the fifth and sixth grades, i.e. elementary school, Roma students start skipping classes without teachers clearly understanding why, since the studentsstudents are often to be found within the school premises. One of the main factors leading to school failure, and eventually to dropout, is absenteeism, oftentimes caused by the frustration felt by studentsstudents for not understanding the contents of the subjects.

According to Magano et al. (2016, p. 6), the prevalence of these educational and life paths “largely depends on public policies and programmes, but also on other individual factors, the kind of support within the household, the presence of role models, the importance of peers, and on institutional factors inherent to the functioning of state school.” Currently, the Roma population’s perspective towards school has somewhat changed, as the completion of primary school is a generalized phenomenon among younger generations and the increase of attendance rates in nursery, kindergarten and academic support lessons seems to have become a reality (Magano and Mendes 2016, p. 22).

For low-income families, the cost of out-of-pocket school (travel, extracurricular activities, school materials, meals) is high. Introducing attendance subsidies (e.g. conditional cash transfers— higher child allowances combined with school attendance monitoring) could lead to higher post-compulsory educational achievement rates. Close cooperation between educational institutions at both ends of the transition from compulsory to non-compulsory education and professional guidance for students struggling to enter post-compulsory education could lead to higher rates of achievement. Inclusive education should be a substitute for segregated education. It would be an essential step to abolish financial and institutional incentives for exceptional school attendance, especially for diagnostic centres and individual schools themselves.

Individual schools should serve the authentic needs of the most seriously handicapped children (if this is their parents' expressed wish). On the other hand, the vast majority of special needs students should be "mainstreamed" into regular schools. International evidence shows that such "mainstreaming" can be a winning approach for all concerned when done correctly. For schools that face more significant burdens in integrating students with special needs, of course, additional resources need to be available. Likewise, stigmatisation and new forms of streaming need to be protected by staff in schools that do mainstream Roma children. Proven cases of discrimination against Roma students need to be punished by the educational authorities.

This section aims to analyze the complex problem of educating Roma combatants who experience social exclusion through a system of stereotypes and prejudices that affect their lives even within school assessment and curriculum issues reproduce negative stereotypes and fail to give space to the Roma to form themselves as integrated citizens. There was highlighted the aspects of tackling this problem institutionally, in rhetoric as well as in real life through daily practice.

5.5 Synopsis

Being a minority, Roma families have been among the first groups to face adverse financial circumstances over the last decades. While struggling to cover basic needs paying expenses for kindergarten, purchasing books and clothes are a far reach for the majority of the Roma community where education is a traditionally community-based process. Children begin the learning process of verbal and non-verbal communication signals in their community at an earlier age than their non-Roma classroom mates. Taking part in the community's daily activities promotes the concept of learning by observing the economic, social, linguistic, political and moral codes of their society.

At the same time, the negative perceptions and attitudes of teachers towards Roma are created by socio-cultural factors which influence the process of teaching and encourage discrimination against Roma children. These discriminations lead among other factors to marginalisation and school failure for Roma students because they promote the formation of negative attitudes from the side of the educators towards the Roma children and fail to acknowledge the failure of the education system in understanding the individual characteristics of the Roma students and acknowledge the individual needs of this group. This has a negative impact on their self-esteem and is interpreted as an inability to join the school. The crucial role of curricula is considered to be pivotal in this analysis since they very often determine the implementation of the educational process because they are identified to contribute to the exclusion of children from education.

Interestingly, education of the Roma is considered by the official state, by the scientific community and by Roma people themselves critical to their integration into society as lack of education becomes exclusion from work, access to services and integration into society. The living conditions of the Roma, the functioning of the school institution itself and the formed historical perceptions about Roma by external social factors are considered as major factors of this exclusion.

Curriculum reconceptualization should focus on recognizing and interrupting dominant ideologies and practices that prevail in Roma students' classrooms by explicitly addressing how a teacher's ideology, sociocultural/linguistic identity, and pedagogy influence the teachers' critical consciousness to encourage the creation of equitable teaching and learning spaces

The objectives of education and curricula are the basis for identifying curriculum and teaching methods. They are closely connected to the general ideological, political, philosophical and economic background of the government, and as a result they form tomorrow's society and citizen identity.

It is unfortunate that the curriculum development model often disregards Indigenous studies and research and is restricted by the predominant political, social and economic stance. Attempting to shape the behaviour of Roma children based on the values of the dominant Greek past means that the minority is deprived of their cultural elements and is an expression of social control by the dominant social group of Roma children in school. Such segregation often leads to lower educational standards and a reduced curriculum, which in turn reinforces the view that Roma students are educationally inferior. Linguistic and socio-economic disadvantage combine to prevent Roma students from attending ordinary schools, with the result that many are after that unemployable.

Development of the multi-ethnic strategy, consultation and cooperation are pivotal and the Roma should be involved in the development of policy and the delivery of education programs. This not only supports legitimacy but also promotes role models and understanding of particular problems.

Examining the area of assessment, it is important to understand that students are primarily assessed not only based on their knowledge at school, but also their perception of social norms and structures which are heavily affected by their immediate environment. School classifications are directly influenced by social classifications with success being evidence of a responsible personality, while failure is perceived as an indication of irresponsibility and indifference and often the root of disruption of the harmonious school environment. As a reflection of society, the evaluation uses the measurement

to obtain a quantitative character and usually results in numbers that are considered objective and comparable. The simultaneous qualitative description of the various aspects of students' performance used by teachers' evaluation and judgments determine their position in the school system.

Performance is directly affecting almost all school activities and functions. As such it is interrelated and affected by culture and immediate environment and as such contributes to the creation of assumptions, and issues minorities face through the learning process.

The Greek school system, fully adapted to the logic of performance, has been organised and operates until today independently of the social stratification of students. For a Roma student to succeed in school, they have to adapt their action and performance to the patterns of behaviour prevailing in the school's social and learning environment. This requires Roma children to ignore and reform their pre-existing experience while at school and be tested and evaluated on experiences without considering any impact this evaluation will have on their personality. Consequently, school failure is transferred from the student to the family and the entire Roma group with the social and cultural "disadvantage" of disadvantaged Roma being the result of the arbitrary nature of the school culture itself.

Such assessment certainly promotes competition and undermines willingness to cooperate with Roma children, always being pushed to the margins of the teaching process. It is unfortunate that Romani children seem to have accepted this marginalisation imposed on them by the school system which leads to poor performance, reluctance to participate in the educational process and subsequently withdrawal.

Looking into policy recommendations, the importance of early childhood education is another area that is more often than not neglected when it comes to Roma education. The critical connections between early childhood education and future progress in education should be made the main focus in the efforts to manage low attendance rates at a pre-school level which have long-term disadvantages for Roma students. In addition, promoting increased participation of Roma in primary, lower secondary and post-compulsory

education is crucial for reducing the phenomenon of school dropout. The question now is what mathematics curriculum could meet the needs of Roma students and what would be the ultimate goal for such a curriculum.

Chapter 6: Identity

6.0 Summary

The aim of chapter six of this research paper is to present the theory related to the notion of identity and how this forms a ground for the development of racism, stereotypes and discrimination within society but also within the education community. The notions of multiculturalism and interculturalism are presented to facilitate the understanding of the policies currently in practice within the European and Greek education framework and how these are restricted by the children's rights to education. Moreover, the role of the school environment in the establishment of an intercultural education community, the influence of the European models on the evolution of intercultural education in Greece and whether these have contributed and to what extent to the social exclusion of the Roma will be presented and analysed.

6.1 The concept of identity

The concept of "identity" is a mental construct. It was first used in 1950 by Eric Erikson. There is remarkable ambiguity in the use of the term. On the one hand, it means the absolute identification of individuals, groups of opinions, perceptions and, on the other, the totality of elements that are separate and unique for each and differentiate it from another.

National identity in the last centuries in Western societies is more closely connected with the creation of a national state. The term "ethnic origin" is often identified with citizenship/nationality and is broader than ethnic origin, which refers to cultural characteristics of human groups. "Ethnic groups" means groups of people who share a common culture, or who have a

standard set of cultural characteristics or attributes that can be used to identify which ethnic group an individual belongs to. Nations, unlike ethnic groups, are peoples who exert or expect, in the future, to exercise sovereignty over an area. Consequently, the Greeks and Americans, as well as the Palestinians and the Kurds, are more nations than ethnic groups, while Pontians, Vlachs, Arvanites and Roma are ethnic groups.

"Cultural identity" is an important concept of reference in many disciplines. Cultural identity is the category according to which the subject places himself and is placed by his social partners in terms of the cultural system and the basic traits characterise or believe in characterising those who belong to the same cultural community as the individual subject (Auernheimer 1995; De Vos & Romanucci-Ross 1975; Jacobsen-Widding 1983; Perunovic 1992).

These are the cultural differences between societies, as well as how human communities define their "self" in relation to the nearby "other" cultural identities in different cultural systems. Cultural identity is not a fixed and unchanging system with fixed and unaltered features, but a "shell" that contains many individual identities. Cultural identity is a dynamic system that is passed on from generation to generation, influenced by the environment, changing and evolving. The individual as a member of a cultural/ethnic group acquires significance for the construction of his self-image and personality.

Cultural and ethnic identity often overlaps, but do not coincide and are not identical. Cultural identity is shaped by specific ecological, linguistic, cultural, political conditions. Cultural identity is a way and attitude of life, it is directly linked to the specific conditions of socialisation of the individual and is broader than the national identity, which is limited, as we have seen, mainly in language, religion and traditions. Minorities, e.g. do not abandon their cultural and ethnic identity, but express themselves freely, without fear and bias. It is essential that politics be separated from nationality, as it was already separated from religion (Tremblay, 2019; Breton, 2019). Some people identify with more than one group, change their cultural identity in a new cultural environment, and develop the ability to move between different cultural

reference areas without losing their sense of individual identity. (Leite et al., 2019; Campbell, 2000).

Consequently, the establishment of these identities is a process that many factors contribute, including the role of the school. The phenomenon of globalisation turned schools and classrooms into culturally and socially diverse environments (Campbell, 2000), where different students from various cultures, socioeconomic backgrounds, and religions coexist. This raises issues of quality of the educational service provided, the assurance of equity, social justice (Connell 1993, 2012; Scrase 2014), and students' achievement rates.

Cultural identity implies that its body goes beyond the limits of nationalism and is linked to the vision of the global community (Altugan, 2015). Being a male or female citizen of the world is an old fact, based on the view that people cannot be isolated from some form of cultural influence. Every civilization accepts influences from others. Moreover, it is true that one way or another we are today facing a new type of man, a social and psychological product of the interconnection of different cultures that have created links within and between local, regional, national and international levels of social organisation. His orientation and his view of the world goes beyond his culture of origin; he develops from the grid of social, political, economic, technological and educational interactions of our time. The impact is enormous. Human connections through communication have made it possible to exchange goods, products and services, and the most critical exchange of ideas and ideas.

The body of cultural identity is mentally and emotionally committed to the fundamental unity of all people while recognising, legitimising, accepting and appreciating the differences that exist between people of different cultures (Altugan, 2015). This new citizen is not determined by the languages he speaks, the number of countries he has visited, or the number of personal international contacts he has (Chzhan, 2016). Nor is it determined by profession, the place of residence or the cognitive complexity. His multicultural identity is determined by the shaping of perspectives and worldview, by how

he recognises and integrates the universe as a dynamically changing process, how the interconnection of life reflects on the thought and action of the person and the way that woman or the man remains open to the imminent intercultural (Valadez, 2018).

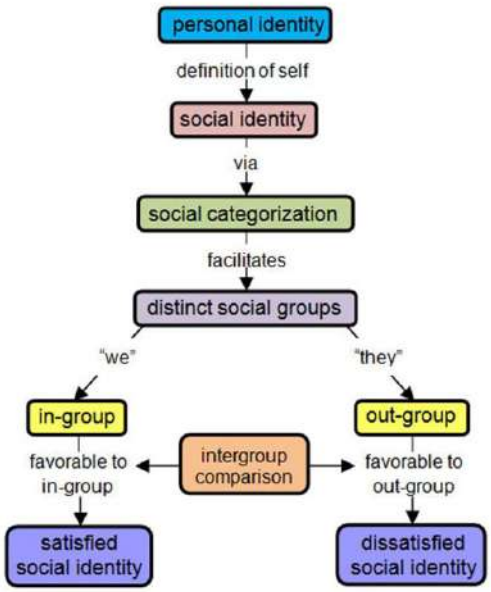


Figure 3: Identity formation

This section emphasizes cultural identity as it is historically shaped and framed in modern society cultural identity It is not something frozen but is under constant negotiation so in a similar way it needs to be approached to be included and used in a mathematics curriculum which will correspond to the cultural identity of the Roma

6.1.1 Racism, stereotypes, discrimination

Racism is both a theory and practice based on the belief in the superiority of a race and involves a negative stance and policy towards the other "inferior" races such as relationships of domination, discrimination, civilian and cultural isolation of extermination. Its fundamental idea is the purity of the superior race and the high mental and cultural qualities associated with this biological purity. The declining prominence of anti-racist practice in education is a cause for concern in a profession premised upon pursuing social justice and serving humanity. This need calls for a revival of anti-racism education within the school curriculum (Ladhani & Sitter, 2020).

It is the egocentric pride of our breed (group, race), the preference for its particular characteristics. The team we belong to is at the centre and all others are evaluated and ranked according to it. It is based on the belief that these features are of biological origin and are bequeathed to succeeding generations. It is linked to hatred and negative, rebellious perceptions of individuals belonging to tribes other than our own. Its primary forms are racial, ethnic, religious, social racism and sexism.

Racism and all kinds of prejudices and stereotypes cannot have a place either in today's democratic society or in new democratic schools. Discrimination may be prohibited by law, but inequalities are more complex, deeply rooted, surviving legal regulations. They require not only legislative but also administrative and organisational measures to promote so-called "positive measures". For example, achieving de facto equality, and not just de jure requires combined policy measures, a coherent national plan, with targets, timing and resource allocation, aimed at changing attitudes (Jason, 2020).

In achieving these goals, the school's contribution is crucial. Education is a place for producing multiple ambiguities and subjectivities. The content of the curriculum in conjunction with the content of the school textbooks and their illustrations, the famous "hidden" curriculum, games and playthings, attitudes, expectations, attitudes, teachers, men and women, that the teachers articulate the interventions of the social environment of the school (parents' associations, church, etc.) can make a decisive contribution to the preservation of traditional roles and behaviours and their ‘internalisation’ by the learner.

As Chisholm notes (2006)

"School continues to play an important role in the processes of reproduction of inequality. Moreover, it does this not by itself, but in conjunction with the roles played by the family and the entire cultural and economic context of the community. School is the most important of decision-making sites because it affects future opportunities and prospects and is, at the same time, an original social context in which experiences that shape self-understanding are gained".

6.2 Defining multicultural and intercultural

The multicultural society is the society in which its members may have different ethnic origins, different language, different religion, different historical, spiritual and social heritage, different lifestyles, different common collective representations, symbols, values, demonstrations, habits, habits, traditions, behaviours, everyday habits, different political and social systems. The term "multiculturalism" states precisely the coexistence in a society of diverse social groups with different national-ethnic and cultural elements. Among these groups, there is no substantial cooperation, but neither communication nor understanding. Groups coexist. The term is used to describe the current state of modern western societies (Childs, 2017; Kalantzis & Cope, 2020).

Interculturalism is linked to the acceptance of culture, the way of thinking of the other and it includes and promotes the ability of individuals to create and form collective identities. Interculturalism includes reciprocity, real solidarity, but also the interaction of the way of thinking and the ideas of the other human being, of ours, and social equality (Santagati, 2021). The term "interculturalism" refers not only to the coexistence of groups in the same region dominated by different cultures, national, religious and cultural characteristics but to the interaction, exchange and mutual recognition of values and lifestyle. Intercultural interaction, the encounter of different cultures, aims at cultural exchanges and cultural enrichment, equal opportunities in social and social life. Interculturalism accepts the basic principles of shaping positive perceptions of differences between cultures, solidarity between people with different characteristics, recognition of cultures as equal, and the prevalence of peace (Elias & Mansouri, 2020).

From the preceding, it is understood that interculturalism refers to "what should happen, to be" in modern societies. Interculturalism presupposes multiculturalism, but it does not arise automatically from it. Multiculturalism is a reality; interculturalism is demanded since it requires social learning processes, which affect society as a whole. (Walter & Webster, 2019). Moreover, the intent "for" in the complex "intercultural" implies the exchange, the interaction between different cultures, but also the cultural osmosis, the

pursued cultural dialogue. The term "interculturalism" describes a dynamic interaction between cultures and people who want not only to meet others and exchange views, but also to borrow words, ideas, perceptions, to adopt symbols of other cultural systems, and to accept the adoption of their own symbols by others (Walter & Webster, 2019).

In the acculturation research, several models have been developed to investigate acculturation strategies, both at the societal and the individual level (Berry et al., 2011). In the individual countries, different approaches to managing the diversity were implemented, and an exceptional and not rarely conflicting relevant dialogue was developed, which resulted in the formation of specific models such as assimilation, integration model, multicultural, antiracist and intercultural which will briefly be presented below.

The assimilation model on the pretext of preserving the social cohesion of the host state, the monolingual and mono-cultural approach is adopted. In this particular model, everyone, regardless of their national and cultural origins, must acquire knowledge and culture that will allow them to participate in the prevailing national culture of the host state. The "difference" is treated as a "problem" that hampers the progress of others. In this model, the focus is on similarities within society and the recognition of one culture: the dominant or majority culture (Verkuyten, 2011). The assimilation ideology is used to reaffirm and justify the majority culture. Immigrants are therefore expected to participate in all the life spheres of the dominant society, and diversity is avoided (Rodríguez-García, 2010).

The aim is to achieve the acculturation process, which follows the stages of contact, conflict and adaptation. Migrants themselves play a key role in integrating into society. Thus, it is extremely important to learn the language of the host country and its sovereign culture very quickly, and to neglect the mother tongue and the culture of immigrants and migrant women, as well as other ethnic minority cultures, which owes to the "other" family and not to the state (Callens et al., 2018). That is why in school, students with migrant backgrounds are taught the official language and are invited to adopt the school's uncultured direction.

The integration model was adopted up to the second half of the 1960s. Accomplishing social integration seems to be one of the most basic assumptions adopted by European states, quite often not even formulated explicitly, but taken for granted (Janicki, 2012). "Integration" accepts the difference, since it does not pose problems of integration, does not lead to conflicts and does not "endanger" the dominant society. Unlike assimilation, which is narrowly ethnocentric, since it requires 'from' different 'to' rejection of their culture and detracts from the value of the impact of their ideas, talents and their hopes in the host society, the difference is considered acceptable without creating integration problems. The person does not have to be cut off from his ethnic roots, and the different elements of his cultural identity are part of his new personality. It is accepted in school that the cultural differences of the students will help them to join the community.

The cultivation of respect, tolerance and understanding, as well as the improvement of self-image and self-perception of ethno-cultural groups, are highlighted in critical issues (Cole, 1997; p.198-199), aiming at enhancing cultural differences. The political power of the state unites all groups and with a neutral attitude, ensures and grants justice. It does not, however, give immigrants the right to participate in the decision-making process in host countries, which is contrary to the view that a multicultural society is working more effectively and harmoniously on the basis of pluralism, which encourages citizens, women and men, to participate actively in shaping society within, of course, within commonly accepted values, practices and processes.

Social cohesion is promoted by recognising cultural specifics and migrant groups in general by shaping a social framework in which all cultures can coexist and grow without endangering the unity and consistency (Huang et al., 2018). Unity is achieved through diversity. Knowledge of their national culture and tradition is recognised as a priority, as it helps to overcome prejudices, racist attitudes and discrimination, and to strengthen the interaction between the dominant group and those linguistically and culturally diverse (Farrell, 2006; Banks, 1989; Cummins, 1995).

The main objectives of the antiracist model are equity, equal opportunities for all children, justice, equal opportunities of residence, equal rights, and access to goods by all (Pearce, 2019; Essed, 1991). In that direction diversity education seeks to recognise the contribution of all to social well-being, but also emancipation. Diversity education occurs when cultural diversity begins to be recognized as a given value (Auernheimer, 1996; p.1). Diversity education challenges the mono-cultural orientation and suggests the formation of a new citizen able to function and communicate in the new multicultural reality and to negotiate effectively and peacefully his new complex relations (Janicki, 2012). It seeks cultural encounters in a spirit of parity, mutual acceptance, understanding and interaction of cultures of countries of origin and host. It creates conditions for accepting the new cultural reality and its dynamics in the host countries. It promotes the review, the review of ethnocentric theories that dominate societies. It is a means of assessing opportunities in life and achieving maximum social and economic integration (Brien et al., 2018).

Learning in a diversity education framework is a process whereby students from different cultural and ethnic backgrounds learn with and from each other, developing greater insight and understanding of different cultures (Brien et al., 2018). The essence of learning is providing space for learning about and understanding one's own and other cultures while providing opportunities for intercultural interaction (Hollinderbaumer et al., 2013; Chan et al., 2018). The benefits of learning are widely reported (Lee et al., 2014; Ciftci, 2015; Brown et al., 2016; Chan et al., 2017) but the learning experiences of home students in the culturally diverse classroom, has received less attention. Communicating effectively and appropriately with people from culturally and linguistically diverse backgrounds is essential in today's multicultural healthcare setting (McCarthy et al., 2013).

6.3 Children's right to education and European and Greek educational policies for cultural identity

This section will provide an overview of European and national policies in place to protect the rights of children and to protect different cultural identities.

Cultural directions in education are accompanied by the corresponding legislative intervention which is the framework in which the members of the educational community act.

The International Convention on the Rights of the Child, adopted unanimously by the United Nations General Assembly in 1989, identifies three main categories of rights: Protection (from all forms of abuse, exploitation, discrimination, racism), benefits for citizens (education, health and welfare) and participation (right to expression of opinion, information, leisure time) The Greek Ombudsman places special emphasis on the support of the right of all children to education as well as a decent level of living. He is constantly asking for "careful steps to gradually support their smooth integration into school, taking into account their needs and the specificities of each region, especially where there is a large number of refugees and migrant women". The obligations of the Greek state regarding the education of minorities and refugees stem from its international contractual commitments and are based on the view that the right to education is a basic human right that the Greek State respects, protects and promotes. In particular, they result from:

1) The International Convention on the Rights of the Child adopted by the UN General Assembly on 20 November 1989. It entered into force in 1990. It is the first international legally binding text on the rights of the child and ensures the most integrated protection. The Convention is made up of 54 articles, and the text of the Convention provides for individual, economic, political, social and cultural rights of children. He points out: "All children have the right to go to school and have equal opportunities in it. The State must take measures to ensure that children are writing and not interrupting school. "According to UNHCR (1994), the basic principles which constitute the core of the Convention and form the so-called "triangle of rights" of children are:

a. The principle of non-discrimination and equal treatment of all children irrespective of race, colour, sex, language, religion, political or other beliefs of the child or his / her parents or legal representatives or their national, ethnic or social origin, their assets, their incapacity, their birth or any other situation.

b. The principle of the best interests of the child in all decisions affecting him, whether taken by public or private social protection organisations, or by courts, administrations or legislative bodies (Article 3). According to this principle, the defence of children's interest must be the basis of state policy for children (Robokos - Karagiannis, 2007, p. 16).

c. The principle of the child's participation in the decision-making process, depending on his or her age and degree of maturity (Article 12).

2) The UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions (20 October 2005). Article 2 states that cultural diversity can be protected and promoted only when one can guarantee human rights and fundamental freedoms such as freedom of expression, information and communication, as well as the ability of individuals to choose their cultural expressions. Article 10 mentions the role of education and wider 77 programs in informing people about the diversity of cultural expressions.

3) The OECD report (OECD, 2012, p. 11) points out that the successful integration of refugee and migrant children is "a key point of reference for the success of social, educational and immigration policies" and adds that integration is achieved through education.

4) The UN Declaration on Human Rights Education and Training, A/Res/ 66/137, was adopted on 19/12/2011 by the United Nations General Assembly, following the adoption of the UN Declaration on Human Rights Education and Training of the same text by the Human Rights Council on 23/3/2011 (A/ HRC/16/1). 5) The Declaration on Intolerance - a Threat to Democracy by the Council of Europe. It is related to the promotion of Intercultural Education and aims at informing about human rights, human rights education, and creating a climate of understanding and respect for "others" and their cultures. It defends human rights and among them the right to education. At the same time, they encourage the recognition of the importance of intercultural education, which should not be taken into account only in the curricula, but also in the initial and subsequent education - teacher training. Due to the collapse of political-social systems in several countries in central and eastern Europe, the Council of Europe has, since the early 1990s, devoted particular attention to the

problems of minorities. This resulted in the signing of the Convention on the Protection of National Minorities.

6) Ratification of the Convention on the Protection and Promotion of the Diversity of Cultural Expressions. It took place in Paris from 3 to 21 October 2005. It was based on the UN General Conference on Education, Science and Culture. It is emphasized that cultural diversity is a characteristic of humanity and a key springboard for the sustainable development of communities, peoples and nations.

7) The Convention for the Protection of the Intangible Cultural Heritage (Paris, 3/11/2003) aims to protect and respect the Intangible Cultural Heritage (practices, representations, expressions, knowledge, techniques, works, objects, handicrafts and cultural spaces) as well as awareness raising.

8) Charter of Fundamental Rights of the European Union (2012 / C 326/02) Article 14: 'Right to education' states that 'Everyone has the right to education and access to vocational and continuing training. This entitlement includes the option of free follow-up of compulsory education. The freedom to set up educational institutions with respect for democratic principles and the right of parents to ensure the education and education of their children according to their religious, philosophical and pedagogical beliefs shall be respected following the national laws governing their exercise. »

9) The Treaty of Lisbon, as we know, aims to make Europe a "competitive and dynamic knowledge-based economy in the world capable of sustainable growth with more and better jobs and greater social cohesion" works supportive of the whole project, the achievement of the above-mentioned objective is to adopt the principles of respect for human dignity, freedom, social justice, democracy, equality, respect for human rights, rights are minorities. The values of pluralism, non-discrimination, tolerance, justice, solidarity and gender equality are underlined, and it is confirmed that, at declarations and decisions, the EU combats social exclusion and discrimination and respects the rights of children.In Europe, the first institutional measures for the education of children of the migrant workforce date back to 1977. Policies applied for a long time accepted the superiority of

the dominant culture, which should not be "distorted" by minorities (Le & Matias, 2018). According to the pedagogy prevalent, foreign students had "deficient" educational capital, which had to be supplemented by compensatory educational measures to be equated with that of "local" studentsstudents (Barglowski, 2018). At the same time, the European Community Directive[29] was adopted, which was considered one of the first attempts to develop a common European education policy. It defined the measures that countries needed to adopt for the schooling of migrant children. Among these was ensuring the teaching of the official language in special classes, enhancing language teaching and minority culture, and creating initial and continuing education programs for teachers involved in the education of children belonging to minority groups. There are three main directions in the EU countries (Eurydice[30], 2004), which will be presented below:

(a) Familiarity with cultural diversity, to cultivate by the students the values of respect and tolerance. However, some countries do not accept this dimension of interculturalism against racism and xenophobia.

b) The European approach, which strengthens the European identity of students. It is achieved by teaching knowledge about European populations, the history of Europe and their country's position on the European continent.

c) The internationalist approach. According to it, the understanding of cultural diversity is strengthened, as interest in the variations in the socio-economic and historical relations of states, especially between the North and the South, and the migratory movements resulting from these fluctuations are being enhanced.

It is also clear that the children of legal immigrants and citizens of the European Union have the same rights. Finally, it is noted that in almost all

[29] The Directive of 25 July 1977 (77/486 / EEC) refers to three main indications: (a) the education and integration of the children of migrant workers into the host system; (b) the training and education of teachers who undertake their teaching of children and c) teaching the language and culture of the country of origin (so-called Mother tongue lesson).

[30] Eurydice is a network of 42 national units based in all 38 countries of the Erasmus+ programme. Its task is to explain how education systems are organised in Europe and how they work. Eurydice publishes descriptions of national education systems, comparative reports devoted to specific topics, indicators and statistics, as well as news and articles related to the field of education.

European countries, the introductory programs of future teachers have incorporated themes related to intercultural education (Karousiou et al., 2018).

6.3.1 European Models of Intercultural Education and modern policies

A study carried out on behalf of the EU by the European Commission, concludes that there are five types of educational support systems for students with different linguistic backgrounds in the European Union. These are:

1) The integrated support model. It was applied in Denmark and Sweden. Linguistic support, academic support, parental involvement, intercultural education and a learning-friendly environment have been proposed since these areas have been considered more important for the integration of immigrants and refugees. In Sweden, intervention programs were mainly implemented in areas facing ethnic segregation. Priority was given to compulsory and upper secondary education, and the starting point was the linguistic development of students with migrant background through the teaching of both Swedish as a second language (SSL) and mother tongue (Eurydice, 2004, p. 8; OECD, 2009, p. 28).

New entrant students, whose parents have applied for asylum or have been granted a residence permit, start their studies at the school in a Reception or Preparatory Classroom where children are taught Swedish and Swedish culture. They have added support not only in language but also in other subjects, intending to integrate them into the typical classroom gradually. The duration of study in these classes varies according to the progress of the student (Eurydice, 2004, p. 5; OECD, 2009, p. 23). In order to achieve a smooth transition to the regular classes, a support teacher is providing additional assistance either in Swedish or in their mother tongue in a group of students in a separate class or individually in the typical class. In this model, the emphasis is placed on parent information and effective collaboration with schools. Parents are informed of their rights regarding the education of their children and receive some counseling and guidance (Taguma et al., 2010, p.

39). In these introductory meetings, the institution of the Intercultural Mediator is used.

2) The non-systematic support model implemented in Italy, Cyprus and Greece. Educational policies are not always clear and long-term, neither are adequately funded and in many cases, they are not being implemented effectively. Teachers, parents and local communities remain largely without clear guidance.

3) The model of compensatory support, implemented in Belgium and Austria. This is where continuous language teaching in the host country is adopted, but with rather weak academic support, with premature separation of children according to their abilities and early division into competence groups. This model is "compensatory" because it aims more to correct differences than to address the initial disadvantage.

4) The integration model, implemented in Ireland. This is where developed cooperation and intercultural educators are developed.

6.3.2 The evolution of intercultural education in Greece

National education policy was implemented in Greece in the 1970s. In the second half of the 1970s, and for the first time, the necessity of reducing the requirements of the school by the students and international students was being addressed. It is recommended that students and students be assessed graciously (based on eight instead of 10) during the first two years of study mainly in language courses. From the 1980s to the mid-1990s, with the increase of emigration and repatriation from Greeks, mainly from the former Soviet Union and North Epirus, the policy of reducing claims was complemented by the logic of compensatory measures.

In 1983, a law (1404/83, article 45) was adopted by the Reception Classes. According to N. 1556/1985, the state now has to provide 10-year compulsory education (kindergarten-elementary school-high school) and optional 3-year education (high school) to refugees. The third period is the creation of a new institutional framework, namely the adoption of Law 2413/96 on "Greek education abroad, intercultural education and other provisions" (Government

Gazette 124, p. A, 17-6-1996). Article 20 of this law states that "intercultural education is about building relationships between different cultural groups in order to eliminate inequalities and social exclusion." Article 34 defined "the organisation and operation of primary and secondary schools to provide education to young people with educational, social, political or cultural specificities".

Thus, 26 schools of intercultural education were established. In these schools, the programs of the respective elementary schools are implemented, with the recommendation to adapt to the particular educational, social, cultural or educational needs of their students and students. At the same time, the Institute for Education of Homogeneous and Intercultural Education was established by Law 2413/1996. It functions as an advisory institution for the Ministry of Education. However, despite the "intercultural intention" (Nicholaou, 2008, p. 44) of the Greek state, especially since 1996, the Greek school continues to operate monoculturally, ignoring the linguistic and cultural capital of repatriated and foreign students.

The fourth period begins in 2010, with Law 3838/10 "on the attribution of Greek citizenship" and the changes that have emerged in the immigration and, by extension, educational policy and lasts until today (Palaiologou, 2012: 60). In this period the institution of the Educational Priority Areas is established. Equally important was the circular, which allowed the parents of non-Orthodox students to request their children to be exempt from the religious lesson (104071 / C2 / 04.08.2008), without the need for justification of choice.

Greece has a multicultural society and as result policies that promote the equal participation of all cultural references in the social and educational process with absolute respect for the identity of the citizen are needed to be adopted and implemented. The proposals that follow are desirable to be a starting point for reflection and fruitful, meaningful dialogue, without prejudices and excuses, exclusions, extremes or hegemonic claims.

At the Society level, it is necessary to raise awareness among citizens. The adoption of appropriate immigration and refugee policy indicates that the

migratory phenomenon is not transitory but has more permanent features. It cultivates the conviction that it is positive, the enriching dimension of diversity and diversity and protection, human dignity and the fundamental rights of immigrants and refugees. What is needed is the information and awareness raising of parents in schools, in cooperation with parents 'and guardians' associations.

Local initiatives need to be strengthened and encouraged by local communities and local authorities, which can help reinforce the coexistence, participation and cooperation of locals and foreigners. Support from the local government of the right of all social and cultural groups to maintain their cultural identity but at the same time to reconcile a more comprehensive framework of commonly accepted values, practices and processes on the basis of which they will peacefully live, assists the work of the school, educators and students to promote human rights and enforce them in practice, strengthens respect for diversity, consolidates solidarity, fosters empathy, and removes racism ethos, stereotypes and prejudices.

At an institutional level, It is necessary to improve the institutional framework for intercultural education in Greece. It is necessary to understand the principles of intercultural education so that the public school offers students the possibility to choose courses, develop their particular inclinations and respond to their interests, to have pedagogical knowledge and teaching methodology for teaching effectively. It is still essential to systematically record the educational needs of students belonging to minorities, designing actions for school integration and development of pilot preparatory actions for inclusion in education such as reconceptualisation of the curriculum material in order to address the students' needs.

At a pedagogical and didactic level according to the Fundamental Rights Agency report on the education of refugee and minority children, published in May 2017, it is necessary to:

1) join as soon as possible the children of refugees in the regular program in schools,

2) enable the school system to integrate them in order to prevent their classmates from attending courses and to be able to develop their skills,

3) promote intercultural dialogue and the participation of refugee children in cultural activities such as sports, cultural events and activities that match their ages.

6.3.3 The School as an Intercultural Learning Community

The Learning Organization and the Learning Community are characterized by the ability to produce, transform and transmit knowledge, their ability to modify their behaviour following the data of new knowledge, and the development of innovations. Learning-oriented individuals thus see difficult tasks as opportunities for growth and development (Payne et al., 2007), seek feedback from others in order to improve (Van de Walle & Cummings, 1997), and frame failure as an opportunity to learn (Farr et al., 1993). An active learning orientation reduces the concern with protecting image and reputation during interpersonal interactions (Frink & Ferris, 1998) and frees individuals to engage in constant improvement.

According to Harvery et al. (2019), teams with a high learning orientation are energised to pursue collective goals that are obtained through behavioural strategies of change and improvement. These teams tend to see problems as opportunities for learning instead of barriers to short-term performance (Alexander & van Knippenberg, 2014). They are energised by finding solutions to severe issues and take a proactive approach to address them when members of the team raise them.

As a result, learning-oriented teams tend to engage in further information exchange (Gong et al., 2013). In teams, learning is produced because the team engages in activities that include the detection and correction of errors as a normative practice (Edmondson, 1999). Team members learn together because they frame the events that happen in teams as opportunities to improve, and intentionally enact strategies that actively pursue exploration, experimentation, and reflection.

Learning and adaptation have thus been observed from teams with a high learning orientation (Porter et al., 2010). As the core characteristics of a school that functions as a learning organisation are considered:

- ❖ Awareness of the need for collective learning of the organisation and meeting the needs of all students and students without discrimination of sex, race, language, religion and culture,
- ❖ Knowledge of the environment, culture, life and learning as well as the level of learning of each student and student,
- ❖ Shared vision and goals set by the members of the organisation concerning intercultural activities enriching all of its work including curriculum programs that are enriched with intercultural activities,
- ❖ Cooperative structures based on a framework of principles: honesty, trust, reciprocity, parity, solidarity, shared (collective) knowledge and memory,
- ❖ Promoting intercultural innovation and creativity (intercultural diary with dates from important celebrations for all students and enriching the school with the students '/ students' festivals - organising musical events in the presence of all parents and guardians, etc.);
- ❖ The recognition of school autonomy and the implementation of practices of intercultural orientation based on the principles and values of intercultural education
- ❖ Upgrading the cultures and languages of migrant/refugee students, while combating any racism in the form of a symbol or behaviour through similar cultural and linguistic elements,
- ❖ Policies to compensate for any "lag" at the linguistic level so that all students and students have the opportunity to strengthen and monitor the courses by ensuring "equal" opportunities,
- ❖ Broadening the child's cognitive and emotional horizons and exchanging information and experiences among students to facilitate communication between them and their more full environment directly and in the long term in society (Pagonis & Papachristos, 2017).

The school unit can be considered as a co-organizer of educational policy. The role of programming can play a crucial role in shaping the specific nature

of each school's culture and climate by identifying specific policies, objectives and action plans for best practice. School leadership is inextricably linked with the upgrading of the quality of education provided to a school organisation, and this is most evident in several aspects of school life, such as the school climate, school culture, student performance, (Loukeris et al., 2009 p. 161-174). Also, there is a need for the use of modern methods of teaching.

School due to globalisation is currently facing challenges caused by the massive flow of information and a dynamic, innovative initiative in education, transforming it into a learning community is a necessity (Karakos et al., 2016). School as a learning organisation is a new trend in the international and European space that has become more and more popular in recent years. To achieve this goal, it is necessary to redesign its structure in such a way that it cultivates a culture of intercultural learning and empowers teachers in this direction (Papachristos, 2009).

In this context, the school as a system should aim to progress and improve it as an organisation that requires time to be implemented and focuses on the process and not on the outcome (Amnesty International, 2007). Additionally, a successful adaptation of the school from a strictly structured entity to a learning and creative organisation takes place through the adoption of multiple levels of leadership in the classroom, at school, and throughout the school community, since every challenge for change is a natural element of organisational change. In this way, the school is a learning-oriented organisation, meaning the involvement of all the subsystems of the school system in the systemic formulation of goals, the building of more profound knowledge and the cultivation of their skills and competencies (Fullan, 1995; Kools & Stoll, 2016).

This section highlights the existence of European and National policies as well as institutional frameworks with a number of pre-defined objectives and steps aimed at establishing and implementing such educational orientation. Although this section seems to impede the flow of this dissertation, it is worth mentioning in order to understand that despite the rhetoric of defending rights, in practice these policies are not being implemented and that what is

happening in schools is anything more than defending the rights of people belonging to several cultural groups.

6.4 Understanding the social exclusion of Roma

Roma is recognised as one of the European Union's largest minority ethnic groups, with estimates that more than ten million Roma are residing across the EU (Council of Europe, 2011; European Commission, 2012). Despite a commitment at a European level to address the continuing disadvantage of Roma and the development of several policy initiatives entrenched disadvantage, discrimination, prejudice and exclusion remain defining features in the lives of many Roma (Amnesty International, 2011). Indeed, it is widely acknowledged that Roma is one of the most socially excluded communities across contemporary Europe (Amnesty International, 2011; Barlett et al., 2011).

Beginning to define and clarify our use of the term Roma in the concept of social exclusion some of the critical characteristics over the exclusion of Roma are outlined regarding specific policy areas of housing education, employment and health. We provide a discussion of the European policy contacts before exploding what is currently known about the Roma communities who have for centuries lived in Europe and Greece.

The term Roma, first chosen at the inaugural World Romani Congress held in London in 1971, is now widely accepted across the European Union as a generic and pragmatic term to describe the diverse range of community members of these communities. Members of these communities may differ in many significant linguistic and cultural ways and include people who identify themselves as Roma whose ancestors originated from Northern India. Similarly, it can also include other indigenous groups in countries across the European Union, such as Gypsies and Travellers residents.

Roma is a particularly tricky social group to conceptualise accurately (Kovats, 2001, p. 7-8) due to the complexities associated with identities which are bound up in a culture, time, practices, ethnicity, language, national identification and show on. Indeed, for some commentators, using a

homogenised label of Roma is problematic, mainly when such definitions are used for policy purposes. While we recognize that the term ‘Roma’ is disputed, and acknowledge that debates around the conceptualization of Roma are ongoing, for these thesis, discussions utilize the concept of Council of Europe definition which uses the term Roma to refer to travelers and Eastern groups and covers the vast diversity of the groups concerned including persons who identify themselves as gypsies (CoE, 2006, p.4).

There are broad similarities between European Gypsies and Travellers populations and the Roma communities, including the history of nomadism, and issues relating to generally poor health outcomes, educational attainment, and other indicators of social exclusion. However, there are also some differences between these populations, not least related to the fact that the Roma in Europe is by and large migrants, and as such face similar issues to other newly arriving communities (for exam language barriers, lack of understanding of the host country’s systems, failure of access to educational attainment and poor housing conditions).

People who experienced exclusion across more than one domain or dimension of disadvantages (Levitas et al., 2007, p. 9) are regarded as suffering profound or severe social exclusion, a situation that many commentators agree is common for Roma communities across contemporary Europe. It is impossible to adequately understand the social exclusion experienced by migrant Roma populations without first appreciating the context within which Roma have lived in their countries of origin.

The following provides an overview of some of the issues and barriers Roma face across Europe in relation to the key policy area of education which has the power to eliminate, even in the long run, social inequalities, to alleviate the problems in the life of the particular population group, and to create the conditions for equal and healthy integration of children into the body of society.

Evidence suggests that Roma children are a particularly disadvantaged group within an already marginalised population (Farkas, 2007). Some of the key and widely acknowledged issues facing Roma children include low levels of

attendance at schools and poor educational attainment compared to the majority population. As a result of sporadic and unsystematic school attendance (Symeou et al., 2009, p. 514), it is crucial that illiteracy rates among the Roma are often more than 50% (CoE, 2011).

This intersection of education and poverty has been highlighted as a critical issue with day-to-day survival underpinning the lives of many Roma (Scullion & Brown, 2013). As such, children are sometimes expected to contribute to the family income by themselves undertaking paid employment, or by looking after young siblings so parents can work (Scullion & Brown, 2013). Furthermore, in addition to residential segregation, educational segregation is systemic in some European countries (ERRC, 2011; Friedman et al., 2009; O'Nions, 2010; Ryder et al., 2014). The ERRC talks about three different types of segregation concerning Roma: segregation in individual schools for children with developmental disabilities often through direct placement without prior enrollment in a mainstream school, segregation within the mainstream schools, and segregation in ghetto schools.

In recognition to the pervasive and ongoing disadvantage and marginalization of Roma highlighted above, the institution of the European Union are openly involved and have been for many years in a number of initiatives to improve the lives of Roma (Barlett et al., 2011), with what some call 'Europeanization of Roma policy' (Vermeersch, 2011, p.96). In 2008, a Commission staff working document set in motion a series of steps that would lead to the development of what was perceived as a framework for more effective implementation of policies to support Roma inclusion within each member state of the European Union. Consequently, in 2011, the European Commission published the European Union framework for National Roma Integration Strategies up to 2020, which called on all European Union member states to prepare or adopt, strategic documents to meet four key European Union integration goals: access to education, employment, healthcare and housing.

However, it is recognised that progress has been slow (European Commission, 2014) with initiatives not always delivering intended outcomes or

providing only short-term solutions that failed to provoke change in the lives of people (Brown et al., 2014, 2015). Approaches across European countries vary, but broadly speaking, they fall into two groups: targeted schemes focusing specifically on Roma or more mainstream approaches with a broader focus to unemployed people, minority ethnic communities, etc.

What is clear is that, regardless of the approach, there is often a disconnect between the strategies that are put in place and their actual impact on the ground. The main reasons cited for the limited effectiveness of existing mechanisms are lack of political will, lack of strong partnerships and coordination mechanics, but also an unwillingness to acknowledge the needs of Roma as an issue (European Commission, 2010). Furthermore, there are particular concerns around the lack of involvement of Roma in consultation, development, and implementation of initiatives (Brown et al., 2015).

Arguably, part of the challenge also relates to competing discourses around Rome exclusion. More specifically, Roma typically primarily emphasise structural factors such as poverty, discrimination and racism and describe the negative impact of these issues have on their daily lives (Brown et al., 2013, p. 54). On the other hand, non Roma often view the social exclusion of Roma as being rooted in the dysfunctional behaviour or culture of Roma themselves. Indeed, racism systems that use individual, physical or collective cultural differences between communities to legitimise discriminatory practices are essential issues that need to be considered concerning the ongoing exclusion of Roma.

Most of the scientific studies on Roma people suggest the existence of racism against this ethnic minority in the classrooms. In some countries, like Hungary, with an average of students with special needs (SEN) higher than the European one, Roma children are routinely placed in individual schools. Petrokou & Dimitrakopoulos (2002) in a study about the academic performance of Roma students, claim that some education authorities state with no evidence that ‘Roma families do not want their children to attend school…the Roma are reluctant to integrate into society… (p. 630).

Drawing on a comparative household study in Hungary, Bulgaria, and Romania on Roma living standards, it is shown that ethnicity and living standards correlate positively. Fox (2002) gathers the primary discourses on Roma people based on data available in the Minorities at Risk dataset, including the partial and racist picture of Roma as ‘dirty, lazy and stupid people who are prone to crime’ (p. 3).

In Chronaki (2005) and Sordé (2014), this "image" is called' gypsiologists.' Gypsiologist's speech has been based on prejudices, stereotypes, and no real evidence. A relevant prior study proposed an effective strategy to "turning problems into possibilities' ' (Flecha & Soler, 2013) to engage Roma learners and their relatives in education through dialogic teaching. The study conducted by Flecha & Soler (2013) challenged many prejudices towards the Roma, developing a community-based school that has shown to be sustainable over time for more than ten years and creating avenues for inclusion and success of Roma students in the most challenging circumstances.

There are not many previous studies about how Roma perform in Mathematics education (Chronaki, 2008). The few pieces of research on this subject indicate that Roma learners with their particular cultural heritage must experience a conflict between a legalised academic discourse, what Bernstein (Bernstein, 2003) called elaborated code of the school, based in the idea of paper-and-pencil teaching and learning. Schools produce a habitus, in Bourdieu’s terms (Bourdieu, 2016) excluding Roma students from the mainstream discourse. This fact, alongside socio-cultural stereotypes against the Roma heritage, produces a situation of poor expectations, as presented by Hudley (2016), about what Roma students may learn in school.

In order to transform this situation, Chronaki (2008) draws on Gutiérrez, Baquedano-López and Tejada’s (1999) concept of hybridity. Chronaki suggests introducing hybrid practices as a way to break with the monologic discourse of the school. Drawing on Bakhtin’s (2010) concept of polyphony, Chronaki argues the need to develop dialogic practices to include the voices of all students within the classroom, not only the ones who share the

monologic hegemonic discourse. Other studies denounce the unfair situation that Roma students face in mainstream schools (Gana et al., 2020; Díez-Palomar, 2018; Stathopoulou & Kalabasis, 2007), but no further ideas about how to overcome this condition.

6.5 Synopsis

In order to understand the characteristics of minorities in the educational process, it is imperative to understand how identity and ethnic identity in particular is defined and shaped. The construction of identity is the object of processing since it is not definitively defined and constantly changing, while it is not given, such as the identity of specific objects but rather into a context of relationships.

The term identity refers to the individual, group, or society and involves the processes required at the level of the individual and the level of the group and society to form it. Through the process of identity formation, the individual understands, organises and communicates their relationship with the entire environment.

Examining the notion of multicultural identity, it is obvious that this refers to the fundamental unity of all people while recognising, legitimising, accepting and appreciating the differences that exist between people of different cultures. Individuals are not determined by the languages they speak, the number of countries they have visited, or the number of personal international contacts they have. Their multicultural identity is determined by their perspectives of the world and society and by how they integrate with the ongoing osmosis in the environment around them. This should lead to zero tolerance of racism and all kinds of prejudices and stereotypes especially within a school environment which should be considered as pivotal in achieving these goals. Curriculum design in conjunction with the content of the school textbooks make a decisive contribution to the preservation or changing of established roles and behaviours and society behaviour.

Greece has taken certain steps towards implementing policies in efforts to promote intercultural education but there is more room for improvement.

Looking into proposals in this direction, a starting point would be raising awareness of the current environment to facilitate collaboration and support within the school community. Improvement of the institutional framework for intercultural education is necessary to understand the principles of intercultural education so that the public school offers students the possibility to choose courses, develop their particular inclinations and respond to their interests would be another important area.

It is still essential to systematically monitor the educational needs of students belonging to minorities, designing actions for school integration and development of actions for inclusion in education such as redesigning of the curriculum material. There should be a shift towards high learning orientation and development of team spirit to encourage approaching problems as opportunities for learning instead of hurdles. This mentality defines the characteristics of a schooling environment that identifies itself as a learning organisation and focuses on meeting the needs of all students and students without discrimination of sex, race, language, religion and culture, knowledge of the environment, culture, life and learning as well as the level of learning of each student and student.

Roma is recognised as one of the European Union's largest minority ethnic groups and is one of the most socially excluded communities across contemporary Europe. At the same time, it is impossible to adequately understand the social exclusion experienced by migrant Roma populations without first appreciating the context within which Roma have lived in their countries of origin. Roma children are a particularly disadvantaged group as they face low levels of attendance at schools and poor educational attainment compared to the majority population which results in high levels of illiteracy.

Unfortunately, it is quite evident that there is often a disconnect between the strategies that are put in place to address these issues and their achieved outcomes as these are observed. The main reasons for the limited effectiveness are lack of political will, lack of strong partnerships and coordination mechanics, but also reluctance to acknowledge the needs of Roma. Research suggests the introduction of a diverse education model to

overcome the obstacles of a monolingual and monocultural educational status quo.

Chapter 7: Curriculum development

7.0 Summary

This chapter deals with the relationship between mathematics curricula and educational reality. The meaning and essence of curriculum reconceptualization is first referred to as approached through Pinar's work. Then reference is made to essential features of intercultural programs while at the same time there is a focus on the Greek curriculum and how it can be reshaped. Finally, reference is made to the special knowledge possessed by Roma students and how it can be utilized in order to reshape the mathematics curriculum with the ultimate goal of restoring social justice.

7.1 Curriculum reconceptualisation

The curriculum is a mechanism that helps to reproduce the dominant ideology and a means of exercising socio-economic and cultural control (Apple 1996; Zhu, 2019) entailing objectives that arise from the requirements of society and the needs of students whose validity and legitimacy are not questioned. As Skilbeck (1984) noted, 'Changes in society at large have their momentum and can have a more powerful impact on the school curriculum. The curriculum should be based on the theoretical assumptions of the post-holistic, holistic theory, which are: reflection, enlightenment, enrichment, conceptual correlations, acceptance of diversity, fluidity, overturned beliefs, critical exploration, action and open teaching and evaluation procedures (Callahan, 2019).

Concerning curriculum planning the focus should be based on the model of future situations, focusing on the preparation of students in situations that will live in real life. A social practices view of literacy understands curriculum development not as a measurable skill, but as purposeful activities embedded

in social practices and informed by both personal and more widely shared meanings and values (Papen & Tusting, 2019).

The curriculum needs to place particular emphasis on creating conditions for active participation of school community members in shaping learning processes, the ability to tabulate their identities so that others can get to know them and understand them in order to shape the learning process. Both curriculum and teaching methods are required to take into account each student's environment and level of learning, through the exchange of experiences among students to contribute to the exploration of their cognitive and emotional horizons, to encourage inclusive communication, upgrading cultures and languages by combating all forms of racism, prejudices, stereotypes and ethnocentrism, inspiring and cultivating human sensitivity, solidarity and cooperation, to compensate for the cultural deprivation of children (Afonso et al. 2018).

Curriculum recontextualisation is linked to the concepts of organization and programming, as well as to concepts of design and implementation. In terms of organization and planning, it may be broader, more general and formal such as a guide, the timetable (lessons to be taught, teaching periods). Also, programming can be weekly, monthly, mid-term, long-term etc. Planning involves the inclusion of data and information, which we generally call experiences and their organization and implementation in practice. Finally, at the level of implementation, we meet the managers, as supervisors in the school unit, the teachers who will implement the program and the students involved in the learning process (Christodoulou, 2013, p. 18).

Pinar's (2009) initial discussion of the divisions within curriculum studies (traditionalists, conceptual-empiricists, and reconceptualists) is, at its core, a discussion of theory and practice. The first of these "are former school people whose intellectual and subcultural ties tend to be with school practitioners" (p. 168–169). Pinar goes on to say that these groups are more interested in "design, change (behaviorally observable), and improvement" (p. 169). The second group is the conceptual-empiricists. This group relies on the basis of social science and sees curriculum as an area to be studied from the outside,

not a discipline to be developed from within. In other words, curriculum becomes something to be studied, relying heavily on the disciplines of social science to do so (Huddleston, 2018).

Pinar (2009) then goes on to make a call for a combination of these three groups in which he says: We are not faced with an exclusive choice: either the traditional wisdom of the field, or conceptual-empiricism, or the reconceptualization. Each is reliant upon the other. For the field to become vital and significant to American education it must nurture each “moment,” its “internal dialectic.” And it must strive for synthesis, for a series of perspectives on curriculum that are at once empirical, interpretative, critical, emancipatory (p. 174).

With the curriculum choices, the flexibility and the capability they give to teachers, students of different ethnic and cultural backgrounds such as Roma are encouraged to learn their cultural heritage, languages, history, customs and traditions and other aspects of the ways of life of their societies and to share it with native students as they learn Greek culture.

The existence of students with different cultural characteristics in the educational systems of host countries is gradually influencing the contents, results, teaching strategies and assessment. Interdisciplinary teaching approaches have also emerged from the reality of migration and the transformation of host societies into multicultural ones. Transformations have retracted pedagogical ideas and demands for equal treatment, solidarity, multiculturalism and school opening in the community.

The future of curricula, which is a distinct speciality in the scientific field of education, is uncertain (Mosely et al, 2020; Pinar, 2010). School changes focus on improvements in student grades in standard exams; the curriculum has been downgraded to a medium for one purpose, has become a means of meeting goals, and a scheme of responsibility. Within a critical reconceptualist curriculum theory tradition, the contingency and socio-historical condition in educational institutions is stressed (Pinar, 1975; Goodson, 1987; Popkewitz, 1997).

In this research tradition, as it has been developed by Englund (1986; 2011), the emphasis is on the content of education, that is, on the contingent ideas and the socio-historical and contextual conditions, on the meaning-making and the plurality of meanings and the possible and conceivable moral and political consequences (Ljunggren, 2010). The interest in meaning-making and the possible imaginable consequences is based on a logical consequence analysis with its philosophical and methodological roots in pragmatism (Brantefors, 2015; Dewey, 1966; Bernstein 1983; 2010).

In what is referred to as Peirce's pragmatic maxim, the principal thesis in pragmatism is expressed: 'The method prescribed in the [pragmatic] maxim is to trace out in the imagination the conceivable practical consequences […] herein lies the whole of the purport of the word, the entire concept (Peirce, 1984, p. 494). In this article, the pragmatic approach means that: (1) the meaning of the content (in education) is viewed as lying in its possible and imaginable consequences, (2) there is an interest in the plurality of meanings and in the different alternatives that are at stake and (3) the educational content is valued in relation to an overall political or moral goal, for example, democracy or, as in this study, the possibility for children to participate as peers.

As Dewey writes in Democracy and Education, under the heading Education as National and as Social: 'The conception of education as a social process and function has no definite meaning until we define the kind of society we have in mind' (Dewey, 1966, p. 97). By clarifying the practical consequences of different ideas about this overall goal, the meaning and the possible future can be anticipated: 'Pragmatists anticipate outcomes. They look to imagined and actual outcomes […]. Pragmatism is a discourse that attempts to bridge where we are with where we might end up' (Cherryholmes, 1999, p. 3). In pragmatism, the future is always built into the analysis. By using a pragmatic approach, the relationship between the communicated knowledge (the content) in school and the possible future society could be elucidated.

An important issue that arises in multicultural societies is related to the role that curricula have to play in schools for the preparation of students in order to

effectively address the challenges of diversity. The curricula, however, reflect the objectives of a country's education system, which is directly related to its broader socio-economic, political and cultural objectives. Intercultural education is applied at three levels: at the level of educational policy, in the form of clear educational goals and objectives, at the level of educational institutions, in particular through democratic administration, student participation, open learning environments and inclusive policy, and at the level of teaching, through the approaches and methods that make up the very essence of this aid.

The first basic principle of intercultural pedagogy is the importance of culture for the development of the intercultural socialised person. The second principle is the acceptance of students' educational background, which is basically the second fundamental principle of intercultural pedagogy and is directly linked to the first substantive principle of accepting the cultural capital of foreign students, and the third principle of intercultural education advocates equal opportunities for all the students, a principle that essentially equates native students with minority students.

The school is therefore obliged to teach students the values that are universal and will help to achieve the harmonious coexistence of students both within the school and into the broader society by linking the constitutive dimensions of ecumenical education to the concept of "Freire" and the concept of "emancipation" of Habermas.

7.2 Characteristics of Intercultural Programs

The choice of the term culture has to do with its frequent use in the European curricula when describing children with ‘immigrant background’, ‘minorities’ or ‘other people’ outside the nation. Culture is, here, used as a collective term for all different ideas and designations that have occurred in curriculum history; all of which have an anthropological meaning and refer to a social group of people, community or nation sharing the same way of life and values. In the documents, culture is often used in a more or less static and homogenous way and has not yet been replaced by anti-essentialist and heterogeneous

concepts. In the first step of the analysis, the homogenous meaning of culture is accepted, although later on in the analysis, an anti-essentialist approach is embraced (McLaren 2007).

However, the aim of the section is not to describe how culture and cultural identity are constituted. Instead, the purpose is to clarify the specific cultural and educational content that is expressed in the curriculum and has to do with cultural relations and the possibilities to participate as peers. In this context, the word 'educative' connects to how Dewey ([1916] 1985) uses the word to indicate the impact on children and young people: 'Not only is social life identical with communication, but all communication (and hence all genuine social life) is educative' (Dewey [1916] 1985; pg. 5). Knowledge and values are in this thesis seen as interwoven, and the selection of specific content in education is always a selection of knowledge and specific values. Children do not only learn facts; depending on the choice of the content, they also learn how to be or behave like human beings in society

The idea of values companioning the choice of content has previously been talked about in terms of 'collateral learning' (Dewey [1938] 1997), 'socialisation content' (Englund, 1986) or 'companion meanings' (Roberts, 1998). That is, educational content is never neutral, but is always filled with ideas and values that teachers must be aware of when making choices for education. Thus, what is at stake here is a particular cultural content in education that has to do with cultural relations. This particular content has an educative potential, which should also be discussed in the development of a culturally responsive dimension in the curriculum.

Intercultural education, which is ultimately aimed at social restructuring, presupposes the following main features in the curriculum (Grant & Sleeter, 1989, p. 7-8):

- The connection between students' abilities and the demands of the school and the broader society in order for students to learn to function effectively in the existing context,
- Focusing on human relationships with the ultimate goal of building positive emotions among students of all ethnic groups to enhance

mutual appreciation and self-esteem, focusing on groups that are underrepresented in existing CAs (e.g. ethnic minorities, women),

- ❖ Exploiting students' diversity and ensuring equal educational opportunities for all students and preparing students for activation as tomorrow's citizens and constructively addressing the difficulties and social problems such as undertaking social action to tackle social inequality and oppression.

In an interdependent society, it is useful to emphasise pluralism, flexibility, respect for the diversity of ideas, values and behaviours, creativity, human rights and the development of shared values, so that separate APIs are not required for intercultural education an intercultural curriculum should (Grant & Sleeter, 1989):

i. Be characterized by openness, which means diversifying the learning objectives by students so that students with different learning conditions and different competencies have the opportunity to acquire different learning experiences through everyday learning experiences.

ii. Be anti-racist, free from stereotypes and prejudices, and be based on the integration of different cultures, especially those experiencing oppression or exclusion from the dominant social group,

iii. Focusing on the student, but addressing all students and - recognising the diversity of the school community, parents, students and staff, in the knowledge and skills of each student, as well as in the cultural groups to which they belong; services and in the planned events during the school year.

According to Lynch, a curriculum with intercultural dimensions is required (Lynch, 1986, p. 84-85) to:

- ❖ Is international in choosing content and global in its perspective,
- ❖ Reflects the diversity of social and ethnic groups in representations and information passed on to children, transfers accurate information on cultural similarities and differences,
- ❖ Presents members of other ethnic groups as individuals with all the diversity of human quality and recognition features,

- ❖ Gives prestige to other cultures and nations and describes them in their terms rather than the terms or norms of the dominant group,
- ❖ Takes into account the different learning styles, experiences, the values and behaviours, as well as sophisticated cultural characteristics of children coming to school.

The process of reforming curriculum to meet the needs of students of a culturally heterogeneous society requires:

a. setting up special working groups for program development,

b. Pilot implementation and evaluation of the proposed programs,

c. Revision of textbooks on content and pedagogical methods used; changes in personal perceptions and attitudes;

The reshaping of the curricula is necessary due to the changes made in the world. Changes made are reflected in their contents and placement. The only certainty is that in the fluid state of our world "change is the new constant" (Anderson, 1998)

7.3 National curriculum and curricular recontextualisation

Some of the educational systems that follow a national curriculum, based on a disciplinary matrix and equal for all (Kärkkäinen 2012), maintain that this option represents a possibility for all students to access “powerful knowledge” (Young 2007, 2010). However, the increasing diversity of students’ characteristics and their different social and cultural backgrounds demand that schools and teachers’ curricular practices account for this diversity. Therefore, the importance of contextualising the national curriculum is acknowledged in order to better correspond to all students and situations. Even though it is not a new idea (Apple 1993, 1999; Giroux 1983; Hall 1996; Kemmis 1988; Lopes 2013; Pinar 2004), contextualising curriculum has recently gained a new significance in international policies (European Commission 2012a, 2012b; European Council 2009, 2013; European Parliament and Council 2006; European Union Council 2011; OECD 2010).

Expecting to achieve inclusive education, these policies stress the need to develop curricular processes articulated with students' life experiences, respecting their learning rhythms. These ideas have also been present in education policy debates in Portugal. The legislation from recent years conceives the national curriculum as a flexible project (Decision no. 5908/2017; Decree-Law no. 55/2018) that needs to be meaningful for different schools and students, which can be achieved through curricular contextualisation practices.

This policy encourages teachers' use of practices that take into account students' previous knowledge, interests, rhythms and learning styles, and life experiences in order to promote learning and achieve the desired student profile (Decision no. 6478/2017) at the end of compulsory schooling. These ideas have also been present in academic debates that highlight teachers' role and their ability to develop curriculum contextualisation practices (Gillespie 2002; Hartnell-Young & Vetere 2008; Paliwal & Subramaniam 2006; Priestley 2010; Smith 2005). It is argued that curricular practices that contextualise the national curriculum offer students more possibilities to become involved in teaching-learning situations, to question situations from their daily life, and to build new meanings about what they know and what they are learning.

Curricular contextualisation is firmly articulated with the concepts of teachers' agency (Biesta & Tedder 2006; Priestley, Biesta, & Robinson 2013, 2015) and curriculum configurators (Leite 2003, 2006; Leite and Fernandes 2010). Based on this rationale, this paper presents a study with the objectives to identify curricular practices most used by teachers; to establish relationships between these practices and processes, aiming for the contextualisation of the national curriculum; and to relate these practices to teachers' perspectives about curricular contextualisation. The study was developed in a period during which educational policies recognise teachers' agency power, expecting from them the development of curricular practices that, breaking with traditional perspectives, engage students in building their learning (Decision no. 5908/2017; Decree-Law no. 55, July 6/2018).

In school education, curriculum refers to a set of knowledge and contents to be taught and learned in the teaching and learning experiences as an organic part of the development process (Doyle, 1992, 2009; Fernandes, 2011; Miller & Seller, 1985). Since education became not only the right of privileged students, there was a need to ensure that all students, regardless of their origin and background, were provided with the same knowledge and opportunities. This idea led to the standardisation of the contents taught in schools (Apple, 1999; Ball, 2010; Ball & Junemann, 2012) and to the establishment of a national curriculum. This curriculum should include the most relevant and essential contents, which Young (2013) identifies as powerful knowledge. Recognising that some knowledge is more valuable than other knowledge, Young argues that schools have to ensure that they are providing youth with the knowledge that they cannot acquire at home or in their community. Although this can guarantee somewhat equal treatment for all students, it raises other issues.

The phenomenon of globalisation turned schools and classrooms into culturally and socially diverse environments (Campbell, 2000), where different students from various cultures, socioeconomic backgrounds, and religions coexist (Leite, 2002). This raised issues with the quality of the educational service provided, the assurance of equity, social justice (Connell 1993, 2012; Scrase 2014), and students' achievement rates. Such diversity conflicts with a "one size fit all "curricular model, requiring a more diversified and broad approach to curriculum organisation and practices (Beane 2003; Field, Kuczera, and Pont, 2007; Nieveen & Kuiper, 2012). Acknowledging this, some curricular policies have granted schools and teachers a certain degree of freedom to organise and develop the education process (Kärkkäinen, 2012). This concept is based on the idea that with more autonomy, teachers can reach their students' interests and needs and contextualize curricular contents to the diversity of students. It is recognised that such an orientation is likely to create conditions for academic success.

Teachers are seen, in this perspective, as curricular co-configurators (Leite 2003, 2006; Leite & Fernandes 2010), with agency capacities (Priestley 2010; Priestley, Biesta, & Robinson 2013, 2015) that allow them to develop

practices of “curricular contextualisation” (Fernandes et al. 2012). Curricular contextualisation can be achieved through many approaches. It can stem from placing the student in the centre of the educational process; it can be based on the place where the educational process occurs; it can be achieved through diversification of curricular practices in the classroom, or it can be achieved even by exploring and managing the curricular contents.

Generally speaking, curricular contextualization corresponds to the way teachers address the contents in the national curriculum, how they teach, and how they adapt their curricular practices, taking into consideration their students and the different resources available. The analysis of policies guiding educational systems shows that they are sometimes oriented towards a curriculum conception based on the ideas of “one size fits all” and of performativity (Ball 2000; 2012), and other times they recognise that the curriculum prescribed at the national level needs to be adapted to the local contexts and the characteristics of students to whom it is intended. This perspective is based on a belief that if teachers use their agency power in curricular decisions, the principles of equity and social justice will more likely be achieved.

7.4 Positioning Roma local knowledge systems within the Greek mathematics curriculum

Many Roma parents do not experience school education as either, substantial or applicative for their children; rather they picture it being a way of managing and intervening in family’s everyday life. The struggle that is present between Roma and school education is found in the opposing structures, values and passions that are used-to help and also keep community cohesion in the different societies. Despite these issues, most Roma communities recognise that school education is the only possible path to literacy for children. Literacy is imagined being essential in modern society where actually the most basic needs like acquiring a drivers' licence, filling in a social security form, and requiring a residence permit call for literacy.

Roma community members firmly believe they have the option to identify the framework of children's education and as a result they should not be obliged

to follow academic decisions made by an external organization like school. Independent behaviour is reinforced in several methods like encouraging kids to seek and also cook their own food, dress themselves, place themselves to sleep with no supervision and even take care of younger family members. A kid's feeling of autonomy is additionally reinforced by an absence of actual boundaries and rules relevant to raising a child.

School education contrasts significantly from conventional Roma education (Dillon et al., 2020; Smith 2005). The classroom environment, where the vast majority of learning experiences take place, varies considerably from the usual cultural Roma community training. A Roma student spends the majority of the day in the family camp, at the house of a family member, or maybe accompanying a family member on a job, where the child might interact with a non-Roma environment.

The classroom, by comparison, is an area where students should be on a regular basis being instructed by a teacher who neither belongs to their cultural community, nor knows the special social, cultural and historical elements that make this population group special. Whilst participating in their community's tasks Roma children find out about the culture of theirs, political, history, economic and social life. At school, they're more likely to understand just about mainstream culture, politics and history.

Through these controversies children are challenged to live and learn in an environment characterized by its dichotomy and in order this gap to be bridged the reconceptualization of the curriculum is suggested as a powerful tool which takes advantage of the children's lived experiences and translates them into school knowledge. Self-determination[31] will be the right of any culturally distinct group to select their very own political, cultural, social,

[31] SDT is an organismic dialectical approach. It begins with the assumption that people are active organisms, with evolved tendencies toward growing, mastering ambient challenges, and integrating new experiences into a coherent sense of self. These natural developmental tendencies do not, however, operate automatically, but instead require ongoing social nutriments and support. That is, the social context can either support or thwart the natural tendencies toward active engagement and psychological growth, or it can catalyze lack of integration, defense, and fulfillment of need-substitutes. Thus, it is the dialectic between the active organism and the social context that is the basis for SDT's predictions about behavior, experience, and development (Ryan & Deci, 2000).

financial, and cultural condition (Stancliffe et al., 2020; Krastev et al., 2019). The degree of self-determination that a group can accomplish is achieved by the government educational policy makers. Culturally different groups, like Roma people, will not realize self-determination until they're in a position to join in much more completely in the layout, distribution, and implementation of school curriculum programs.

Mathematics was developed by the human need to successfully deal with everyday situations or to explain specific phenomena. However, their teaching at school, primarily aiming at the formation of generalized knowledge and focusing more on the final product and less on the process of mathematical creation, tends to present mathematical knowledge outside the contexts in which they emerged or integrated into situations less related to personal student experiences. Such a teaching practice, on the one hand, ignores the socio-cultural character of the process of constructing mathematical knowledge and, on the other hand, degrades the importance of students' diverse mathematical experiences outside of the classroom associated with that process.

Formal mathematics are defined as the exercises and concepts of mathematics as defined by the official educational curriculum and are common to all educational units in Greece. As far as the informal Mathematics are concerned, these concern the offer of mathematical knowledge, which, however, goes beyond the standards set by the curriculum and the textbooks of the course (Stathopoulou, 2017; 2005). Sitabkhan et al. (2019) also define them as extracurricular mathematics which constitute the mathematical knowledge acquired from knowledge that exists through daily practices and from personal experiences. It is an informally structured body of knowledge and for this reason it is largely associated with Roma students.

Here we are called to identify a particular element. On the one hand, there are the typical Mathematics, which are the Mathematics taught in school and based on the Curriculum and the books published by the Ministry of Education (Stathopoulou, 2005). At this point, Miles (2019) and Bishop (2005) states that formal education and the tools he uses are a process of introduction to the

prevailing culture, that is, an effort of cultural assimilation. On the other hand, there are the informal Mathematics, the daily non-class experiences of the student, related to mathematics, offer the environment in which informal mathematical knowledge is formed, a knowledge that is a product of the individual's effort to respond to real situations and can characterized as applied, dependent on the circumstances in which it arises and rich in mathematical relations (correct or incorrect).

According to relevant research (Caruso, 2017; Ragsdell et al., 2016), this informal knowledge is a valuable reference framework for at least the initial meaning given to students in mathematical concepts, representations and processes, especially when they are called upon to engage in activities that refer to real situations that require use. of specific knowledge. Encouraging this practice contributes to the continuous use of informal knowledge for a deeper understanding of mathematical ideas, as it activates the thought processes that govern mathematical thinking. However, as noted above, the usual teaching approach in the mathematics class offers few opportunities in this direction, which limits students' ability to form the appropriate links and transformations that will allow them to gain access as well as control. in standard school mathematics.

It is now generally accepted that much of mathematical knowledge is formed outside of school (Knapp et al., 2017; Kaffousi et al., 2019). This acceptance inevitably leads to the recognition of the effect of students' socio-cultural experiences on the formation of mathematical meaning, imposing a new way of dealing with mathematical education, in which the student's experiences related to mathematics, both inside and outside class, play a central role in the design and implementation of the educational practice.

The finding that mathematics is a subject of learning both in the school environment (formal or school mathematics) and beyond (informal mathematics) has, for at least two decades, turned the attention of many researchers in mathematical education (du Plessis et al., 2019; Boaler, 1999) to exploring the characteristics of mathematical knowledge is approached in the context of the daily activities of the individual, as well as its relationship

with mathematical knowledge formed in the school classroom of mathematics. Research shows that often students or adults who fail or have failed in school math are particularly effective at tasks that require high-level math skills and abilities.

Stathopoulou (2005) conducted research in school classes of native students with a small number of Roma. In the case of her research conducted with data collection through interviews, it is mentioned that Roma students found a way to teach arias about their own data. For example, where there was the use of standard mathematics, such as multiplication and division, then Roma students had difficulty solving them. On the contrary, the existence of more open-ended exercises compatible with informal mathematics showed the real possibilities of the Roma students. According to Stathopoulou's research (2003), Roma students can only use specific numbers such as one, five and ten but not intermediate numbers. This phenomenon was due to the fact that Roma students had experiences from their parents' commercial activities and subjectively linked mathematics to arithmetic.

Here we have a special element which is what the international literature states as proximity and approximation. Bishop (1998) refers to the fact that minority students have different perceptions of a number of concepts related to mathematics such as space (for example how do I go from school to home?) Size (for example my home is big or small?) and quantity (for example I go shopping and I want to determine if the goods I bought are many or few) and finally the numerical concepts that as mentioned by Stathopoulou's experiments (2001, 2005) the Roma often cannot give clear answers.

Through many years of teaching Roma students, it has become clear to the researcher that the main problem was that the books in mathematics were asking for the exact result. In fact, the new textbooks flood every page with lots of information, pictures, instructions and points for answers, a structure that confuses Roma students as they can't navigate the book's page and treat their book but their lesson as completely difficult to understand mathematics. It should not be neglected the fact that Roma students come into contact with

written language exclusively at school as the library is completely absent from their home, even in its most rudimentary form, and any advertising or non-print publications they come in contact with must have images to gain their interest. A feature of this view is that there are very few Roma adults who can read a newspaper both because of their illiteracy and because of the large amount of information gathered on each sheet, which makes them feel difficult to understand.

The mainstream student who on the one hand has more friction with the printed word and the various books and on the other hand better reading and comprehension skills of the exercise but also the relevant theory can give an accurate result while Roma will give an estimated result. Of course, this has been noticeable in recent years. The result is that school textbooks for the subject of mathematics turn to evaluating a result first and then to the exact result itself.

Assessing the result as a cognitive process requires a completely different set of skills than what it takes to solve an exercise, and there is an increased difficulty for students to answer this question, with teachers usually skipping the steps required for assessment. After all, it is not uncommon for Roma traders to practice and calculate the cost of the various items they sell without knowing not only the technique of multiplication but the vast majority of them and the propaedeutic.

Stathopoulou (2001) states that a special issue is the fact that the construction of the mathematics course in the modern school is largely based on a strict curriculum that rejects or even despises the special knowledge that the Roma have. Unlike other children, Roma have a closer relationship with reality. They will go out of their way to work and face social problems from an early age. Mathematical education in the Greek educational system does not present the solution, based on the teaching of Mathematics in everyday problems, but is based on sterile mathematical problems that are not very related to children's cultural and historical background.

Stathopoulou (2003) reminds us of the fact that the Roma as a people even 30 years ago lived as nomads. The fact that they lived in a nomadic or even

semi-nomadic environment also meant that they did not need very precise definitions. For Roma students, the space was not clearly defined. While the native students have a specific home and a specific address, the Roma student does not have this element as he is constantly changing residence. The same goes for what his father does. While for native students the job is specific, e.g. mathematician, the majority of Roma fathers (since a small number of women work in these communities) do not have a clear and specific job.

Researchers (Ernest, 2018; 2019, Barton, 2017) state that the education system is what often leads to the misuse of mathematics. While mathematics may be a field that can give Roma students the opportunity to play a more active role, the reality is that the prevalence of formal mathematics and the use of formal curricula in general that ignore students' cultural background shows that there is an important responsibility of the education system for the poor performance of students from vulnerable social groups.

Roma children have been suggested to learn informal mathematics because of its practical utility. Situations like carrying out transactions in stores, food-sharing with members of their family and playing board games (Blevins-Knabe, 2016; Young-Loveridge, 1989). The degree to which children had experienced “mathematical” activities at home varies greatly among the different home environments.

All Roma children seemed to have experiences setting the table for their families although counting out the correct number of items and quantities is difficult. Moreover Roma children go grocery shopping on a daily basis with a member of their family but few of them took an active part in the shopping process where notions of weighting and counting are embedded. Many children are familiar with playing card and dice games but the mathematical oriented extent of this experience varied greatly. Most children have experiences relevant to time counting, use of calendars and calculators but these experiences were not connected to mathematical concepts. Most of the children had helped their mothers with baking, but few had been involved in the weighing because simple tasks were not accompanied by high-level task-

orienting talk that explained and organized cooking task processes. Continued mathematical skills development may be stimulated by measurement talk, especially when Roma children frequently provide measurement talk along with task-orienting scaffolding (Seung-Hee & Jin Herr, 2020).

An important role in the integration of new knowledge is played by symbols. A key feature of the symbol is that of interaction and communication between students and teachers in an equally situated complicated conversation.

The content in a multicultural curriculum should be constructed with a selection of resources, the majority of which could be placed in the community knowledge which is acquired outside of the institution (Doran & Singh, 2018 ; Gay, 2010). Cultural heritage should play a major role in the creation of the curriculum in which the goal is connecting school mathematics to the personal experiences of Roma students (Suffari and al., 2019). The goal of a reconceptualized mathematics curriculum is student success. Gay (2010; p. 127) states that "to be effective, knowledge must be accessible to students and connected to their lives and experiences outside of school."

An element which significantly influences how students learn would be the education they get at home. Integrating familiar contexts related to Roma students' cultural heritage within the currere process has the ability to facilitate learning. Valuing the knowledge students received at home and within their community will offer mathematical contexts which are relevant and significant to students. The learning situation then gets recognizable and has meaning for them.

Zaslavsky (1996) informs us that multicultural training will be the duty of the community and the family along with the college. Valdez (2019) realizes the benefits of culturally relevant education where essential attributes of the students and their neighborhood culture are connected to classroom educational practice and have the chance to be incorporated into mathematics curriculum.

Community participation is vital for a selection of reasons: it fortifies the link between community, school, and home; it strengthens the link between school

and the local important others who influence students (Ray, 2019). Giving voice to cultural diversity has strong benefits and incorporating cultural point of views within the training of mathematics, motivates students to find out about their culture while simultaneously learning mathematics. Students have the opportunity through this process to persuade relationships, actions or situations of their community and their family which are considered normal. They reexamine their reality in the lenses of mathematics education confronting a conflict which in addition to cognitive, is mainly sociocultural. Culturally related pedagogy validates students' cultural backgrounds, and ethic profile and offers ways for educators to help cultural connections between the community and the school (Medina et al., 2020; Orey & Rosa, 2013).

Curriculum developers along with mathematics educators ought to utilize the cultural diversity of students to improve the learning of mathematics through cultural and social activities. According to Entremont (2014) we today observe the student as actively creating meaning, connecting information that is new to pre-existing knowledge structures, and producing relationships that are new among structures. This may be done by incorporating student lived experience into the mathematics curriculum. The learning environment must value and respect the variety of students' experiences as well as ways of believing, so that they are comfortable with the intellectual chances offered, asking questions and thinking aloud.

Teachers should find ways to work with students' strengths and differences to make mathematics significant. Students must be actively involved in curriculum recontextualisation by sharing cultural happenings from which the researcher is able to develop mathematical tasks which match to certain mathematical concepts. The curriculum material cannot moreover be a set of goals and activities, but it is subject to the lived experience of the Roma students. It is apparent that cultures that are different have different histories and different traditions (Gladyshev et al., 2019; Asher, 2002) and opportunities provided in a mathematics classroom make them view critically their own value system as well as the others'.

Curriculum developers, system designers and mathematics teachers must have this diversity into consideration to correct mathematics learning through cultural and social activities. Cultural diversity is a power, "a continual, vitalizing pressure in our civic and personal lives" (Gay, 2010; p. 15). Gay (2010, p. 164) states that academic success is improved by accepting the fact that mathematical and scientific knowledge is present in all cultural groups, extracting math and science knowledge and skills embedded in the everyday activities and cultural heritages of different ethnic groups and connecting school mathematics with the funds of knowledge present in different cultural communities. Educators need to understand their own culture and how cultural biases can influence teaching styles which in turn influence student academic performance (Arnold & Versluis, 2019; Rosa, 2010). This awareness must then translate into action.

Reforming the math curriculum is a complicated conversation. The existing curriculum, as mentioned in previous sections, is structured by strict guidelines, focuses on goals and identifies the expected results. The perspective of the present study promotes the curriculum that will remain a vivid conversation, an interaction. The restructuring of the curriculum paves the way for discussion opportunities and an understanding of the needs and requirements of teaching mathematics through communication between students and teachers.

The fact that students and teachers are highly structured personalities complicates this discussion significantly, as it is understandable that each person brings to this discussion his own previous knowledge, aspects of his personal history, his interest and the current circumstances that affect his life. At the same time, this interaction is influenced by the settings of the place where the curriculum is applied, the state of the planet and the wider social situation. The educational climate and learning environment of each school separately is clear that it affects the communication between students and teachers.

The answer but at the same time the proposal in all this is the living experience of the mathematics curriculum, the true and evolving process of

the educational procedure where the curriculum is not rigid and pre-documented. The form of the curriculum as a verb-currere- is preferable as it emphasizes the live- and not the planned- curriculum, emphasizes the action process and experience as opposed to the outdated curriculum which aims exclusively at completing the learning process and achieving common goals for all students, regardless of the environment in which they live and from which they come.

It is a fact that when a learning session ends, its consequences continue as they are socially subjective and spiritually interconnected with the students' own lives. The course takes place simultaneously with the discussion and encourages the educational experience. Indeed, the use of the verb currere emphasizes the individual's daily experience and his ability to learn from this experience, to reconstruct the experience through thought and dialogue in order to understand. This understanding is achieved through intensive interactions of each child's story and experience and can help us recreate it with our own subjective and social becoming. The educational experience proposed through the present research allows for subjective and social reconstruction and provides a tool capable for removing social inequalities that have existed for years and restoring social justice.

It is a fact that the pedagogical process is related to the subjectivity of the individual. However, in order to be able to understand mathematics, there must be not only one student who meets the teacher's challenges, but one person who will evolve through the educational process. Students at school encode the information they receive, especially when summarized in a linear and logical form of structure such as the one in the existing textbooks. Teachers do not become able to teach if they do not express themselves through the topics they love and feel and students can only learn when their curriculum allows them to incorporate their subjective knowledge and gain the courage to form relationships and beliefs that diverge from social norms and strong stereotypes. There is no comment that can transmit knowledge without it being infected by the history and experience of the people who study and participate in this process. This fact does not negate the existence of substantial content that students should acquire in the course of mathematics

but means that this content must be translated in order to be understood by the students in question.

It is a fact that the reason for the existence of the curriculum is the understanding. Understanding is treated as a spiritual and emotional process that is often involved in biological and neurological concepts. Dealing with the curriculum as currere means that understanding is individual and socially directed at the moment but directly influenced by the past.

According to Pinar, this dimension of understanding but also the multiplicity of expectations it creates, degrades the static knowledge of the subject and gives precedence to the productive imagination of the individual who can relate and create new ideas for a different and better social context. The influence of allegory on knowledge causes a constant transformation of attitudes and thoughts about reality. By linking the facts of the living experience that students experience through their interactions in the context of mathematics, the weakness of a perfect unity between reality and the theory of curricula is highlighted. This weakness can cause a continuous transformation with fertile extensions.

7.5 Synopsis

Curriculum planning and design should be based on the preparation of students in situations they will experience in real life. The curriculum needs to focus on creating conditions for active participation in the learning processes. Both curriculum and teaching methods should consider each student's environment and level of learning by actively engaging them in the exchange of experiences to facilitate the exploration of their cognitive and emotional horizons, inclusive communication, the upgrading of cultures and languages in the efforts against racism, prejudices, stereotypes and ethnocentrism. Curriculum recontextualisation refers to the concepts of organization and programming, as well as the concepts of design and implementation.

An intercultural curriculum should be open, anti-racist, and focused on the student and their capabilities incorporating at the same time their diverse background and experiences.

Analysing the process of reforming curriculum to meet the needs of students of a culturally diverse society, it has been identified that it requires special working groups for program development, pilot implementation and evaluation of the proposed programs, revision of textbooks on content and pedagogical methods used; changes in personal perceptions and attitudes. It has also been noted that the redesigning of the curricula is necessary due to the ongoing changes taking place across the globe.

Literature indicated that teachers play an important role as they act as the agents who establish relationships between educational practices and processes, aiming for the contextualisation of the national curriculum as education should be seen not as a privilege of the few but a commodity of the vast majority. Teachers should be seen as instrumental in curricular contextualisation; they should place the student in the centre of the educational process, promote diversification of curricular practices in the classroom, and explore and manage the curricular contents.

Investigating the perception of Roma parents of school education, it is obvious that education is not perceived as substantial or applicative for their children but as a way of managing and intervening in a family's everyday life. Despite these issues, most Roma communities recognise that school education is the only possible path to literacy for children and is acknowledged as being essential in modern society to meet the most basic needs like acquiring a drivers' licence, filling in a social security form, and requiring a residence permit.

Controversially, the Roma community believes they have the option to identify the framework of children's education and they should not be obliged to follow academic decisions made externally. Independent behaviour is encouraged at multiple levels of behaviour and is reinforced by an absence of actual boundaries and rules relevant to raising a child placing formal schooling in an opposite position.

Considering that formal mathematics is defined as the exercises and concepts of mathematics dictated by the official educational curriculum and is common across all educational units in Greece informal Mathematics, the daily non-

class experiences of the student, related to mathematics, offer the environment in which informal mathematical knowledge is formed, a knowledge that is a product of the individual's effort to respond to real situations.

Based on the experience acquired over years of teaching Roma students, it has become apparent that the issues lie within the textbooks themselves rather than the students' aptitude of mathematics as these do not form an aspect of their daily routine considering the level of illiteracy among the Roma communities. While mathematics may be a field that can give Roma students the opportunity to have a more active role, the reality is that the prevalence of formal mathematics and the use of formal curricula in general that ignore students' cultural background shows that there is an important responsibility of the education system for the poor performance of students from vulnerable social groups.

Integrating familiar contexts related to Roma students' cultural heritage within the curriculum process should be considered a given as it would promote relevance and direct outcomes. Educators should act as the facilitators of this approach towards curriculum design and teaching methods applied within a class in the efforts to promote cultural inclusiveness and understanding of diversity.

7.6 Summary of the part A

Summarizing the theoretical part of the present dissertation, reference is made to the fact that the researcher has been working for a number of years in a school located in the center of the Roma community. Through this contact with both the students and the Roma community, he observes a series of prejudices and stereotypes that take place even within the school environment, creating negative consequences for the students. In order to investigate the extent of this phenomenon, ie whether it is something that happens locally or if there is a similar phenomenon and in the international literature he makes a broad theoretical analysis which includes issues of culture, identity, racism and prejudice but also issues related to mathematics

pedagogy. It thus appears that Western mathematics is a major factor in categorizing students and creates barriers to successful learning due to their rigorous content which is unrelated to daily life and practice. At the same time, it is observed that research interventions and rhetoric oriented towards intercultural education do not manage to reverse the climate that exists in the school community, with the result that Roma students stay away from school. At the same time, issues of mathematics curricula are raised, which must be treated as dynamically adapted to the evolving reality and the historical present of the respective students. Consequently, the existing trivial research models are considered insufficient because they can not meet the specific research needs that arise. Even qualitative research, critical ethnography, if followed with faith and consistency in its steps, adopts a colonial rhetoric according to which the researcher, taking into account the thorough observations, tries to bring about change in the life of the participants through properly organized interventions. . Therefore, there is a need to review the research methodology and the conceptual framework, both of which are described in the following chapters.

Part B: The research

Chapter 8: Research design

8.0 Summary

This chapter explains that post qualitative inquiry is not a pre-existing humanist social science research methodology with research designs, processes, methods, and practices. It cannot be accommodated by nor is it another version of qualitative research methodology. It refuses method and methodology altogether and begins with post-structuralism, its ontology of immanence, and its description of major philosophical concepts including the nature of being and human being, language, representation, knowledge and truth. Its goal is not to find and represent something that exists in the empirical world of Roma students' lived experience but to reorient thought to experiment and create new forms of thought and life which have the potential to reconceptualise rhizomatically the mathematics curriculum.

8.1 Introduction

Education policy trajectory studies identify practices that were being neoliberalized. Relevant research literature found "curriculum policies as numbers' to be widespread (Dadvand & Cuervo, 2018; Lingard, 2011) and policies driven by the neoliberal politico-economic ideology are believed to have altered the practices of schools in many Western liberal economies. Globalization shapes our present circumstances, the ruthless promotion of standardized assessment, technology, and through them curricular content. Reactions against globalization testify to the pervasiveness of its psychic and political penetration.

In contrast to globalization, "internationalization" is a term Pinar (2014) reserves for the cosmopolitan cause of curriculum studies, the articulation of difference through democratic dialogue among educational communities within and across local and cultural borders. Such conversation requires clarification through questioning of and by educational communities as concepts are understood first on their own terms, then recontextualized according to local circumstances and subjects involved.

The internationalization of curriculum studies encourages “postcolonial” networks that challenge dichotomies such as formal/informal knowledge, theory/practice and epistemology/ontology as we engage each other in complicated conversations not only by multiple languages but by concepts that must be contextualized locally in order to be understood internationally. Politics, culture, and history undoubtedly affect such a complicated conversation (Slapac, 2021).

To enact curriculum, conceived as a subjectively oriented and historically attuned conversation (Aitken & Radford, 2018; Pinar, 2004) means associating academic knowledge with the individual him or herself, teaching not only what is, for instance, historical knowledge, but also suggesting its possible consequences for the individual’s self-formation in the historical present, allowing that knowledge to shape the individual’s coming to social form. Doing so is an elusive and ongoing threading of subjectivity through the social forms and intellectual constructs we discover through study, reanimating our original passions through acting in the world. “What we do in school in the classroom,” Alan Block (2009) suggests, “is to forever pursue lost objects” and “this pursuit and effort is both a personal and a communal obligation”.

The main curriculum question remains the same over the years: What knowledge is of most worth? This question remains unanswered as it is an ongoing pedagogic provocation in which remembrance knowledge matters. Knowledge cannot be replaced with a skill set standardized tests measure and the “global marketplace” presumably employs. Expressing students’ subjectivity through academic knowledge is how the live curriculum may be linked with the planned one, how the learning and teaching process of mathematics in the classroom can speak to the students and how the students will actually gain a voice through their mathematics involvement. In fact, according to Pinar (2004) the future will not be found in front of us at all, but in back of us. Reactivating the past reconstructs the present so we can find the future.

Freire and Habermas reject the notion of objective knowledge since in practice, real conditions can only be used through interactive social interactions. Therefore the production of knowledge is a social process which is impossible to be considered independently of human subjectivity. Freire believes that all knowledge is created through dialogue, while Habermas, based on 'intersubjective consensus within discursive communities' (Walker & Lovat, 2017; Morrow & Torres, 2002; p.54) follows the same logic. Both researchers identify at the center of the research process the human interest and human need for emancipation, the reversal of oppression within society, and fruitful dialogue with themselves and the world.

Having taken into account the relevant literature and the methodological considerations described in the previous chapters, in this section the research strategy will be described in detail. This research is an active critique of neoliberal research which valorizes big data, key performance indicators, evidence-based practice and which seek to discipline and regulate what counts as qualitative research (Taylor, 2016; Childers, 2013). Furthermore, this research disentangles the epistemic codes of 'good old-fashioned qualitative inquiry' (Brinkman, 2015) where human is different from all other creatures, that he acts as a subject. This anthropocentric approach gives the researcher the role to capture and understand these perspectives using traditional qualitative data collection methods and try to give them voice through researcher's empathy (Brinkman, 2015; p. 620).

8.2 The critical research model

Three epistemological approaches in educational research can be identified: positivist, interpretive and critical (Kemmis, 2010). The positivist approach is based on the claim that knowledge exists independently of human subjectivity and thus it suggests preformulated scientific methods (Stinger, 2013). Interpretive approach is based on observation notes and reflective writing as the great sources of data, thus, taking under consideration human subjectivity.

Habermas (1972) criticized both epistemological approaches as human beings are characterized by strong social influences. Humans are complex

and content-dependent beings so both approaches fail to provide detailed explanations in the educational research process, limit knowledge extraction and overlook the fact that knowledge is socially constructed. Habermasian critical theory focused its attention to discover the possibility of a rational society- and emancipation from domination- that could be derived from an idealized reconstruction of implied yet failed processes of reasonable, transparent interactions among participants (Honneth et al, 2019; p.3).

The third epistemological approach, which is the critical research model, assumes that knowledge is socially constructed, contextual and dependent on interpretation. This research model aims at transforming a current situation in order to improve human existence (Avci, 2020; McLaren & Giarelli, 1995) defending that reality should not be taken as a fixed and rigid state. The critical research model allows researchers to search for possibilities oriented toward human emancipation (Avci, 2020).

Critical mathematics education (CME) can be characterized in terms of concerns: to address social exclusion and suppression, to work for social justice, to open new possibilities for students, and to critically address mathematics in all its forms and application. CME claims that mathematics education can be counter hegemonic ; it can promote critical citizenship and justice-based participatory democracy (Avcı, 2018). CME has the potential to democratize classroom life, to transform classrooms into a mathematics learners community and to offer meaning to mathematics teaching and learning.

Skovsmose & Borba (2004) argued that research methodology in CME is inextricably linked to the three situations which are the basis of research practice: the current situation, the arranged situation and the imagined situation. The conceptualization of an alternative reality to that which exists may only be possible through examining the parameters which shape the existing reality (Hughes, 2020) which in turn is shaped through significant intellectual histories. Intellectual histories are prerequisite to understanding our present circumstances. However, in fact, in order to determine these distinct stages, we need a well-formulated epistemological and ontological

perspective. In this direction the ideas of the Habermas and the Freire provide a strong theoretical background for critical research model since it is suitable both as a research methodology and as an educational approach

The reconceptualization of the existing practice in relation to mathematics teaching in schools is not only geopolitical action, it is also a historical. A person cannot grasp “place” unless he knows its history and how it is shaped. Becoming historical means knowing where you are and what time it is. It is an expression of professional ethics in this time of “obsessive contemporality” (Ivor F. Goodson in Pinar, 2004). In contrast to positivist and interpretive approaches, CME argues that education is a political action (Goodchild, 2020; Kemmis et al., 2014). CME research is based upon the theoretical and philosophical background developed by both Habermas and Freire and thus, enhances the internal coherence of the research in terms of epistemology, ontology and methodology (Avci, 2018).

Curriculum studies may have originated in the United States, but in countries with distinctive histories and cultures worldwide its recontextualisation underscores its localized and reconstructed character. The particular remains primary despite globalization and its common denominator: standardization through assessment and technology. Despite this homogenization, the distinctiveness of national history and local cultures continue to inform the curriculum as it is enacted in concrete classrooms in specific cultures, regions, and localities.

These approaches dictate research models that should not have predetermined action plans but should be open to uncertainty.. Originally designed research cycles can create unexpected findings as human subjectivity also plays a role. Critical theoretical approaches reveal that all identities are hybrid, multifaceted and that recognition of the ‘other’—what one is not, one’s difference, so to speak—is always in relation to one’s ‘self’ (Pinar, 1993). And, thus, educational researchers are linked to their participants; the stories of those on the margins are connected with the ones of those at the center; and the lives of teachers are connected with those of their different students. We need to engage in deep self-reflection and analysis so that we

can see not only ourselves more clearly but also recognize how the other is always implicated in the self, in order to see “how one’s own past, present, and future are linked to those of different others and vice versa” (Asher, 2003; p. 238).

8.3 Towards post-qualitative inquiry

Although Skovsmose (2014; p.112) has as standpoint a positivist and naturalistic approach in research methodology for CME, he mentions that just like positivism and naturalism critical research model offers limited possibilities to the researcher while at the same time he supports that epistemological and ontological frames in the research context are potentially harmful to the aims of CME. Skovsmose realizes that the research portrait remains blurred since it is neither clear whether a model can qualify as research methodology when it is not adequately framed from an epistemological and an ontological point of view nor CRM itself presents a coherent and definite philosophical-ideological background. He says (Skovsmose, 2014; p.125) that ‘I have tried to step outside assumptions about the existence of some kind of reliable foundation for becoming critical. However, this brings me into a much more troublesome situation’.

In fact, the theorized methodology that emerged as a response to the neoliberalization of practices during the research work directly slowed down researcher rationality (Savin-Baden, 2020; Stengers, 2005a).[32]Critical mathematics education took shape following the initial period of critique that characterized early ethnomathematics, combining the social justice and political goals of critical mathematics education with the anthropological and cultural knowledge afforded by ethnomathematics. The key idea that is relevant for this research is that critical mathematics education accepts the paradox of ethnomathematics as celebrating local knowledges yet somehow in the process as relegating them to second-class status, as an unavoidable catastrophe of colonialism, and our current geopolitical and sociocultural transnational situation as a particular example of coloniality (Appelbaum,

[32] Critical Ethnomathematics is the term we are using for those forms of ethnomathematics that specifically center their work in addressing coloniality.

Stathopoulou & Xenofontos, 2021, under press). Apparently, post-qualitative research is more affectionate to techniques of postmodernism deconstructionism which authorizes epistemological doubt and interpretive multiplicity and which focuses on writing experimentation (Taylor, 2016).

Foucault said that it is impossible to develop an inviolable way of interpreting the conceptual fruits of a research since these fruits are involved in the activities and in the minds of individuals. Everyday life and spontaneous action is what will give meaning, substance and implications to the research results. So Foucault's work and his thoughts on social phenomena do not provide a methodological tool for analyzing any context but are essentially a canvas that has the potential to support a number of interpretations that remain the unconscious mind of collective thought. Effectively, the process of creating and disseminating knowledge deemed valid, Foucault mentioned, was made exclusionary in the same form in which it was legitimated.

This fact has direct causal relation to the idea of haecceity which “has neither beginning nor end, neither origin nor destination; it is always in the middle” (Deleuze & Guattari, 1987). Such a “middling” though is not an isolated or isolating one, but rather one that is entangled. St Pierre (2011) turns to quantum physics to develop this idea further, using the work of Karen Barad (2007), where Barad suggests that,

“[T]o be entangled is not simply to be intertwined with one another, as in the joining of separate entities, but to lack an independent, self-contained existence. Existence is not an individual affair. Individuals do not pre-exist their interaction” (p. ix).

Self-knowledge requires social knowledge, requires attending to what is happening around as well as in one, knowledge that is simultaneously subjective and historical, as the present is itself never identical with itself, is always the latest wave washed ashore, carrying us away, miles from where we began, miles away from where the wave began (Pinar, 2014).

In that sense researching and writing a research dissertation may occur as a haecceity. There is a binary opposition of researcher as a person and writing

researcher as a verb engaging people, ideas, physical objects etc. that also are (be) coming into being in relation with the writing (Heimans, 2016) . St Pierre (2011) argues that “Much data that we think with when we think about a topic were identified during analysis and not before. Until one begins to think, one cannot know what one will think with. In that sense, data is collected during thinking and, for me, especially during writing (p. 621)”.

Researching and writing as a haecceity[33] –performing, intervening and reflecting- are methodological innovations which could lead to the dis-position of the researcher; interwoven with and emerging from a variety of human and non-human others, upsets and rearranges the existing positions. It focuses on specific ‘actualities’ which shape the sociocultural reality and drawing on them emerges as a response to the neoliberalization of mathematics education as described before (Heimans, 2016).

Qualitative methodology, in order to take into account the personal stories of the people involved in the research, uses data collection and coding methods in order to understand the meaning of the individual's experiences. The humanitarian basis of qualitative methodology - dialogue, voice, empathy, narrative, meaning - aims to rephrase the way in which qualitative research is done and to enable the production of different types of knowledge. Post-qualitative new empiricism gathers together a variety of philosophical orientations characteristic of the ontological turn and my purpose in this section is to provide an introductory overview. Readers should bear in mind that the post-qualitative new empiricist field offers an alternative, divergent, uneven and emergent set of approaches.

Summarizing the section we realize that postqualitative research intends to lead to further innovation, to participate in a new way of thinking or seeing the reality. Research seeks to provide means to produce ideas and make conclusions that run counter to hasty and easy conclusions aimed at categorizing schools, students and teachers. Poverty and sociocultural

[33] **Haecceity** from the Latin haecceitas, which translates as "thisness") is a term from medieval scholastic philosophy, first coined by followers of Duns Scotus to denote a concept that he seems to have originated: the irreducible determination of a thing that makes it this particular thing. Haecceity is a person's or object's thisness, the individualising difference between the concept "a man" and the concept "Socrates" (i.e., a specific person).

diversity are not meant to be associated with stupidity and incompetence offering thus a different view of the existing reality.

8.4 A post-qualitative research paradigm

In contrast to a set of protocols and teaching procedures for qualitative research methodology, post-qualitative research has already managed to both deconstruct parts of humanism that are a problematic inheritance for research and man himself and unpick humanist mastery of the coding and thematizing practices. Qualitative methodology possesses a technique for its application which is based on concepts of tradition and expectations, so that it often defines and regulates what counts as knowledge. So trying to lift social and educational inequalities conventional research creates a new cycle of inequalities that individuals are called upon to deal with.

Post-qualitative research is an intensely political act requiring post-qualitative modes of writing and communication, that is according to Taylor (2016), “writing which shows that the dirt from fieldwork is still under the fingernails, that the data that refused to ‘speak’ has not been left on the shelf, and the meanings that evade the cover story of the ‘finished’ research remain to puncture that smooth and soothing narrative surface” (Senior & Solomon 2013; Holmes 2014; Koro-Ljungberg et al. 2015).

Post Qualitative research is based on the ontological assumption that reality exists in a dynamic relation to the time. Post Qualitative research critiques the static human being as human, situations and interactions are always-already-becoming of entanglement of the human subject with the becoming world (Lather & St. Pierre, 2013; p. 629). Post Qualitative research begins with the assumption that there is no a priori category of human (Malone et al., 2017; p.20).

This assumption offers numerous possibilities of viewing data. Bornedal (2019) notes that there is an irreparable rupture between this present and that past, and we are unable to restore the past with any modicum of sufficient clarity and precision. Memory sinks back and disappears into what Derrida (1997) understands metaphorically as an indeterminable trace where the

relationship with the other is marked in the entire field of entity. The field of entity, before being determined as presence, is structured according to the diverse possibilities of the trace (Epstein, 2019; p. 158).

Derrida (1966, 1970) presented his famous lecture on deconstruction , one of his major philosophical “Structure, Sign and Play in Discourse of the Human Sciences”. Derrida (1990) wrote that “deconstruction is neither a theory nor a philosophy. It is neither a school nor a method. It is not even a discourse, nor an act, nor a practice. It is what happens” (p. 85). Deconstruction as an approach to data is in opposition to positivism where predetermined categories are used to analyze data. Deconstruction is not a method and cannot be transformed into one” (p. 3). For Derrida (1967/1973), a thinker with a method has already decided how to proceed and is simply a functionary of the method, not a thinker. As Derrida (1993/1994) explained, deconstruction is not necessarily intentional—it is what “happens” (p. 89)—and categories like the research process, the interview, the field, data, data collection, and data analysis fell apart (St. Pierre, 2018).

Deconstruction does not reject what it deconstructs but rather it overturns and displaces a structure to create space for something different. In this view, post qualitative inquiry does not reject the conventional humanistic qualitative inquiry as an existing research methodology. Deconstruction rises when “something in the world forces us to think" (Deleuze, 1968/1994; p. 139); when the given, the dogmatic image of thought, no longer suffices (St. Pierre, 2017).

Deconstruction blasts

“all the familiar landmarks of our thought, breaking up all the ordered surfaces and all the planes with which we are accustomed to tame the wild profusion of existing things” (Foucault, 1966/1970, p. xvi).

Post Qualitative inquiry is “useful in deconstruction essentialist representations, interrogating how forces such as colonization and Eurocentrism shape identity and culture, and forging discourses about difference more attuned to the nuances and complexities of present-day

classroom contexts" (Asher, 2003; p.236). The post qualitative inquiry allows for this deconstruction and destabilization in the research process in a way that avoids conclusions and “refuse a dogmatic image of thought’ (Deleuze, 1968/1994, p.143) as “Thought does not need a method. Method is a means by which we avoid going to a particular place, or by which we maintain the option of escaping from it” (Deleuze, 1983; p.110).

Analyzing data through the post qualitative inquiry lenses, offers a potential to explore participants’ narratives as they arise through the lived experience of the mathematics curriculum. Thinking with theory, especially Derrida’s theory of deconstruction, provides the base of the theoretical framework. Barad (2012; p.207) mentions that ‘‘theorizing is a form of experimenting, is about being in touch. What keeps theories alive and lively, is being responsible and responsive to the world’s patternings and murmurings. Doing theory requires being open to the world’s aliveness, allowing oneself to be lured by curiosity, surprise, and wonder”.

Theories are living and breathing reconfigurations of the world’’. Foucault (2000) explained that “What I’ve written is never prescriptive either for me or for others—at most it’s instrumental and tentative” (p. 240) so it is not a mere methodology to be done every time we need basic flexibility elements to make a difference and reshape concepts, make the necessary approaches and do every time we analyze detailed information about the application of a different nature and application.

Research approach as described by Deleuze (1989) as “situations which we no longer know how to react to, in spaces which we no longer know how to describe” (p. xi), promotes the practice of putting theory to work in a move that begins to have sense and way of thinking methodologically and philosophically together that is up to the task (Jackson & Mazzei, 2017). Thus, the methodology stays on the ‘move’ and it is not reduced to simply another way of interpreting findings after data collection. Thinking with theory has already happened and is happening in each “now” of philosophically informed inquiry (St. Pierre, 2011): Thinking with theory is entangled in a space-time assemblage and impossible to extract and individuate.

To follow Deleuzian thought is not only to choose concepts presented by Deleuze & Guattari (like nomadism, rhizome, lines of flight) and to frame these notions with examples from data. Rather, to think with Deleuzian concepts engages with “new processes more than new products to energize new modes of activity that seem to offer a potential to escape or overspill ready-made channelings into the dominant value system” (Manning & Massumi, 2014, p. 87). Theory functions to see how it may get substance in real life situations and opens them up to the new: Theory is responsive, not merely an application or a reflection.

Deconstruction as an approach seeks to bring to the light important deconstructive moments looking for sources of tension and disruption (Derrida, 1997). Instead of looking for the truth of the students about the teaching and learning of mathematics, we focus on the differences and contradictions that exist in their learning experiences. Researching in such a framework, it is taken for granted that students do not have stable and unchanging experiences that can be studied in advance and approached with predetermined steps. In contrast, learning situations and opportunities-mentioned as currere- arise in response to the living reality that students experience.

This living reality is determined by cultural, social, political and historical parameters. Foucault (1983) advises to “refuse what we are” while we are entering into disciplines –like mathematics-, fields –like education- and hierarchies-like student/teacher relation-. He also says (1996; p. 133) that ‘‘A man of knowledge, a man who manipulates various forms of knowledge, who reveals some parts of knowledge and disqualifies others, who moves within this kind of knowledge game. He gets around the problem, to find something that is not a part of knowledge but deserves to be.’’

Use of a diffractive analysis process permits knowledge production through the plurality of theories. The method is affirmative, creative, intuitive and non-representational. Post Qualitative researchers respect non-representational inquiries that move beyond the personal and refrain psychological, psycho-analytical or sociological interpretations that involve reflection on the past

(Koro-Ljungberg 2016; Lather 2016; Patel 2016; St Pierre et al., 2016; Taylor & Hughes 2016; Vannini 2015; Coleman & Ringrose 2013). Diffraction “moves us away from habitual normative readings and accounts grounded in discursive readings that often fail to account for material intra-actions" (Jackson & Mazzei, 2012; p.114).

Curriculum fashions, it has long been noted, are subject to wide pendulum swings (Huddleston, 2018). While this metaphor conveys something of the shifting positions that are constantly occurring in the educational world, according to Huddleston (2018), this phenomenon might best be seen as a stream with several currents, one stronger than others. None ever completely dries up. Huddleston’s view of the curriculum fashions looks like what Barad (2014; p.168) discusses as an ‘earthworm’ which makes compost by ‘turning the soil over and over – ingesting and excreting it, tunnelling through it, burrowing, all means of aerating the soil, allowing oxygen in, opening it up and breathing new life into it’.

Relevant literature research attempts to touch post qualitative inquiry trying to minimize the consequences of applying predetermined stages in research and at the same time give meaning to cultural events. Although these researches are innovative, they do not manage to escape the bond between humanity and the restrictions it imposes on the research process. Some of this questioning has resulted in narrative research (Barone, 2001; Clandinin, 2007; Clandinin & Connelly, 1999, 2000), life history (Cary, 1999; Munro, 1998; Weiler & Middleton, 1999), experimental writing forms (Lincoln, 1997; Richardson, 1997), and performance ethnography (Denzin, 2003; Gannon, 2005; McCall, 2000). Contrary to merely deriving and constructing knowledge, research methodologies enact pre-existing social and material relations that fix its conditions of possibility ((Kumm & Berbary, 2018; Foucault, 1972). Preoccupied with the “how” of the research methodology, researchers blind themselves to methodological processes that preload, pre-authorize, and predetermine knowledge production (Kumm & Berbary, 2018).

Post qualitative inquiry often receives strong critique because it is suggested both to lack concrete analysis of data and to fail to identify desired outcome at

the end of the research. These critiques start from the positivist perspective where valuable knowledge developed by a research methodology is equal to science. In that sense, a researcher possesses power because he studies within a specific context as a colonialist. He enters the field of study with predetermined study techniques and draws conclusions concerning the subjects of the research. The strength of the post qualitative inquiry lies in the philosophical foundations of flattened ontology as living and thinking happens synchronously.

Post Qualitative research attempts to move in a highly dynamic context characterized by less stable and dogmatic a priori designs. In no case does it aim to create a new, better or more accurate methodology but instead aims to create space for alternative forms of emotion, thought and action in a framework of rapidly changing socially subjective contexts that give different dimensions to evolving research. Post Qualitative research seeks to maintain its methodological pace in relation to the social theory that allows a radically different epistemological approach from that of humanity (Kumm and Berbary, 2018).

According to Kumm and Berbary (2018) flattened onto-epistemology abandons the vertical and hierarchical, “tree of knowledge,” with its root-trunk-branch-twig structure of humanist research. This tree is less a metaphor and more an “image of thought,” which can be defined as a spatial “system of coordinates, dynamisms, orientations: what it means to think, and to orient oneself in thought (Deleuze, 1997; p. 148). The epistemology of post qualitative research abandons the model of the beautiful hierarchical tree of knowledge that has humanitarian roots, branches and fruits. However, the trunk may be built on a well-established and ingrained knowledge, but the branches are spreading in different directions. Flattened-on-epistemology refuses arborescent structure, relying, instead, on other images of thought (Kumm & Berbary, 2018).

Deleuze and Guattari (1987) refer to the concept of rhizomatic thinking. Rhizomatic thinking is compatible with Derrida’s theory of deconstruction. Kumm & Berbary (2018) state that “the image of rhizome is a subterranean

network of tuberous growth that puts up propitious shoots, strangling “the roots of the infamous tree” (Massumi, 1987; p. xii)”. A rhizomatic network allows a non-hierarchical multiplicity of dimensions; it has neither beginning nor end, but it is always located a nomadic middle: “The rhizome is altogether different, a map and not a tracing. The map is open and connectable in all of its dimensions; it is detachable, reversible, susceptible to constant modification” (Deleuze & Guattari, 1987, p. 12).

Johansson (2015) notes that “Rhizome is a concept of becoming, that contrasts the metaphor of a book. In comparison to a book, the rhizome does not contain any blood of life, no roots below and branches above the ground. Instead, as this research has done, the rhizome moves in many different directions simultaneously. Thus, the rhizome lacks both core and origin, but also aims and goals. Although the rhizome is growing, the figure is neither about growth nor about development or progression. It is instead defined by its inherent possibilities to create new, unforeseen territories. The rhizome is constituted by different kinds of openings which make the figure embedded with uncertainties since it always contains aspects impossible to imagine”.

The mathematics curriculum is treated in modern education as a mirror of our intentions and goals. On the contrary, through the eyes of post qualitative research, the curriculum is a failed representation of the desperate efforts of educational researchers to capture topics and turn them into useful and validate knowledge. The logic on which the structure of mathematics curricula is based is the Cartesian approach of the mind where education is the product of the division of the interior from the outside. The researcher in this perspective has a dominant knowledge of the student's world and seeks to impose a change on that world. It thus creates arbitrary distinctions between subject and object.

In today's educational reality, teachers are called upon to record in advance the learning objectives and steps they will take to achieve it, and they are asked to evaluate this educational process in terms of whether they have succeeded or deviated from those objectives. In the light of translational research, this logic is the definition of passive teaching and learning. Such a

mathematics curriculum needs to be deconstructed. This deconstruction can be done when the curriculum is treated as a temporary possible proposal, a reality that emerges in a way beyond our control without frames, but in the mix of various tracings on a map of possibilities (Deleuze & Guattari, 1987). Current research removes its focus from the advantages and the constraints that exist and interact with students, add, subtract, change, challenge, disrupt, and complicate mathematical reality. Reconceptualized mathematics curriculum is written neither on a “butchers’ paper that reminds us of the pedagogies of the slaughterhouse (Pedersen, 2013), nor on an immigrant paper that has come on a ship from London as packing material, yellowed by window sun” (McKnight et al., 2017).

8.5 Post Qualitative inquiry approach

The post-qualitative inquiry is the research approach which is used to explore the accounts of Roma students that follow primary school mathematics classes. This research focuses on the use of deconstruction theory. Deconstruction identifies and highlights data that will lead to the reshaping of the mathematics curriculum, incorporating, with critical critique, political, cultural and historical elements that will highlight discourse on how students conceive mathematics through their lived experience. Along with this understanding of the mathematics curriculum, a number of directions are developed that give meaning to the learning process and enrich the children's mathematical experiences.

The concept of taking action through critical thought is developed by Freire and it is called conscientization (Freire, 1963; p. 97-113) . A definition developed in the field of psychology is that it is the complex and liberating “mobilization of consciousness aiming to produce critical historical knowledge about oneself, and about the groups to which one belongs, thereby producing a new understanding and giving sense to one’s temporal and spatial place in society, from one’s specific life-world” (Montero, 2009, pp. 72–73). Post Qualitative inquiry permits viewing students’ accounts through investigating how students’ accounts for their learning experiences, competing forces and interests permit us to build alternative forms of mathematical knowledge if the

curriculum could be more committed to their cultural, historical and political contexts, which is the first dimension of the fundamental research question. Moreover, the post qualitative paradigm examines how the application of students' lived experiences by using cultural and historical rhizomatic systems make mathematical teaching and learning processes more admissible, applicable and purposeful, which is the second dimension of the main research question.

Post Qualitative research is a roll of the conceptual dice, and this constitutes the pedagogy of the concept which cannot be determined in advance (Deleuze & Guattari, 1994). We can never know in advance what someone will learn, or think, or do in response to the concept. "The same pedagogical status of the concept can be found everywhere … The concept is the contour, the configuration, the constellation of an event to come" (p. 28). In this research pedagogy is an incorporeal sense event actualized through the bodily experience of teaching and learning. Pedagogies move like storms over the landscape, precipitating the experiences of teachers and learners, then moving on or drying out, increasing or decreasing in intensity (McKnight et al., 2017). The mathematics curriculum which suffers from a lack of predetermination and goal details, is offset by immediacy of actualization. The roll of the pedagogical dice makes the decision instant.

Researching through post qualitative inquiry lenses offers the possibility to study specific oppressive elements like race and class without reproducing what is already known. Post-coding analysis functions like a rhizomatic analysis and permits to view the way in which experiences are materialized rather than on how they functioned (Jackson & Mazzei, 2013). In mathematics, when a specific concept is approached in a rhizomatic way, it migrates out of the purely mathematical semantic field and crosses into other regions, where it connects up with sociocultural concepts, losing its disciplinary content and revealing itself as an aspect of lived experience (Kennedy, 2012). Fixed concepts that inform the mathematics curriculum, according to Kennedy (2012), "once their solemn aura of univocity is dispersed, become tools for interrogating the curriculum itself as a knowledge

system--for demystifying it, for problematizing it, and for transforming it in the image of their connections and correspondences".

Following Deleuze and Guattari philosophical thoughts, this research does not follows or produces any method itself, but through “transcendental empiricism” whose function is to picture the “conditions for the production of novelty” (Deleuze, 2002), we propose an approach which is critical and beneficial in creating data (Deleuze, 2001). In that approach sense-data are no longer to be taken as the fundamental givens of empiricism, but as transcendental singularities which structurally define and actualize themselves (Deleuze, 1990; p. 103).

Although transcendental empiricism is perceived as a paradox, in our research it offers possibilities to overcome shortcomings of both the transcendent and the empirical (Margarit, 2012). It creates spaces for abolishing dichotomies between formal and informal mathematics knowledge and highlights, thus, conditions that make experiences possible. Johansson (2015) states that “it is not the experiences as such that are of interest according to Deleuze, but rather the virtual conditions that actualize them.

When assemblages connect to each other through lines of becoming on the plane of immanence, the virtual, or the already-existing, becomes actualized. In that sense, the plane of immanence always contains aspects of the not-yet-seen. Transcendental empiricism thus creates a map of the plane of immanence through what is empirically actualized”. In our point of view, transcendental empiricism draws attention to how students’ disconnected experiences can be used in order to reach an understanding of how these lived experiences can become a rhizomatic path toward breaking binaries between researching and teaching.

8.6 Post Qualitative research strategies

Research literature coming from the post qualitative paradigm is increasingly critical of “conventional humanist qualitative methodology” (St. Pierre, 2016; p. 2) because onto-epistemology is limited to a simple methodology. Combining conventional qualitative methods with post qualitative inquiry, according to St.

Pierre (2015, 2016), “is onto-epistemically incommensurable just as Foucauldian genealogy would be at odds with a positivist paradigm”. As Foucault (1981/1991) explained, “And if I don’t ever say what must be done, it is not because I believe that there’s nothing to be done; on the contrary, it is because I think that there are a thousand things to do, to invent, to forge” (p. 174).

One of the most difficult and particularly important innovations of post-quality research is to disengage with hierarchical ontological heritage and to accept it in the logic of flattened ontology. This creates a great deal of stress as research seeks to portray humans along with a continuum of matter without complete agency. Deleuze and Guattarri report, however, that the researcher never actually had complete control over humanitarian projects to improve collective existence.

Post-qualitative research seeks to upgrade the state of essentiality (Bennett, 2010) which consists of the process of learning and understanding mathematics by Roma students. Although the basic methodological question when we consider the reformulation of mathematics curricula remains how, the answer is not so simple as we seek to design our own projects with special attention to real-life problems and existing theories, inventing approaches that will act as intra-active agents and forces in becoming.

The epistemology of processing research is certainly influenced by the ontological view mentioned above. Classic view of epistemology involves concepts of being and knowing which are treated as cultural reality, static and immovable realities. Presentation metaphorical research focuses on process, existence and meaning. Researcheris not limited to describing what, how and why research, but researcher is interested in sharing a picture of the whole vital process that is moving, evolving and resisting the charm of finality. It is not possible to propose a new curriculum for mathematics if we do not consider the reality in which it is formed.

Post-qualitative research rejects theory as a priori required for the research process. Although the theory is valuable and used at every stage of the research, the crucial difference is that this theory no longer comes to confirm

and legitimize the data, analysis, findings and subjectivity that emerge through the research process, but Theory is an action functional dimension of research that is influenced and influenced by the other elements that exist. Just as individual elements (for example the role of the researcher, the participants, the research context, etc.) are not considered immobile but help the study, so theory affects and is influenced by the whole process.

Regarding the research methodology that is followed, we refuse any attachment to given and traced concepts of methodology since each new problem is different and it is not possible to deal with it with the same old tools that you have. We invest in the practice of "deliberate imprecision" (Le Grange, 2018; Law, 2004), which is able to open new horizons and “keep the researcher alive to change and chance, to …new twists and turns of direction and focus” (Dewsbury, 2010, p. 324). At each stage we imagine creatively methodological possibilities to follow the research that takes place in an unknown territory while we rediscover approaches.

At the same time, the post-qualitative shift of the research does not dictate any form of data collection but aims to highlight the way in which this data is displayed and that within the research situations existing cultural capital is expanded in a way that becomes evident and valuable . The highlighting of the data is not unequivocal and irreversible, but it offers a new understanding of the situation and a shift in research focus. Deleuze and Guattari (2011) described this as a cartographic endeavor, a highly experimental and risky enterprise that transforms. Thinking with the theory of deconstruction is a conceivable weapon to identify data and answer research questions. Deconstructive moments with students produce an understanding of the multiple forces, intensities, and interests of their student and learning profile. Linking these deconstructive moments to the theoretical –cultural, historical and political- rhizomatic system helped create new knowledge.

The research is not leveling in terms of developing conclusions that apply to all participants but show more dimensions of living experiences, differences in way of thinking and living. Kumm and Berbary (2018) mention that “post-inquiry, as becoming, is often left open-ended or spilling over. As we have

tried to articulate, post-inquiry works by adding, rather than subtracting; broadening rather than narrowing; and by connections that potentially open, augment, or expand how we think, feel, and live. When it works, inquiry is performative, active, and engaging. But there is no point of saturating, completing, or exhausting the project, even though a researcher may feel herself, particularly exhausted. Instead, one reaches an edge that cannot be breached, one runs out of space or opens space just enough to move on, reaching a plateau and walking away". St Pierre (1997) mentions that writing in such a research is a method of inquiry which pays attention to both the process and the products of it. Writing this research in not only inscription but also discovery.

Deleuze and Guattari (1980/1987) use another concept of subjectivity to trouble the concept and the field. They suggest that a nomad "operates in an open space through which things-flows are distributed rather than plotting out a closed space for linear and solid things" (p. 361). In fact, St. Pierre (1997) affirms that "nomads deterritorialize space that has been territorialized, charted, ordered, and then shut down. Nomads search for mobile arrangements of space where thought can settle for a time and then multiply and recombine, always displacing the sedentary and unified". A researcher who practices nomadic inquiry, an "itinerant" (Deleuze & Guattari, 1980/1987, p. 373) science, can never be sure of the field and thus has trouble locating it because "deterritorialization constitutes and extends the territory itself" (Deleuze & Guattari, 1980/1987, p. 372). The field grows; it erupts in some strange, new place; it refuses to be coded; and it advantageously invents itself outside interiority (St. Pierre, 1997).

My involvement in the work of nomadic subjectivity is motivated by the belief that in an age of strong globalization and technological change, individual ways of thinking and human habits are becoming obsolete. In such an age where mathematics is considered a global language and gatekeeper for social success and flattens individual cultural contexts, post qualitative research is a starting point for conceptual creativity and theoretical courage that will bring reversal of current attitudes concerning Roma children and mathematics. Virginia Woolf in the novel "Waves" says "I am rooted but I flow". Although

Delueze and Guattari (1987; p.499) caution against the proliferation of research models, as a researcher I accept the need to make the research process understandable, intelligible and accessible presenting research's strategic practices below in a similar way to St. Pierre (2018).

8.6.1 Read and read and read

St. Pierre (2016; p. 106) advises new post qualitative researchers to start by deeply engaging reading. As a researcher I have understood that the relevant theory of intercultural education and pedagogy of mathematics does not make sense unless adapted in a real-life context where theory and data constitute one another. Consequently, theory should be read alongside with study of students' reality. My point is in unison with Pinar's view (1975) that "the applied character of curriculum studies can be strengthened by systematic attention to the field's intellectual history and present circumstances"

Roma schools are geographically located in degraded areas of Athens. The school where this research has been conducted for many years did not exist on maps such as Google Maps and its mailing address was 'anonymous street'. When a teacher is placed in such a school, his first and foremost concern is to be able to move to another work environment, citing important personal reasons. These two dimensions have defined for me from the beginning that my work experience in a school with Roma students will be a challenge and at the same time a milestone in my career as a teacher.

From the very first day I tried to get to school, I was faced with a strong reality. While I was just a block away from the school, I asked for information from school-age children on the street about their neighborhood school and they either gave me the wrong instructions or told me that there was no school here. As I finally arrived at the school, talking to the principal, I received the obvious interpretation of the situation that "the children here do not know where they are and who they are". This initial experience has made it clear to me that the learning process requires constant attention that is intellectually advanced, capable of deciphering the complexity of the problem it seeks to approach. Instead of interpreting what we live in a humanist way, I have

argued that study is the site of education, study is a more appropriate term for understanding Roma children educational experiences, as it incorporates questions of agency and volition, interest and curiosity as well as interpellation and knowledge acquisition (Pinar, 1975).

As a teacher, I have worked with the Roma students' population for eleven years. I have been immersed in the schools, home, and community in which the research took place. In addition to studying the theory, it is necessary to study the experiences, cultural, historical and political contexts of the Roma community of students. It seemed very strange to me that clever children who are able to deal with real-life cases cannot describe where their school is located. These experiences influenced my decision to use a post-qualitative inquiry which proposes to pay attention to events and particles which both attest to our 'raw partiality' as researchers in initially selecting them as objects of attention, and forgo the pretense of 'purification and cleaning' that transform experience and events into 'data' (Ljunberg et al., 2015).

After ten years in the Roma community, themes and patterns have emerged while studying the rhizomatic system in which Roma students can learn mathematics connecting students' voices-as human- and things –non-human social, historical and political contexts-. Roma students and their families are very interested in school. They treat the school as a vehicle that will enable their children to escape the economic and social problems they face today. At the same time, however, they believe that school is a place where social inequalities are reproduced and where their children are confronted with an educational culture that considers them culturally inferior. As a result, Roma students do not develop interpersonal relationships with their teachers, trust relationships are rare, and there is a floating suspicion in the school environment that negatively affects the entire educational process. This suspicion is expressed in cases of violence, schooling and denial.

Indeed, during the founding of the proposal for my doctoral dissertation, some research attempts were made to portray the field to be studied. During certain teaching hours in mathematics, as a teacher and researcher, they also tried to listen to the different mathematical practices of Roma students. The following

week, during these meetings with the students, the department was emptied of students. Roma children stopped coming to school even though they did not experience negative emotions but through a discussion they talked about how they deal with mathematics in their daily lives.

The reason for that was that their parents thought that this 'interview' was about examining students' knowledge in order to make a report to social welfare. It was then realized that it is impossible to conduct research if the bonds between teacher-researcher, students and parents are not strengthened. Rhizome researcher embed himself in the lives of their students in order to have the freedom to follow lines of flight and seeks to break free from objectifying people as he considers himself rhizomatically embedded to the students'. As a researcher, I did not try to identify how Roma students could overcome oppressive elements, but I aimed to see the difference as positive 'data creator' and not as lack.

In order to achieve this, I developed in the first years of my work in this school, special interpersonal relationships with the Roma community. After all, trusting relationships do not strengthen in a short period of time, but they acquire substance in relation to time. The culmination of building trust was that I became the godfather of two Roma students. This event was very important for the Roma because they felt accepted and accepted a school teacher to formalize the existing interpersonal relationships. The role of the godfather is very important in the Roma community both because the parents trust their child in the godfather and because it follows an open celebration in the community that calls for any possible remnants of racist treatment. Rhizome researcher develops sensitivities to the aspects and people that are not part of the status quo in an action of deterritorialization.

8.6.2 Writing to the bone

Following St. Pierre (2016), I come to suggest that thinking within Deleuze and Guattarri's ontology; writing should be conceived as a form of thinking rather than a form of representation. St. Pierre (2016; p. 2) states ``I would argue that it is in writing, in putting words together (or not), that I first

understand I cannot ‘apply’ or use a concept from one ontology in a different ontology”. It is in writing that I begin to get ideas in my bones [when words and things ‘seep into one another’ (Deleuze, 1986/1988, p. 33). In this way, I become interested in language, and for Deleuze language is on the same flattened ontological plane as a galloping horse, the color red, a representation of a bird, the concept of justice, and five-o’clock-in-the-afternoon. Acknowledging that writing is an empirical application shifts educational research from its recent attachment to the social sciences to its older attachment to philosophy and literature”.

As a researcher, I realized that the theoretical issues portrayed above as a rhizomatic system, should be addressed through direct creative engagement to the research field rather than as a discursive reasoning. The text is approached as a creative space and the theoretical framework functions as an 'attractor' which helps us to think hard to orient ourselves to the possibilities of the text (Hanley, 2018). St. Pierre (2017) wrote that “it is in writing that I begin to get ideas in my bones…in this way, I become in language”. The theoretical chapters of the dissertation as they were formed functioned as a driving force that on the one hand emphasizes the internal coherence that exists in the part of the theoretical framework which is a formulating power of the terrain of my researcher being and on the other highlights a dissolving territory since it is not able to bring about the desired change in teaching and learning mathematics with Roma students.

This conceptual “seepage” (Deleuze, 1986/1988) of the theoretical background made me think with theory methodologically and philosophically together (Jackson & Mazzei, 2013). St. Pierre and Jackson (2014) noted that thinking with theory is difficult, and not something that can be scripted; rather, it is something that is “put to work in a particular project” (p. 717). This ‘seepage’ has made me write inventively in order to undo the presumption of objectivity. The Post Qualitative paradigm recognizes the partiality of our knowledge, acknowledges that which is beyond profound interpretation, and appreciates our situatedness and uncertainty (Taylor, 2016).

As the study focuses on the relationship that Roma students have with mathematics, we observe that the situation remains stagnant and there are no signs of improvement despite the interventions made. Along with my role as a teacher at the school where Roma students studied, I had also taken on the position of educational collaborator in a program at the University of Athens on Roma student education. My contact in this part of the program with Roma students attending other schools, made me realize that the educational interventions made by specialists do not bring positive results in the field of mathematics, in contrast to the improvements observed in the field of learning the Greek language. How is it possible for an educational program based on the pillars of intercultural education to fail in the field of mathematics education of the Roma?

Intercultural education fails to de-center the human in order to recognize the agency of the non-human influencing factors. It is based on the binary representational logics on which the Cartesian knowing subject and his knowledge-making practices rest. Post Qualitative paradigm displaces these views which “posit ‘truth about’ and ‘power over’ by forms of immanent, embodied and embedded knowing-in-being which better attend to indeterminacy, excess, flow, dynamics, multiplicity and happenstance” (Taylor, 2016; p.3).

Post Qualitative research inquiry does not focus on identifying the truth of the students but aims to highlight the views of the students during the interpretation of the individual mathematical situations. The following data is examined in conjunction with the theory and new connections and combinations are created that expand the cognitive basis of mathematics teaching. Following Jackson’s and Mazzei’s (2012, p. 5) proposal, current research “is deliberate and transparent in what analytical questions are made possible by a specific theoretical concept and how the questions that we used to think with did not precede our analytic practice (as research questions might) but emerged in the middle of “plugging in”.

The purpose of the research is to create new discourse about the experiences of Roma students which may be related to mathematics and are powerful

enough to turn the obsolete mathematics curriculum into a vivid currere which will give new impetus to the whole learning process. Taguchi (2016; p. 213) uses “concept as a method” recognizing that researchers, data, discourses, and institutionalized practices all “transverse each other” and can uncover new realities.

8.6.3 Living theory into the field of experimentation

As a rhizome researcher, I search for research aspects that are sometimes ignored. Practically, this means that while writing the dissertation, the topics selected in advance for the research are less specified and are not placed in chronological order. They are shaped by coursework, school and community interactions and reading. The adoption of this strategy accepts data that does not fall within the scope of application and moves the researcher in rhizomatic directions, highlighting connections that seem unlikely.

Writing a research with post qualitative inquiry challenges the standard way of writing a doctoral dissertation and strict schedules, however it leaves a wide margin of creativity that will positively complicate research paths and ultimately highlight new mathematical concepts. Disrupting “when” and “how” this work occurs—refusing it as a stage in a procedure and using it as the process itself (Jackson & Mazzei, 2012; p. 5) Rhizome research experience is a desire for becoming rather than copying what is seen.

The readiness, creativity and familiarity to deal with research findings and the freedom to manage them as they see fit create the feeling that every day in the field of research contains new opportunities. A researcher following a qualitative research strategy remains committed to specific teaching standards and established study program paths, having a constant anxiety about whether he is satisfied with what he has done. Placing research within a rhizomatic path, the conversational act of resurrecting pedagogical ideas becomes a revitalized educational possibility (Sellers, 2015).

These reflections on the experience lead me to conclude that ad hoc application of theory at the end of a study is definitely inadequate. While reading and writing, I was becoming capable of new ways of analyzing

because of a world with different and new possibilities. Deleuze and Parnett (1996) described an aleatory practice of “being on the lookout” for “jolts and disturbances by a thought or idea emerging from various encounters” (McCoy, 2012, p. 763 in St. Pierre, 2018).

“A season, a winter, a summer, an hour, a date . . .are haecceities in the sense that they consist entirely of relations of movement and rest between molecules or particles, capacities to affect and be affected” (Deleuze & Guattari, 1987, p. 261). Starting the research process with a few specific mathematical activities that in any case were based on the life of Roma students, I was faced with unpredictable extensions, unexplored dimensions and impressive meanings that determined my next steps.

Charteris et al. (2019) propose w-e (the noun “w-e” is a proxy for the authorless singularity of “writing-and-experimenting collective”) embark upon relations and senses embedded and connected to the (data) making processes and thisness, which may be called “data haecceity” (see also St Pierre, 2017). They continue (p.2) that “W-e lived haecceity without a proper “we.” W-e created a season, a collective of data words, data energy, feelings, and ideas that span space and time and moves, still. The beginning of this event was a moment in time when all that had come before, and all that would come after, were placed within a specific material arrangement that was made to matter more (Barad, 2007)”.

8.7 Research setting and participants

The data sources of this post qualitative research were the 3rd grade Roma students enrolled in and attending school education at the 23rd Primary School of Acharnes in Athens. The choice of the 3rd grade Primary School students was made because the students had already developed a school mathematics learner profile after having been in contact with mathematics for two school years.

The Municipality of Acharnes occupies a significant part of the prefecture of Attica both in terms of area and population. The area is 146,406 acres and the population based on temporary census data / population of 1991, amounts to

61,352 people. However, the permanent residents of the municipality are many more. The population of the Municipality is currently estimated at 120,000. Indicative is the fact that according to data from PPC and the Municipality, there are about 35,000 households. It should be noted that between the years 1961 - 1991, the population growth was 263.9% compared to 71.2% of the population of the Prefecture of Attica (source: ESYE censuses). It is noteworthy that the population growth in the Municipality continues at a significant pace, which is due to a number of factors such as:

- The establishment of a significant number of returning Pontians from countries of the former Soviet Union, repatriated political refugees, etc. (The number of returnees in the area is estimated at about 40,000).
- The projects were planned in view of the organization of the 2004 Olympic Games, as well as the development projects in the area, which will offer several jobs.

Regarding the population composition, it should be noted that the Municipality of Acharnes has always accepted mainly low economic strata, generally workers and manual workers. Today, the problem is exacerbated by the influx of returnees from the former Soviet republics and the permanent installation of gypsies in shacks. Unemployment shows explosive growth trends, with direct consequences on the social behavior of residents.

The educational level of the inhabitants of the Municipality is one of the lowest that is observed in the Attica Basin. According to the 1991 census only 6.4% of the population has or is going to receive higher education, 18.3% has completed secondary education, 13.5% of the population has completed it high school, 42.0% are primary school graduates while 19.7% of the population or not finish elementary school, or are illiterate.

Drawing on the above information from the official website of the municipality of Acharnes but also from a demographic survey of the University of Athens regarding the educational level of the residents of the municipalities of Attica, I am negatively impressed since I notice that the Roma population living in the area is not mentioned. It is necessary to note at this point that the Municipality

of Acharnes, as well as the neighboring municipality of Ano Liosia, are the two municipalities where the Roma first and foremost live in Attica.

The old Greek inhabitants of Acharnes, started several years ago to sell to the Roma degraded pieces of land at low prices, plots which were located in areas where they were flooded by the winter torrents of Mount Parnitha. At the same time, as we have already mentioned in a previous section, the central state systematically seeks to transfer these minority populations to areas outside the urban centers in order to keep them isolated. As a result, the Municipality of Acharnes has a huge number of Roma residents who have increased its population. Of course, this valid historical reality does not have enough glamour to be mentioned on the official website of the municipality, so the officials preferred to hide even the term Roma from their demographic data.

8.8 Data 'collection' process

In Deleuzian terms, the rational, linear and 'arborescent' nature of the development of the concept mapping field from its roots, as provided by Ausubel, may now be perceived as a 'hegemonic cultural model' (Kinchin, 2020) with consistent negative impacts on Roma children education. Thus, in this research, concept mapping of the 'rhizome' has become a powerful tool to enhance Roma children's interaction with the process of learning mathematics. Snir (2018; p. 302) mentions that "the problem for Deleuze lies in the imperialism of common sense, in the way it takes over thought and action, casting them in conformist patterns…even when trying to be critical, common sense thought in fact reaffirms and reproduces the prevailing political order and the meanings it assigns to subjects and objects".

From its very first stages, it was confronted with two basic common sense pylons that strongly shape the education of Roma students. The first pylon is related to the fact that Roma are happy with their way of life and therefore do not consider education and school in this case important to them, while the second one is the perception that Roma students are very good at math because they can easily manage practical day-to-day transactions. It was

undoubtedly identified that the research should cover various discursive plateaus in order to uncover the existing multiplicities that construct the mathematics rhizome itself.

In order this to be realized, the research writing process was approached as an explanation of travel through the rhizome where according to (Rajchman, 2001; p.21) “there are different conceptual ‘bits’, each initially introduced in relation to a particular problem, then reintroduced into new contexts, seen from new perspectives. The coherence among the various bits shifts from one work to the next as new concepts are added, fresh problems addressed; it is not given by ‘logical consistency’ among propositions, but rather by the ‘series’ or ‘plateaus’ into which the conceptual pieces enter or settle along the web of their interrelations”.

When starting to read post-structural theories, I have realized that “old words do not work anymore. Derrida wrote that when you use a concept you bring with it the entire structure in which it is thinkable…What is particularly helpful in Deleuze and Guatttari’s work is that they have given us lots of new concepts that are not embedded in humanist epistemologies and ontologies" (Guttorm et al., 2015; 15). This opens up two separate implications for our research.

On the one hand, we discover that rhizome has the potential to inspire researchers and students while realizing the interconnectivity within the curriculum (Tillmanns, 2014), and on the other that these rhizomatic assemblages are made up of messy bundles of lines and have emergent properties modified by interactions along lines. Although it is not our intention to provide a strict framework for a reconceptualized mathematics curriculum as this would have been an anti-Deleuzian perspective of the research, we explore that while exploring mathematics multiplicities with Roma children, these are constantly transforming as a process of becoming which can be recorded as through the process of tracing. Tracing multiplicities is a first step towards research writing as haecceity and may be translated onto a mapping of the lines of flight which divert the process of becoming.

The importance of providing feedback on students' maps is emphasized by Kinchin (2020). In our case, because we do not aim to build a vertical connection between the concepts related to the mathematics curriculum but rather a rhizomatic approach, we intentionally do not choose to provide specific feedback to students as it would be subject to the constraints of positivism and conventional humanism research methodology. Instead, we seek to rely on discursive plateaus as highlighted by students and thus structure the next lines of flight without having predetermined the content or structure of the mathematics curriculum.

8.9 Trustworthiness and validity

Trying to describe reliability in a post-qualitative study requires a review of the fundamental assumptions associated with a study of this kind. Of course, it should be noted that the validity and reliability of a research are conditions that are subject to a research method dictated by the positive movement and attachment to the idea of humanity. The goal of such positivist research is neutrality and objectivity in research methodology. In contrast, manufacturing research aims to verify.

The post qualitative research seeks to "test the limits of our knowledge" "by using thinking with theory (Jackson & Mazzei, 2012). Thinking with deconstruction as the theoretical framework for teaching and learning mathematics with Roma students permitted me to work within and against interpretivism during data analysis. As I analyzed data, the processes of folding and flattening, and plugging data into theory allowed me to skip the limits of humanism (Pederson, 2020). While the ongoing development of CL has given rise to a great variety of theoretical and pedagogical applications, all of these approaches share the goal of developing what Freire (1970) called a 'critical consciousness' through a pedagogy of situated dialogic inquiry for the purposes of educating citizens capable of participating in a democratic political system for the purposes of increased social justice and social agency (Luke, 2012).

Freire theorized that all traditional models of literacy do not contribute to the development of students a dialectical relationship between knowledge of ideology, culture and power contained in texts and other forms of funding such as representations of real life. Indeed, as in the case of Roma students, the autonomous concept of literacy is not able to place the knowledge acquired within the distinct structures of the school in order to determine whether specific groups of people will benefit from this knowledge. According to Freire, this critique of the social inadequacies of traditional forms of planning requires simultaneous 'reading the word and the world' or the situation of received knowledge within the discursive nature of a society in order to be truly literate (Freire & Macedo, 1987). Freire's (1970) definition of literacy as 'reading the word and the world' was used to create a pedagogical space in the classroom that required 3rd grade Roma students to situate and critique mathematics knowledge, texts, and discourses dialogically in order to represent and reform knowledge in ways that could enhance their social agency and transform the material conditions of their social worlds (Beach & Myers, 2001).

In order to ensure the reliability, the researcher-teacher carried out prolonged participation and persistent observation in the field, thinking with deconstruction theory while data happened in everyday life ("slice-of-life" data items). Triangulation of data was achieved by using information from at least two different sources (so that the data obtained from each source overlapped), to deepen its understanding and maximize its confidence in the results of the qualitative study. In terms of transferability, the collection of detailed descriptive data helped the researcher-teacher to present a complete description of the framework (thick description of the context), design decisions and research results.

In order to ensure the validity of the research process, the researcher-teacher maintained a research reflective diary throughout the research, used triangulation of the data (overlapping data), and used the discussions with the critical friends to examine the analysis and interpretation of results. The same strategies were used by the researcher-teacher to ensure the confirmation of the research process. That is, the researcher-teacher maintained a research diary throughout the research by enhancing the reflective process, conducted

discussions with critical friends, and used triangulation of data to identify subjectivity in the data through reflection.

Social validity is an important parameter for designing and implementing an educational program. Specifically, it studies whether the curriculum is important and meaningful for students. Social validity focuses on the acceptance of teaching objectives and teaching methods, as well as the importance and social acceptance of behavior that has changed through the implementation of the educational program (Spooner & Brown, 2011). In this context, in order to ensure the social validity of an educational program, data related to the selection of objectives, the process and the results of the educational program need to be collected.

To achieve social validity, the researcher-teacher collaborated with students and their community. More specifically, students guided the way in which the mathematical issues on which the research focuses were highlighted. The individual mathematical topics were highlighted through the needs and dimensions that the students offered in the educational process. Students and their community recognized the social usefulness of mathematics learning, highlighting the importance of linking the educational process with the socio-cultural context of students.

8.10 Ethical considerations

Regarding ethical issues, it is necessary to make a substantiated and thorough reference to the following:

a) ensuring the conscious consent of the participants in the research or of the parents / guardians of the students, when the research is addressed to minor students,

b) ensuring the anonymity of the participants in the investigation and the protection, in accordance with current legislation, of their sensitive personal data;

c) the provision of the possibility for the participants in the research to terminate their participation at any stage of its conduct;

d) the protection of research participants from exposure to potential physical or psychological danger, or suffering or other adverse effects on themselves and their loved ones in the context of their participation in the research process.

In particular, with regard to ensuring the conscious consent of the participants in the research or of the parents and guardians of the students, when the research is aimed at underage students, the researcher is obliged to ensure that all participants (parents / guardians, students and teachers) in the research fully understand:

1) the purposes of the research,

2) the process in which they are to be involved,

3) the reasons why their participation is necessary,

4) the optional nature of their participation

5) their ability to leave at any stage of the investigation.

In order to ensure the conscious consent of the research participants, the researcher writes a relevant letter, which he incorporates in the detailed research plan. In cases where the research is addressed to minor students, the consent of the parents and their guardians is required. The letter of information and securing the consent of the participants in the research is a necessary document for the opinion process from the institute of educational policy.

In addition to the formal part of securing, through a letter, the conscious consent of the participants in the research or of the parents and guardians of the minor students, it is necessary for the researcher to take care of the harmonization of the conduct of the research. Articles 3 and 12 of the Convention on the Rights of the Child, which provide that: (a) in all actions concerning children, the best interests of the child shall be a primary consideration (art. 3); to guarantee the right of children who are able to express their views, to express them freely, taking into account their age and maturity (art. 12).

Therefore, in the context of conducting the research, in parallel with the letter of parental consent, the minor students should be provided with the appropriate facilities in terms of:

i) informing them of the aims and process of the research,
ii) ensuring the anonymity and confidentiality of the data,
iii) the voluntary nature of their participation and
iv) their ability to withdraw at any stage of its conduct.

Finally, in the spirit of respect for human rights, it is expected that every care will be taken by the researcher, so that the research is conducted in consultation and with the cooperation of the Principal and the teachers' association of each school.

In relation to (b), that is, ensuring the anonymity of the participants in the investigation and the protection, according to the current legislation, of their sensitive personal data, the researcher is obliged, in accordance with the current legislation (Law 4624/2019 “Principle of Personal Data Protection, implementing measures of Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data and transposition into national law of Directive (EU) 2016/680 of the European Parliament and of the Council of 27 April 2016 and other provisions ”, General Data Protection Regulation (EU) 2016/679“ on the protection of individuals with regard to the processing of personal data the free movement of such data and the repeal of Directive 95/46 / EC ”), to ensure, at every stage of the investigation (collection, processing and publication), the anonymity of all those involved in it and to treat the research data as top secret.

Recording methods, videotaping and recording raise serious issues of protection of the anonymity and personal data of students and teachers. Therefore, the researcher took into account the particular conditions of the research. Specifically, although the researcher has developed personal relationships with Roma students and is accepted in the local community as a result of his many years of interaction with the community as described in a previous section of the dissertation, it is understood that this population group

lives and works in the border between legality and illegality, with the result that any attempt to videotape or record it acts as a deterrent to the smooth conduct of this research. Therefore, photographs of the research were chosen in order to capture the necessary sampling material, hiding persons and objects while respecting the personal data of the participants.

The use of material rewards as incentives for the participation of students in the research is avoided with extreme caution and to avoid choices that may have undesirable results. In addition, in the above context, it is pointed out that the use of material rewards as incentives for the participation of students in the research is considered problematic in terms of possible bias in the sampling or in the answers of the participants.

Teachers who are involved with the role of the researcher in action research conducted within their workplace must also secure the consent of the participants by explaining the dual role they play in the classroom ensuring the anonymity of the participants, as described above according to the guidelines of the national supervisory body. In this case, in order to ensure the consent and positive mood of the students as well as the important people from the local community who were potentially involved in the research process, the researcher took care to actively secure their consent and intention to participate by creating opportunities for interaction inside and outside the school and creating a climate of trust and respect between the parties. This was not a process that was easily accomplished because initially the Roma community reacted cautiously to the researcher.

8.11 Synopsis

During the process of research design, several methods were considered to identify the most appropriate for the purposes of the particular research, primarily qualitative and post qualitative methods. It has been decided that the researcher would adoptan active critique of neoliberal research and disentangle the epistemic codes of ‘good old-fashioned qualitative inquiry’ (Brinkman, 2015) where humans are different from all other creatures.

In support of further understanding three epistemological approaches in educational research have been identified: positivist, interpretive and critical with the first one being based on the claim that knowledge exists independently of human subjectivity, the second one being based on observation notes and reflective writing as the great sources of data, thus, taking under consideration human subjectivity and the third one assuming that knowledge is socially constructed, contextual and dependent on interpretation.

A thorough analysis of Critical mathematics education (CME) has been presented which showed that CME aims at addressing social exclusion and suppression, working for social justice, opening new possibilities for students, and critically addressing mathematics in all its forms and application. Relevant literature indicates that research methodology in CME is linked to the three situations which are the basis of research practice: the current situation, the arranged situation and the imagined situation. In this direction the ideas of the Habermas and the Freire provide a strong theoretical background for critical research model since it is suitable both as a research methodology and as an educational approach

The researcher has chosen to review a qualitative methodology, in order to consider, the personal stories of the people involved in the research and use data collection and coding methods in order to understand the meaning of the individual's experiences. At the same time a post-qualitative research is an intensely political act requiring post-qualitative modes of writing and communication and offers numerous possibilities of viewing data and offers a potential to explore participants' narratives as they arise through the lived experience of the mathematics curriculum. Instead of looking for the truth of the students about the teaching and learning of mathematics, the researcher focuses on the differences and contradictions that exist in their learning experiences.

In detail, the use of a diffractive analysis process permits knowledge production through the plurality of theories and as post qualitative research attempts to treat the mathematics curriculum in modern education as a mirror of our intentions and goals. The researcher in this perspective has a dominant

knowledge of the student's world and seeks to impose a change on that world. Regarding the research methodology that is followed, any attachment to given and traced concepts of methodology has been rejected as each new problem is different and it is not possible to deal with it in the same way.

Summarising the data collection process for the purposes of the present research concept mapping of the ‘rhizome’ has become a powerful tool to enhance Roma children's interaction with the process of learning mathematics and the attempt to describe the reliability in a post-qualitative study requires a review of the fundamental assumptions associated with a study of this kind. Triangulation of data was achieved by using information from at least two different sources (so that the data obtained from each source overlapped), to deepen its understanding and maximize its confidence in the results of the qualitative study. In terms of transferability, the collection of detailed descriptive data helped the researcher-teacher to present a complete description of the framework (thick description of the context), design decisions and research results.

Finally, looking at the ethical considerations for the purposes of this research particular attention was placed on ensuring the conscious consent of the participants in the research or of the parents / guardians of the students, when the research is addressed to students belonging to minorities, the anonymity of the participants in the investigation and the protection, in accordance with current legislation, of their sensitive personal data, the provision of the possibility for the participants in the research to terminate their participation at any stage, and the protection of research participants from exposure to potential physical or psychological danger, or suffering or other adverse effects on themselves and their loved ones in the context of their participation in the research process.

Particular emphasis was also placed on ensuring full comprehension of the purposes of the research, the relevant process, the reasons why their participation is necessary, the optional nature of their participation and their ability to leave at any stage of the investigation.

In order to ensure the conscious consent of the research participants, the researcher writes a relevant letter, which he incorporates in the detailed research plan. In cases where the research is addressed to minor students, the consent of the parents and their guardians is required. The letter of information and securing the consent of the participants in the research is a necessary document for the opinion process from the institute of educational policy. To protect the integrity of the research, conscious efforts are made to prevent the use of material rewards as incentives for the participation of students in the research as it is considered problematic in terms of possible bias in the sampling or in the answers of the participants.

Chapter 9

9.0 Introduction

This chapter will present the research (non) data which are also the research findings. Initially there is a table of contents related to the activities which are developed in collaboration with the students. This table is helpful to make the further presentation of the research data more understandable. This summarizes the reasons for the mathematical activities that take place in the first phase, the generalizations that they then undergo, the extensions and consequences in real life, and finally the reference to the myths and prejudices about the Roma that are deconstructed in from the remodeling of the mathematics curriculum.

Then the individual mathematical situations that take place during the present research are presented in detail together with their respective photographs from the field of action. The mathematical situations at the same time with their presentation, are analyzed and commented and interpreted as they acquire meaning within the social cultural and historical context, which makes it meaningless to make a simple reference to the research findings without the simultaneous commentary.

9.1 Table of activities and participants

Names of participants			
Gregory	Moglis	Dimitris	Ephraim
Vasilis	Irene	Cuckoos	Valantis
George	Evangelia	Maria	Timos
Lakis	Marina	Raphael	Katerina
Voula	Panagos	Euthalia	Spyros
Taxiarchis			

Table of activities

Reason	*Initial activity*	*Generalization*	*Real Life extensions*	*Myths about Roma that are being debunked*
Birth of a child	Length measurement	Tree shadow-Height of a man		Roma people are of limited intelligence and excel only in commerce
	Room construction	Circle length, distance of two parallel lines, finger counting	Pakistanis who are legitimized because of their mathematical knowledge, interpretation of common misunderstandings with the white race	They like to live in isolation and not interact with the rest of society or for their true needs, they are insolvent and break agreements
Torrent	Construction of a bridge with modelling clay	finding the shorter route to school, clarification of the reasons why students are often absent	Realization of the bridge after some months, tackling the problem of school dropout and students' compliance with school hours	They are indifferent to the educational process and prefer to stay at home, they are late for school in the morning because they stay up late, they are lazy
	Distance measurement, use of map and familiarization with map scale	students make school maps and play the game of lost treasure	Interaction with concepts related to the definition of space and become familiar with giving instructions in real	they think wickedly and give the wrong instructions in order to confuse people in order to lead them to a

			life.	dangerous part of the neighborhood and steal them, they want to keep the integrity of their area.
Covid19 pandemic	Placement of the chairs in triangle and square formation	Exploring the properties of the isosceles triangle	Understanding the difference between the non-dimensional point and an object	They enjoyed the incarceration during the pandemic and they do not want to go back to school
	Number line for each class of the school	Measuring equal distances, understanding the value of zero	Placing the students at equal distances from each other, mathematical thinking outside the school context	Mathematics have an abstract object and lack utility in everyday life
	Use of bricks to make a cube	Representing the sale of antiseptics as well as lighters	Exploring different ways of problem solving	Roma students even quarrel with each other for no reason, they are constantly looking for reasons for conflict with social groups
Dice in a corner	Form the maximum add with the dice, solve a mathematical puzzle	Interaction with abstract concept of a mathematical puzzle	Working with classmates to find the best solution to the puzzle	They give up the effort at the first difficulty, they are unable to cooperate
Introduction	Games with	Representing	Roma see the	Whatever

to probabilities	the dice	the results with a bar chart	dangers of illegal activities as a matter of luck. correlation of luck with the probabilities.	Roma do not understand, they reduce it to issues of luck, prejudice and fate
Venn diagrams	Examining applications of Venn diagrams is real life.	Identifying union and intersection of sets.	Give real meaning to venn diagrams by raising issues of incest, gender differences and differences between socially rival groups. Mathematics become universal language because through them we can describe real life relationships	Roma girls are only interested in becoming mothers, Roma belong to the same race and fight with each other, they have a low mental level because they incest, they do not estimate school as educational service.
Parallel lines	Mathematical puzzle	Rainwater and house roofs	Parallel aesthetics	Roma are frivolous in their decisions and even build their houses randomly and carelessly
	Improvised loom	Reviving old traditional handicrafts that have, they take initiatives at school eventsbeen lost.	Mother and schoolgirl outside the community make rags. School knowledge becomes a vehicle for interaction outside the Roma community.	Roma are indifferent to the interaction with the wider society, the school for them is soul parking as they want just to spend their time out of home.
Mathematical	Mathematical	Separating	Real life	Roma do not

patterns	puzzle	lions from zebras	experiences between community members and police, separating opposing Roma groups. Technical knowledge and life knowledge of the students are highlighted	have the patience to acquire knowledge, they are only interested in easy and fun tasks.
	Relating paces, surface and quantities	Problem solving	Identifying mathematics is real life tasks.	
Introduction to fractions	Playing with lego duplo bricks	Different representations of fractions	Linking fractions to musical chairs game.	They do not use knowledge from school.
	Music and mathematics	Comparing quantities	Realization of the equality of fractions through music	Roma hate mathematics because it has a twisted epistemological content
	Euclidean division and playing cards	Learning division in an alternative way	Dividing with simple tools (like rocks etc.)	They do not want to improve their life. Mathematical knowledge improves their lives.
Number deeds	Additons, subtractions and multiplication			They finish primary school and do not know how to perform the four basic arithmetic operations

Symmetry	Symmetry and road signs	Symmetry and art	Identifying symmetry in everyday life	Their painting is immature since they are children with disabilities
	Identifying the symmetrical axis		Estimating the value of symmetry in their life	it is impossible to connect mathematics with Roma students' real life
Odd and even numbers	Represantation with coins and playing cards	Odd and even numbers with bodies	Techniques to make pairs of similar objects	They have their warehouses full of useless objects because they have learned to live in the garbage.
Measuring quantities	Trying to measure different quantities of fruits	Developing different measuring strategies	Interactions at the grocery's	Roma student because of their poor cultural capital do not have imagination.
Scale and kilos	Trying to measure the quantity of cherries.	Use the scale. Creating comparisons	Roma daily practices and habits gain interpretation and meaning	They may not know how to count but they know how to deceive you during trading

9.2 Measuring length

In the area of Avliza, where this research is conducted, Roma welcome a new member into a family. Since this family has a prominent social and economic position in Roma society, the birth is accompanied by a series of events, which acquire special meaning for the participants. Thus, a series of constructions are created in the area next to the family's house in order to protect the child from possible danger. This series of events, which is highly important for the students, becomes the focus of the research. The research focuses on activities where students are involved in order to highlight mathematical situations that are intertwined with these activities.

The first activity concerns the construction of an improvised fence in the neighboring stream in order to prevent the baby from falling into the water while preventing the various rodents that live in this polluted environment from circulating in the neighboring road and inside the houses. On this occasion, there is a discussion with the students. We discuss about the way their parents (as well as the students themselves who always help the parents in construction activities) count in order to understand how much length they need to block as well as how to determine the amount of material they need to gather to complete the project.

Picture 1: Fence in the stream

In the photos, we see the improvised fence that the Roma have built on a torrent's bank, which consists of rectangular pieces of plastic and tin. The students report that the measurement is done with brooms. "The broom's pole length, you count how many poles and calculate the distance" they typically state. This means they do not use the meter tape at all. Then the researcher asks them what happens if they need to measure something high that they do not reach, such as a tree and Gregory typically states, "Since I do not reach the tree, I see the tree that has a sign from the sun in the yard (meaning the

Picture 2: Pieces of plastic and tin

shade of the tree). So, I count the sign with my feet, one, two, three feet, three meters and then I put (meaning I add) the part that is behind the wall, that the sun does not catch, let's say one point eighty, and three, four point eighty and a little more because the sun loses, let's say five, five and a half." In this excerpt from the verbal description of how the student calculates, we understand that students use an approximate method based on certain assumptions.

First, they use the shadow of a tree to measure its height in steps. They know that a large human step corresponds to about one meter, so they calculate its length by adding any parts that are not reflected in the shadow of the tree – such as the one behind the wall in this case. Since the wall prevents the depiction of the trees' whole trunk in its shadow the tree's trunk appears from one point and above.

It is also interesting how they calculate "one point eighty" since Moglis typically states "I conclude it is one point eighty – 1.80 – because you are about the same, you are one point eighty, one point ninety" meaning the height of the researcher. At this point, we find that Roma students are absolutely familiar with the concept of human height as they can calculate human height with almost absolute accuracy. They also compare the height of a person with the height of objects. For example, in this case, it is not easy for them to calculate the height of the concrete stand behind which the tree is located, (this stand prevents the shadow of the tree from one point and below and for this reason is involved in the measurement process).

However, they realize that the stand is the same height as the researcher. They accurately calculate the height of the researcher since they are familiar with people's heights and then use this ability to measure different objects by making the necessary comparisons. Finally, we observe that the student has

a feeling that the sun “loses”. This practically means that his approach is not accurate, so he adjusts his final answer by correcting the length and even increasing his estimate by a few centimeters.

The teacher then urges the students to calculate exactly the length of the tree as well as the length from the makeshift wall they are making. This confuses the students and one of them, Dimitris, obviously irritated answers: “Dude, what do you want exactly? What will you do with the tree? You only care it does not fall and brings the cables down. Five meters from there (meaning the side where the power cables pass) if you drop it, I tell you there is no problem. The same happens with the fence, we measure with broomsticks, I take the broomstick with me to the place I go to collect the tin and the plastics and I count up to how many I want. And if there is any dog I send it away”

At the same time, another student, in order to relieve the intense irritation in the atmosphere, explains “Teacher he means that you don’t always have a tool in the laboratory – where the wooden tables are made. You measure comparing one object to the other. Here in the classroom, if you want to measure the closet, you measure using the desks or chairs (meaning how many desks the length of a chair corresponds to), you then take the chair and go wherever you have to work. We had once brought a “Balamo” to close my grandmother’s yard to construct one more room for my aunt. He measured everything using paper and a calculator. Do you know how many left overs we had, teacher? Bits of all the materials from here and there. Waste of money. Teacher, the way we measure materials nothing is left over, everything comes out accurately”.

Through this incident, we see that the Roma are purposefully using their own way of measuring distances. They use their experience and the practical significance of each measurement to calculate what they need. In our case, they are not interested in accurately measuring the height of the tree since this activity is automatically adjusted in relation to their daily life that is whether the tree can fall on the power cables. Whether there is a potential risk of a possible tree fall.

After all, the calculation of the length of the tree's shadow on the ground is clearly related to how far the tree will reach after a possible fall. In other words, they directly connect a mathematical issue, such as measuring the height of a tree according to its shadow, with its practicality as well as with the extensions of this practicality into matters of security. They consider whether there is a risk of injury or electric shock in the case of a tree's falling and are content with this calculation that will ensure a correct answer to the practical problem they have. Outside this living experience, students do not find it meaningful to measure the exact height of the tree because they certainly do not need it.

Accordingly, Roma students associate the importance of a measurement with its results and the practical implications it may receive. A "Balamo" does an accurate measurement that may be made by a specialized engineer, they obviously mean an engineer whom they consulted for building the extra room or a building material clerk who measured and calculated the amount of materials needed. This measurement will provide some data, which form the basis for purchasing appropriate quantities of materials. This data will be rounded to buy the required materials depending on the packaging sold by the building materials' stores.

In our case, the Roma got into the process of buying extra materials, which were finally left over resulting in a waste of money and unnecessary garbage. On the contrary, using their own strategy, they do not have surplus materials because they measure exactly how much they need and then buy or collect the required quantities. In fact, the instrument they use can also be used for their safety by removing the aggressive dogs during the process of collecting or purchasing the materials.

This contradiction creates controversy in Roma's society because the community's members find it difficult to understand why they have an excess of building materials, accusing the "Balamo" engineer for insolvency. At the same time, they devalue the essence of the measuring process as it gives an incorrect result that causes financial loss, which could have been avoided if the calculation had been made in their own alternative way. As a result,

students are not happy to participate in accurate measurement processes even if they are related to their daily lives because there are negative experiences that deprive this process of its meaning and usefulness.

Another activity that has as its starting point the birth of the baby is related to the construction of a new, additional room to accommodate this new member. Indeed, as shown in the pictures below, the Roma are building a makeshift room. Unfortunately, its construction took place at an unsuspecting time, at night, to avoid the legislation on illegal construction. Thus, it was not possible to participate in the process from the first stages of building the new room. However, the researcher and the students were at the site on the electrical installation's day. At this point, we interacted with three separate mathematical situations that will be described in detail below.

Picture 3: Electric installation works

During the electrical installation process, the measurement techniques are distinguished in two basic cases. The first circumstance is to measure the necessary length of the cable needed in order to lead the cable through the electrical channel to the house's electrical panel. We notice that Roma students help their parents as they are asked to measure the lengths of the plastic channel which the power cable will go through.

Picture 4: Measuring the plastic channel

Instead of measuring with the measuring tape (which is also present at the construction site), all those involved improvise measuring with their hands and showing the plastic pipe's length with their finger. Then they cut the plastic pipe exactly to the dimension needed to match the wall. Ephraim typically states, "Teacher, with the measuring tape you can only measure what is

exact. If there are halves, it makes things difficult and then you have to rub to match it exactly. With your finger, you cannot go wrong. The thing is not to make a mistake because you will have to do everything again, you will lose time and you will be caught, teacher. Speed counts". Moreover, a father says "Here we talk, laugh, drink. If you use the measuring tape you forget what you have measured. Using your hand, you do not have to use your brain. The more you catch, the more you cut".

Picture 5: Measuring with finger

Through this incident, one realizes that each of the techniques they use is not accidental but acquires substance within the context of their lives and actions. They face a cognitive difficulty as they find it difficult to calculate the millimeters as shown on the measuring tape. However, at the same time they prefer to use their hands in order to be less focused on their work. Thus, they are able to communicate, converse and have fun while working. This activity becomes part of a community celebration.

Picture 5: Length of a cable and circle circumference, circular coil of cable

At the same time, the cables and piping for electricity that form a circular shape are observed and the researcher asks the students how they decide how much cable they will buy (since in the shops you find them in circular coils) in order to have no excess as it is required. Vasilis characteristically explains, "I take a round one from the cable (meaning a circle of cable), pull it out of the coil and straighten it to see how much it is. This is about as long as the length between the palm and the elbow. I count how many hands the wall is and in the shop where I go I count the rounds on the cable. The more hands there are, the more rounds you need. I buy as much as it comes out". At the same time, his father adds, "the cable has a loss – he means that pieces are left

over while some others are cut – so you take a dozen more rounds to last out. The little that is left over you put it in the lamps afterwards, it is not wasted". In other words, because it is difficult to cut a piece of cable to measure the required length, they have matched the length of the circle to the length of the arm. Using this approach, they can easily calculate how many meters of cable they need to buy in the shop by measuring exactly how many circular cable sections they need.

However, the researcher notices there is a measuring tape in the improvised construction they are preparing. Asking the children why there is one at the construction site while practically they do not use it at all, the students typically answer, "This has been forgotten by the Pakistani who will come to put the aluminium windows. Teacher, aluminium does not allow for repairs and mistakes. If something goes wrong with the aluminum, then you are left with a hole that allows air and water to come in. He knows and counts them properly because he knows we will beat him to death if he makes a mistake".

It is therefore understood that students have a relative familiarity with the accuracy provided by the standard measuring tape even though for their own reasons, as mentioned in the individual examples, they do not prefer it. However, when the work requires detail such as the installation of an aluminium window then they highlight and accept the usefulness of the standard measuring tape and the corresponding measuring tool. At the same time, we observe that they apply an improvised technique for measuring the circle's length. They measure the length of the circle; they convert it to a length corresponding to a straight line and then adjust to fit the actual meters needed.

Consequently, some social issues also arise. Although Roma students and their families experience intense violence and prejudice, Roma students reproduce violence in social groups that they consider inferior to them. Many Roma host immigrants of Pakistani origin who live illegally in Greece and treat them in the same way Roma themselves experience racist behavior by people from the dominant culture. Violence breeds violence and stopping its reproduction is a matter of education. A Pakistani craftsman who

manufactures aluminium by possessing mathematical knowledge that allows him to use the measuring tape with millimeter accuracy, works for Roma community in order to complete the construction of the windows so that the room becomes habitable. Thus, he becomes valuable to the local Roma community and, in this context; discrimination and violence against him are reduced. This person, although he belongs to a group that is treated with racism by the Roma society, accepts their respect and acceptance because of his ability to apply mathematical knowledge to his manual work.

Then, we observe that we need to accurately measure a point which the cable will go through. In order to do this, they measure with their palms the distance from the hole at the top of the plasterboard to the point they want, on the vertical axis – that is, as much as they measured with their palms as well as in the gap behind the plasterboard. Then they measure again with their palms a distance on the horizontal axis. We observe that during the measurement they note a soft dot that shows the exact distance on the vertical axis. The imaginary line of this faint dot – which acts as a mark – becomes a starting point to measure the palms on the vertical axis in order to locate the exact point in which they choose to place the electrical cable.

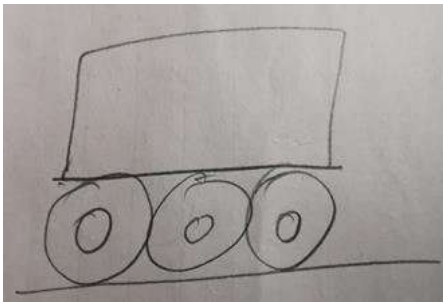
Picture 6: Distance between lines in imaginary lines

Through this process, they realize that there are two conceivable parallel lines at a constant distance from each other. Such measurement and design practices find direct application in Euclidean geometry and, in our case, the constant distance between two parallel lines is one of the fundamental theorems of Euclidean geometry. The Roma use the application of parallelism's theorem without knowing that there is a fact that confirms that mathematics is based on everyday life's real situations and cannot be considered on their own and independently of their practical applications.

Motivated by the image of the cable, which has a circular formation, we discuss with the students about the concept of the circle's length. Specifically,

there is a discussion with the students about the fact it is not always possible to create the mapping of the length of the circle to a straight line segment. Therefore, we may need to calculate the circle's length in an alternative way. Indeed, students perceive the weakness that is verbally described by the researcher through representations of their daily lives. That is why they typically state, "He is right. You cannot measure the car's wheel. It is not possible to cut it and make it straight. Not even the iron wheel of the train"

At the moment we mention the representation of the train's wheel, Irene, who is a child with a talent for painting, seeks to connect the circle with the straight line through painting and suggests that "Teacher , let's say on a train are the wheels. If you calculate how many wheels fit one another (she means in a straight line) comes with the train". We ask Irene to represent with a sketch what she is thinking and draw us the figure in picture 8, which aims to say that the length of a circle's diameter equals the length of the corresponding straight line.



Picture 7: Sketching train wheels

It turns out that the student confuses the length of the circle's circumference with the length of its diameter. Because students are young and it is not easy to understand the concept of mathematical process involved in the algorithm that measures the cycle's length, we take advantage of Irene's talent in painting and give to a group of students the opportunity to create a train using real paints on the school's wall. The aim is to give the required emphasis to the train's wheels so that the students will overcome their cognitive obstacle in an experiential way. Irene states with enthusiasm "Teacher, I know very well how to draw trains. Since I was a small child, we lived above the trains. I saw them every day. They were next to our house".

Picture 8: Illustration of a train with real colours

During this activity, with the help of the Art teacher the train carriages were initially designed in pencil. The train's wheels were not designed to give children the opportunity to act on their own and engage in reflective thinking and reasoning. The students worked outside the mathematical context and enjoyed their contact with painting.

Picture 9: Emphasizing on the wheels

When Irene got to the point of drawing the train's circular wheels, the researcher intervened by asking why she did not draw them exactly as on the paper, that is, one next to the other, since this is how their length can be measured. The answer was that "There is no real train that has wheels one next to the other. If the wheels come one next to the other the train will not be able to slide. They want apla (it means space) to turn. The other was a painting. You told us to make a real one here, didn't you, teacher?"

In other words, we understand that the student realizes through her experience and the observation she has made in her real life that the length of the circular wheel is greater than its diameter but does not have the mathematical readiness to express it. This emerges from the fact that in the ongoing discussion with the researcher she states that "the middle circle, let's say if we spread it (shows the two concentric circles formed with different colors on the train's wheel) does not match, will go out of plan. They have also said it yesterday when talking about Cuckoo's cable (she refers to the previous incident described and concerns the electrical cable). That is why they said that the cable has a loss. You cannot find exactly how much it is. You overanalyze it. Is the outside circle the same as the inside?"

As this incident shows, when the student spontaneously paints, she is not interested in accurately depicting the real situation of the train's wheels. On the contrary, when she prepares something that is more important, such as the permanent painting on the school's wall, she uses her experience to express the real image of the train. Her life experience on trains makes clear that the wheels must abstain from each other to create "apla" in order to

rotate. She even justifies through this experience the cable's circular arrangements. As she claims not all the cable's circles have the same length (compares with the identical train's wheels) and this is the reason why they correct the final result by "overanalyzing it" (she means by taking the necessary corrective actions).

9.3 Measuring length – use of the map[34]

The Roma camp is separated from the school by a water stream, which makes their access difficult especially when it rains. This is a tremendous difficulty that students have to face. They are forced to walk an enormous distance during the winter without having the necessary clothing. At the same time, on the way to school via the alternative route the students and their parents are confronted with the control of the police. Therefore, the task for the students was to reflect on the route they follow to reach the school. The individual measurements will highlight the need for constructing a bridge.

The main aim of this module is to familiarize students with the concept of the meter as a unit for measuring length. Students need to get acquainted with the length corresponding to both one meter and half a meter, to compare length measurement results, and to measure length using the measuring tape. The way of teaching these concepts proposed by the official curriculum is abstract and fails to develop a connection with Roma student's reality. The tasks of the textbook belong to the realm of semi – reality; they have no experiential character. They promote neither the students' ability to respond to a real – life situation nor the effective transition to scientific school knowledge.

A series of activities are designed to respond to the specific cultural and educational needs of the Roma students. The source for designing these activities is a real – life problem faced by Roma students in their daily lives.

As far as locating is concerned, Roma students were asked to identify the shorter route from their neighbourhood to school. They indicate the perimeter

[34] Kyriakopoulos, G., & Stathopoulou, C., Exploiting the six mathematical activities for responding to a real community's problem with young Roma students, Quaderni di Ricerca in Didattica (Mathematics)", Numero speciale n. 7, 2020, G.R.I.M. (Departimento di Matematica eInformatica, University of Palermo, Italy)

route instead of the direct route as shorter. The students, since they had to respond to a real life problem, a problem of their experience, took into consideration the whole context: the stream is an obstacle for the safe transition on foot. Thus, what appears to be a false mathematical estimation of distance is correct in the real life context. Students draw on a paper a yellow line to indicate the direct and perimeter route to reach school. The exact distance in meters as well as the map of the region is presented through the Google Earth software.

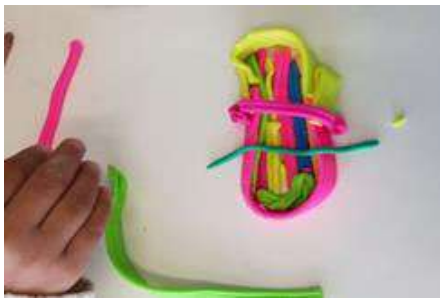
Then a relevant video was presented in order to make children understand that constructing a bridge would be a solution for their problem as well as to provide instructions relevant to constructing a bridge. The video was presenting the need to create a bridge in order to walk over water in the forest.

Taking advantage of this activity teaching was expanded to include counting and measuring experience while students once more exploited culturally acquired knowledge. The students used their feet for measuring the classroom's length and they found several results, a notice that led students to be ready to move from arbitrary units to the formal measurement's units.

Moreover, students were asked to consider why they prefer walking over the electricity pylon to walking down the stream. Students find as reasons for this practice the water and the harmful objects found in the stream. They do not realize that the straight distance of the pylon is shorter than the slope of the stream.

Picture 10: The fallen electricity pylon

Then the students were asked to measure the current distance on the worksheet in a straight line and on a slope using modelling clay. After comparing the modelling clays' lengths, they realize that another reason why they prefer to walk over the electricity pylon is that it provides the shortest way (picture 12). Moreover, they get familiar with the use of the ruler.



Picture 12: Representing spatial planning with modelling clay

As far as designing is concerned, the students use modelling clay to represent the stream and the two ways of crossing it. In particular, they use the green thin modelling clay to show the way through the bridge they will construct (picture 13). In any case, it is noticed that the focus of the conversation has been transferred to how they will cross the stream while they have abandoned their original beliefs about the perimeter road.

Picture 13: Thinking about crossing the stream

As far as playing is concerned, students play the game "I am moving 1 – 5 steps to get on top of the other". Initially, students believe that the more they move the easier it will be to get on top of the other. However, after a couple of rounds they realize that "I have to observe not only the size of my tread but also that of the other's tread" and that "the trick is to pick a few steps at the beginning so that the other does not catch you".

Students then come in contact with the measuring tape and perform some measurements in the classroom on both real-world objects and representations on corresponding worksheets in order to become familiar with the standard measurements. In addition this process helps them realize what

Picture 14: Using the meter tape

the length of a meter corresponds to as well as get familiar with multiples and subdivisions of the meter. Picture 14 is included to present the way Roma students explore this learning process through evidence of logical thinking and reasoning.

It is particularly impressive that the students discussed this activity with their parents. After seven months and the gradual collection of materials required by the Roma, this bridge was implemented as shown in the adjacent photo. In other words, this mathematical activity significantly affected the Roma's life by increasing the participation in school of the children who live in that area. Thus, it contributed to the improvement of their quality of life's quality. A simple construction brings them closer to the rest of the society and makes their interactions easier and more enjoyable. It is a fact that the construction of the bridge offered an improvement solution to two problems that plagued the school community and concern the first in the school dropout during the rainy winter days which was drastically reduced as well as in the timely morning arrival for the start of the reduced time it takes for students to get to school as well as the improved route they took.

Picture 15: The constructed bridge

It is further understood that the prejudice that Roma students and their families are indifferent to formal school education is dispelled. When the content of the mathematics curriculum is developed based on your real needs as they arise at a given historical moment, then the educational process is not completed at the end of the school year but acquires a social status and creates the basis for interaction with the community and empowerment in order to change daily life for the better. Such an educational ideology is impossible to embody and implement through predetermined teaching goals and strictly structured mathematics curricula.

9.4 Measuring distance – Innate qualities of the square and the isosceles triangle

Due to the school's reopening after the restrictive measures for Covid19 pandemic, the students recalled their existing knowledge by trying to implement the restrictive measures in practice. According to the directives of the disease prevention center, the distances between the students within the school classroom should be 1.5 meters.

The way the desks were placed initially caused the students discomfort, as they were located one behind the other. As a result, the children did not have eye contact with each other and came in direct contact exclusively with the teacher and the blackboard (placement of desks for traditional frontal teaching). Thus, the students were asked to place their classroom chairs in an appropriate manner in order to apply the necessary precautionary measures for the virus' spread.

Initially, the students counted the number of desks in each classroom and began to think about different placements so that each student has a distance of 1.5 meters from his/her classmates. Students were deliberately asked to separate the chairs in two classrooms. This happened because the first classroom consisted of eight chairs and the second consisted of eleven chairs. So, while the students tried to separate the eight students they were expected to form two groups of four chairs. Thus, they placed the chairs into a square formation as they easily recognized that the square has equal sides. They use a measuring tape in an auxilliary way, with which they were now familiar, after their previous contact with this measuring instrument during the activity of measuring length and using the map.

Picture 16: Placing the chairs at equal distances

In our attempt to reveal the reason why the students immediately thought of placing the chairs on a square's tops, Valantis explains, "I thought of the

television. If you put them like the TV set, one side is closer, the other is farther, so you cannot do it. Then you think of the triangle, like a little piece of cheese pie. This can be done but eight chairs do not fit in a triangle because some are left over". At the same time, Stavros said in order to comment on the triangle formation "the little piece of cheese pie does not always do, it can be pointed – meaning triangular – without every piece being equal. It only fits sometimes. My mother has some towels hanging that fit equal distances". Thus, we understand that students use objects of their daily life such as television or handmade embroidery to guide their thinking to the appropriate mathematical arrangement.

Picture 17: Creating a triangle with chairs

At this point, we must analyze the fact that students informally recognize perfect and imperfect division. The perfect division, for example, has to do with the placement of the eight chairs in two squares, while the imperfect division has to do with "the eight chairs which do not fit in a triangle because some are left over". Children make this distinction even though they have not been taught division at all at school. At the same time, students recognize the innate qualities of triangles as far as their sides are concerned since they realize that a pointed formation can sometimes fit and sometimes not fit, that is, sometimes an equilateral triangle can be formed and sometimes a scalene triangle.

Picture 18: Examining equilateral triangle properties

The students' attempt to form an equilateral triangle is particularly interesting since the goal is to place the three chairs one and a half meters apart from each other. At the beginning, they easily place the two chairs and form one side of the triangle. However, they find it difficult to put the third vertex in such a way that it is equidistant from the other two.

They do several tests and talk to each other for a long time until they realize that “in order for the third chair to be two away from the other two we have to find 75”. When the researcher asks them how the number 75 comes about they say “I have one and a half. Half of one is 50 while half of 50 is 25. So 75. There, the other chair should step on 75”. Thus, they use the measuring tape to measure 75 cm. That is the middle of one of the straight sections, which happens to be right on the til’s joint. This joint forms a straight line that runs through the tiles and becomes the reference point. As soon as the students realize that the middle is on the til’s joint, they are very happy while George says “Come on, it is nothing. Now it is easy that it has fallen right up here. Take it all straight. The chair should be put in this line here.”

Picture 19: Calculating half of a distance

In fact, the students place one foot of the chair on this straight line, that is, on the perpendicular bisector of the line segment of the equilateral triangle’s base. Then measurements begin on both sides of the triangle to create the equal distance by moving the chair properly. However, after a short time of testing, they find it difficult to mark accurately the distances as they find that, although their measurements are based on the line of the perpendicular bisector, the two sides of the triangle continue to be unequal.

Then, Valantis, who until then observes, tells them “the chair is not like the lines you draw with the pencil that do not catch centimeters, the chair catches centimeters. Half of the chair must step on half of the line. We cannot do it by putting the foot that is at the chair’s end”. Indeed, the other students accept his point of view and measure the chair’s length. Then, they place its middle on the line of the perpendicular bisector, as it is marked by the tiles’ joint. That is, the student at this point

Picture 20: Finding the perpendicular bisector

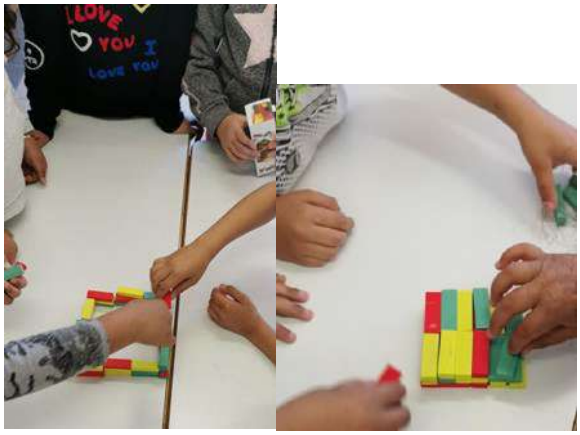
realizes that the reason why the triangle does not become equilateral is the chair itself that has dimensions. Therefore, he suggests placing the middle and not the end of the chair in the perpendicular bisector in order to achieve the desired result.

At this point, we observe that students have an understanding of the dimensionless character of a triangle's point and vertex as well as its different innate quality in relation to an object that has dimensions such as the chair in this case. They finish this assignment by measuring exactly the equal distances on the equilateral triangle's sides. Finally, when asked how to place the eleven children into formation, they easily state they will form two squares and a triangle, thus making an Euclidean division using geometric terms.

Picture 21: Understanding the difference between a point and an object

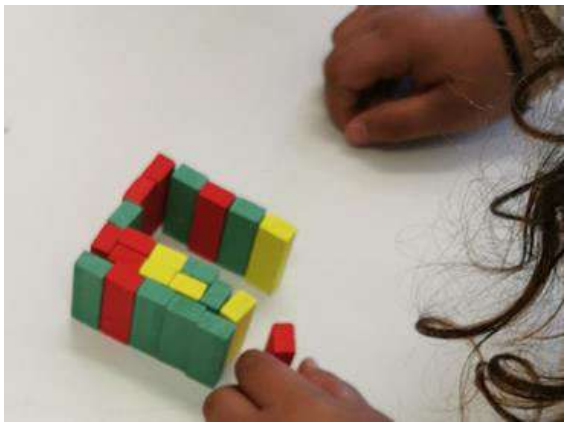
9.5 Geometric solids: Cube formation from rectangular parallelepipeds

As students return to school after the restrictive measures to limit the spread of Covid19 pandemic, they transfer to their school environment their experiences from the time unprecedented for them. We are told that things have changed and that they have faced financial difficulties since people were confined to their homes and they had missed the opportunity to sell small things on the streets to earn their living. Ephraim says, "Things have changed, teacher, and now we sell antiseptic wipes and such, people no longer take the other things (meaning lighters, rosaries, etc.) because they are disgusted by them.



Picture 22: Forming a cube

Based on these students' experiences, we represent a package of antiseptic wipes, which has the shape of a rectangular parallelepiped, with a wooden brick. The goal is to be able to form a cube with equal sides using as many as possible of the 45 bricks we have in total. Students experiment enough to achieve their goal. They also work in separate groups, something that is not usual in the activities that have been designed and implemented so far. One group places them around the perimeter of the square while the other group tries to place them around the perimeter and then fill the cube with the remaining bricks. The third group, consisting of a single girl, places the bricks in a vertical arrangement without being willing to work with the other children. She seems to be confident in the way she tries to build the desired cube.



Picture 23: Vertical arrangement of bricks

Students disagree with each other about the arrangement they should follow and the reason for their disagreement is the different experiences they bring with them in the educational process. As far as the first group is concerned, the children belong to families who do not engage in retail items. Therefore, it is difficult for them to understand that they have to place bricks inside the square as well. They form their layout as if they were building a room with bricks. That is, their experiences determine the way in which they structure mathematical knowledge. This happens despite the fact that the researcher shows the students a wooden cube in real dimensions in order to realize that they have to place bricks inside the cube.

The second group, realizing the need to place as many antiseptics as possible in the cube-shaped basket, tries to arrange them as neatly as possible "so that they look beautiful and people want to buy them" as they report. At the same time, the way they place the wooden bricks is influenced by their familiarity with the construction activities, since they directly recognize that the

sides of the rectangular parallelepiped from the bricks have a ratio of 1 to 3, as in the case of normal bricks. Typically, Marina states “Six – two (meaning that the rectangle’s six sides of width correspond to two sides of rectangle’s length). We put them as we put the bricks since one long (meaning length’s side) goes as long as three narrow (meaning width’s side)”.

Finally, the third group, which consists of a single girl, places the bricks vertically. The other students ask the researcher – teacher to stop her and take her bricks so that they can use them while she insists that this is the right way. It is at this point that some slogans about her mother begin to be heard. Irene gets angry and says, “Look at your own mothers and leave mine alone”. Trying to highlight what exactly is going on in this controversial incident among the students, the researcher realizes that Irene’s mother only sells lighters that are placed upright, the same way the student places the bricks. The other students tease her that “her mind doesn’t cut (meaning she is not smart enough like her mother)” to place the bricks differently and that she places the bricks just like the lighters without “looking to put as much as possible in the basket” because the only thing she knows to do well is selling lighters. They refer disparagingly to the schoolgirl’s mother because for some reason, unknown to us, she prefers to limit her street vending activities exclusively to the sale of lighters.

At this point, we observe that the experiences of this particular student act as a deterrent to the way in which she places the bricks to make the cube. At the same time, the student experiences negative feelings from her classmates, since they find the opportunity at an unsuspecting time to make fun of her for issues related to her family’s environment and even for her mother’s work. All these elements prevent the student from realizing exactly what she has to do. That is, the student faces difficulties that are related neither to her perception nor to the acquisition of the mathematical object and it is necessary to interpret them based on the existing situation.

It is particularly interesting the fact that, after a few days from this activity, the researcher notices that in the neighborhood around the school a fence has been set up in the vegetable garden that Ephraim’s family took care of.

Ephraim enthusiastically explained, “We got the idea from what we made with the jenga in the class and because we had wooden pallets rotting from water, my cousins and I discussed: why aren’t we doing what we did with our math teacher? We laid one next to the other so that the goats that the shepherd has do not come in and eat the leaves and we quarrel all the time”. On the occasion of a mathematical activity that is appropriately related to the students’ socio – cultural context the students acquire an idea (their analogical way of thinking draws a parallel between the wooden parallelepipeds and the colorful bricks) that, as it is implemented, creates the conditions for a more peaceful coexistence with the other members of the local community. Therefore, mathematics becomes a driving force of action and contributes to the restoration of social peace between the Roma families and the native shepherd.

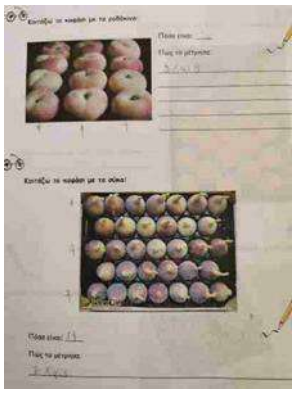
Picture 24: Creating a fence similar to the mathematical activity

9.6 Measuring quantities

Because the Roma live on the margins and are almost excluded to a certain part of the wider Municipal Unit, their exits from the area where they live are limited. The purchase of goods that are necessary for their living is done either by a local grocery store or by itinerant greengrocers or retailers. The itinerant greengrocer is a commercial habit that was encountered in folk neighborhoods of old Athens about 30 to 40 years ago and has disappeared nowadays as a professional activity. The Roma’s life is characterized by beautiful and ugly moments of everyday life, by the existence of several tensions but also many funny moments of relaxation.

When such an itinerant greengrocer crosses the street outside the school, the students start shouting at him “Mitsos, how many fruits do you have? Do you have a lot of merchandise today? Will you make enough money to spend with your woman at night?” Based on this incident, the students were asked how

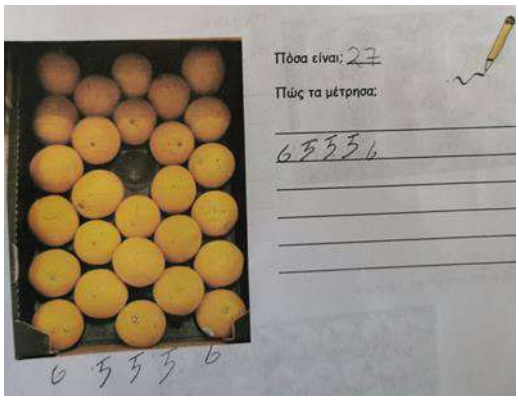
many fruits there are in the greengrocer's crates, in other words, to consider how they could calculate the amount of fruits the greengrocer has. For practical reasons a relevant worksheet was prepared with a crate of peaches, a crate of figs, a crate of oranges and, finally, a crate of cherries.



Picture 25: Worksheet for counting

In the initial arrangement of the peaches, the students measured them either in threes or in fours, that is, they used the horizontal arrangement, "I measured them from end to end" (measuring the horizontal arrangement) or the vertical arrangement, "I measured them from top to bottom". In the calculation, they used either the repeated addition or four by four (there is an error in counting four by four while the multiplication is normally done as an operation).

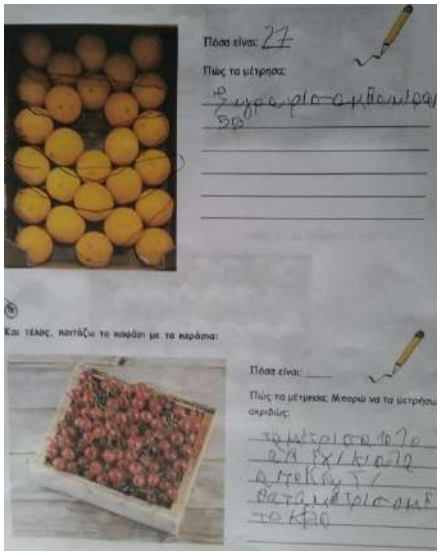
Then, the students had to calculate how many figs are there in the crate. The figs are not placed in alignment like peaches. So, they report that they count them "side by side" (that is they count them one by one per row) while some note the rows that have seven figs and the rows that have six figs and then make the product three by seven and six by two in order to calculate the result. However, they do not seem to select the repeated addition per row to calculate the result in this case.



Picture 26: Counting oranges

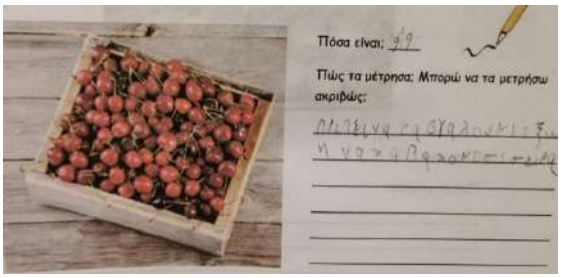
When students are asked to count the number of oranges, their thinking becomes more interesting and they respond impressively. Specifically, they count them in sixes and fives vertically (that is, from top to bottom) because this way there is an alignment and the counting can be done more comfortably.

Evangelia characteristically states, “Since it is very confusing to measure them as they are because they do not have an alignment, I will draw a boomerang with my pencil (she draws as shown in the photo below). The first one (meaning the one on top) is not good, is a bit damaged, it is the oldest. That is why they put it on top in the oranges’ boomerang, to get the old one first. I put them like this now, they are five – five (meaning five oranges in each of the five boomerangs) and there are two more left. They are all together 27”.



Picture 27: Boomerang formation & counting cherries

In other words, she transforms the seemingly disordered group of oranges into a representation based on the games of her daily life (the boomerang and the paper plane) and thus solves the problem. In fact, the student has developed her imagination as she immediately finds the excuse for a formation that does not have order like the rest. She imagines that she is in a bazaar where she sells oranges and even places the oranges that are “damaged”, that is, those that do not perfectly fit in the form of the boomerang, in the most obvious place.



Picture 28: From counting to weighing

At the end, the students estimate the number of cherries in a wooden crate. They immediately realize that it is impossible to calculate exactly how many cherries there are since “there are others below the first row”. They suggest either to “put them on the table in tens in order to count them” or to “put them one by one to count them” (showing as an example the number line stuck in the classroom) or finally they mention the concept of kilo in order to count the cherries.

Essentially, they are transferred from numbering to weight measurement. Weight, scales and kilograms, as a way of determining quantities, are familiar

to Roma students. However, it was not preferred from the beginning to deal with the concept of weight because the students, during the funny incident with the itinerant greengrocer, asked him for information about the number of his products and not about how much they weighed. Therefore, it was preferred to follow the students' way of thinking and to approach the concept of weight only if it emerges through the study of the real situation. We saw that the concept of weight is introduced to students only in the case where it is not possible to count the fruit, that is, weighing is used as a tool that will help them overcome counting problems.

9.7 Scale and kilos

On approaching weighing and mass issues by students who try to count quantities of fruits, we choose to engage in a series of activities related to weighing and calculating qualities. Students are quite familiar with the scale and its use as the scale is a tool that is widely used in their daily activities.

We first ask the children to explain to us how the itinerant greengrocer calculates the mass. Children are familiar with the existence of electronic scales and even battery – powered scales that are portable and can be used at any time. However, at the same time, the relationship of mass with the quantity and appearance of an object is highlighted, since Timos typically states, "We do not use a scale, because we do not need to measure exactly, there is no reason.

You take, let us say, cherries that are not like the other fruits that are counted one by one and you put them from the big crate into smaller ones. That is, if you buy the big crate for 30 euros, you look to divide it into eight, nine smaller crates because each one costs 5 euros, so you have to earn some money. The small crates must also appear full, that is, you inflate them a little, you put them a little cleverly so that they make a good impression and the other one gets a crate. Teacher, your mind is sharp, isn't it? Do you have to take a scale that will cost you so much money?" While smiling, Maria continues saying, "Teacher, it is similar to the roses that you hold together and say five euros at the traffic light. The other thinks that all of them cost five euros. However, if (s)he takes out the money and you go to give him/her the flowers, you give

only a few, one bunch, and you keep the other similar bouquets that (s)he doesn't distinguish".

Then, we asked students to identify an old scale that was used about forty years ago. This image is very familiar to them and they all answer that it is used by the pawnbroker, that is, where you give the jewelry and (s)he must weigh them accurately to calculate how much money (s)he will give you. Of course Timos in continuation of his previous idea adds that "Again, here it does not only matter how thick the chain is (that is, how heavy it is) but what kind of gold it is. If it is 18 carats, if it is 24 carats it attracts different money. Therefore, again we do not care to calculate exactly the weight. The question is how much you will gain when you sell the chain or the cherries or whatever". Students are asked to weigh a melon and see how the scale works. In other words, we observe that although children are familiar with the concept of kilo and the concept of gram, in reality the concept of weighing and mass is complicated by the way it always deals with issues of financial valuation, buying and selling. As it turns out, it is not necessary for the Roma to calculate exactly one quantity. However, what is necessary is to structure the required quantities in such a way that they will achieve the maximum possible profit in their commercial transactions.

Picture 29: Weighing with an old scale

Picture 30: Getting familiar with kilos and grams

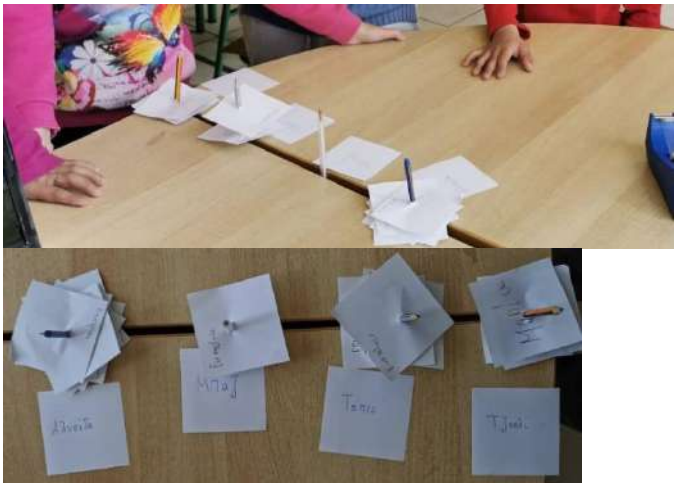
When the subject matter of the discussion is shifted from buying and selling issues to clear weighing issues, students become quite resentful and there is a grumbling within the students' group that it is not necessary to find out exactly how much something weighs. However, the children use a series of items contained in packages that indicate the mass in grams in order to be able to calculate the mass of two lemons as well as the mass of an open package of spaghetti. At this point, we observe that students easily move from the unit of kilo to the unit of gram, reading the masses in the various packages.

They fully recognize that they need to multiply or divide by 1000. Although they are not familiar with decimal numbers at this stage, the children use decimal numbers to determine accurately the mass of certain objects, such as the spaghetti, which is half a kilo, or the tomato paste, which is 250 gr. or a quarter of a kilo as the students report. At this point, we observe that Roma students make multiple objects' combinations in the comparison scale in order to achieve balance.

They automatically realize that the scale needs to balance. In fact, Timos records the indications of the different packages that he places in the comparison scale and concludes that the two sides of the scale differ by 10 gr. even though the packaged items weigh the same. Therefore, the two lemons have a 10 grams difference. Finally, the children use an informal form of numeral performances since they make multiple additions on both sides of the comparison scale and then they subtract to find the mass of the requested object.

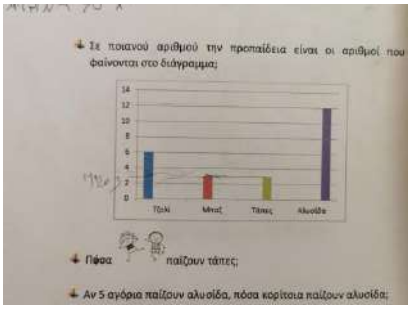
9.8 Charts, data collection, multiplication table and fractions.

Students during the breaks and in their extracurricular life play with four different games that become the subject of study and discussion during the research process. Specifically, there is a classroom research on the game that each child prefers to play. The children write their name on a piece of paper and place it in the appropriate column with the game they are playing. This creates an improvised bar chart, which is then transferred to the paper. Thus, the chart from concrete becomes abstract. Students are asked to calculate how many children prefer each game through the bar chart printed on paper. They group the data and present it through diagrams.



Picture 31: Voting and chart representation

We observe that children calculate the number of the children playing plugs. They also easily distinguish through data visualization, which is the most favourite game. In other words, they compare numbers in a different way and find the result with great ease and in the right way. Specifically, to calculate the number of children who play plugs or buzz Maria says, “There are three children because they are half of half. Since on top is four and on the bottom is two. There are three. Because it is not possible for half a person to play. It has to be one whole person.” That is, she looks for an integer between two and four and finds the result three.

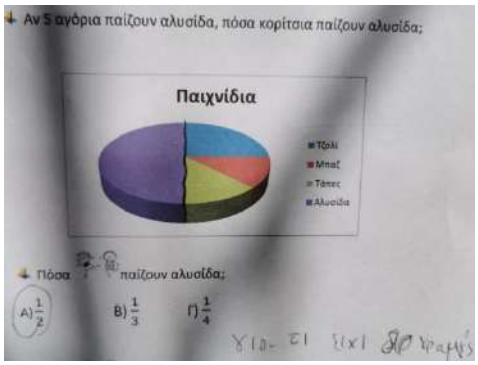


Picture 32: Chart data recognition

We also notice that they can process the data given in the diagram but they do not easily calculate how many girls play the game called chain although they know that the number of boys is five. This happens because children are trapped in the thought that the two groups should consist of the same number.

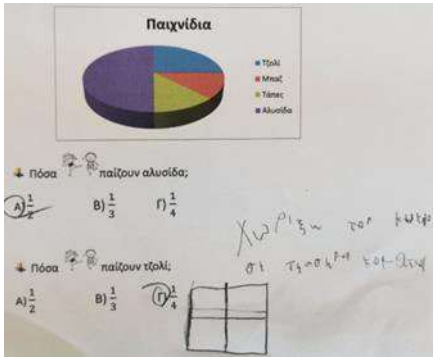
They say, “There will be five girls because there must be five girls and five boys”. In other words, they extract data from the bar chart and process it effectively as long as they break away from the constraints set by their cultural context. In fact, Lakis states, “To see how many girls there are, I have to see how many people there are. They will be twelve minus seven, five girls. So, six is the right answer. Because six and six they must be, both teams must be equal”. Thus, a stereotype emerges, that girls should play in separate groups from boys, which in turn prevents the application of the new knowledge in real – life situations.

As for the pie chart, it is essentially a different representation of the corresponding bar chart data. The difference is that, in this case, we are not interested in the absolute number of children who prefer each game. We are interested in what part of the whole the children who vote for each game are. The answer is structured by using fractions. Children are asked to answer which fraction is the most appropriate and which corresponds best to the corresponding color covering the voted game on the bar



Picture 33: Pie chart data recognition

chart. Therefore, the children find that the game “chain” is preferred by ½ of the children “because the circle has two lines, it breaks in half” says Irene. While for the “jolie” which is preferred by the ¼ of the children, Marina explains, “I divide the circle into four pieces and I take one of them”. In order to be able to explain better, she also draws a rectangle, which she has divided with two lines into four equal parts.

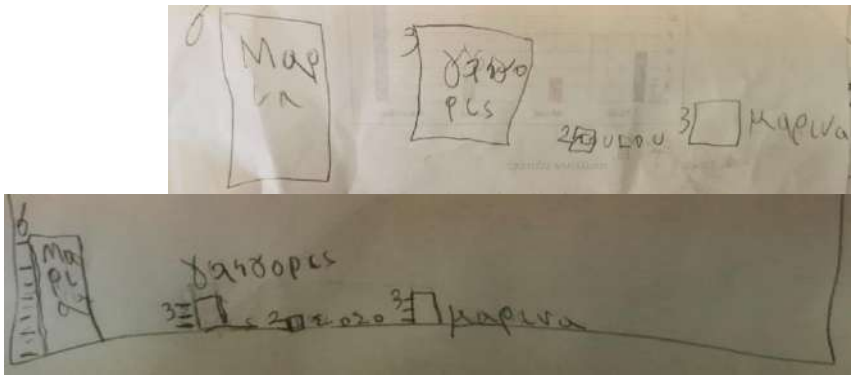


Picture 34: From pie chart to fractions

In the next phase, students who experience feelings of excitement from the new mathematical knowledge with which they interacted, suggest playing a game that resembles the voting process of the various reality shows. Students

Picture 35: Playing a voting game

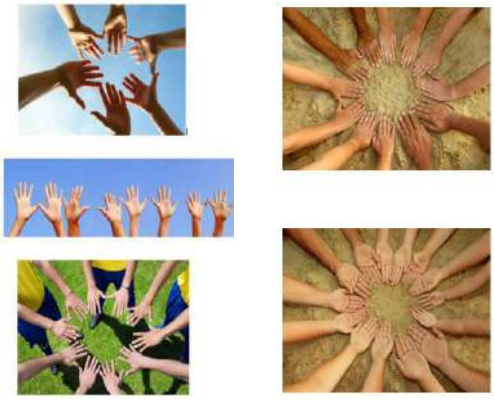
vote for a student, who is proposed to withdraw, and cast their vote at a ballot box. Then, they count the papers with the names and suggest themselves to present the result through a diagram because “you can immediately understand by looking at it who wins”, says Maria. In fact, they draw their improvised diagrams on paper as shown in the following photos. We notice that the students relate the height of the graphs to the corresponding numbers. In one case, Gregory simply draws the boxes from the graphs, writes the name of each child who has received the votes and writes the number of votes next to it. In the other case, Timos notes the value of each bar chart with dashes and numbers. That is, he displays the results with different representations. He also places the diagram on axes. Unlike the first child, he does not use simply placed rectangles. It is proved in this way that Roma students do not hesitate to use the new knowledge when it has been well established. They generalize and apply what theyl have learned as long as the framework created has as a source their real interests and educational needs as they arise in each time. Consequently the mathematics curriculum when characterized by flexibility and dynamic adaptation classmates and in the current socio-cultural conditions is able to achieve the maximum possible results.



Picture 36:Representing data with graphs

9.9 Measuring and measuring estimates

Students are given two worksheets with pictures showing the hands of different people. Students are asked to count the total number of fingers in the hands. Students process the photos and begin to make estimates on the number of fingers in the photos' hands.



Picture 37: Introducing measuring

Picture 38: Finger counting

Picture 39: Counting in pairs, introduction to odd and even numbers

At first, children all together wonder about the total number of children that show their fingers in the photos. Therefore, they start making their estimates by counting the hands in pairs to answer about the number of students in the photos. Students count the hands in fives and tens. Each time, doing the corresponding trial, they use the fives if the hands' number is odd and the tens if the hands' number is even. However, no reference is made to the concepts of even and odd numbers. At the same time, the students report that each person has two hands. Therefore, we can count them in pairs saying "ten, twenty – ten, twenty – ten, twenty (for the hands of each child) as shown in picture 39.

Then, the children are asked to leave a print of their palm on the blackboard

Picture 40: Counting fingerprints

and then Evangelia counts the number of children who left their print and how many fingers they had in total. Therefore, she starts counting the handprints in pairs (she shows with her hands that she counts the hands in twos) but she speaks as if she counts one by one. That is, during her calculation she transforms a pair of hands (she sees) to the child they belong to (she counts the number of children). Then, she begins to count the pairs in tens and says "ten, twenty, thirty, forty … eighty".

Then, the researcher erases some palms from the middle of the board and Evangelia is again asked to count the existing number of children and fingers. The erasure was done in such a way that there are three pairs of hands and one single hand on the board's left side and three more pairs of hands on the board's right side. Therefore, Evangelia begins to count in the same way as mentioned before (that is, she points in pairs and counts in ones). She observes the extra hand and answers that all the children are six and a half with great ease. At this point, it is worth noting that children have not been exposed to the meaning of decimal numbers. At the same time, she concludes, "there are seven children because having an extra hand means that there are six normal children and one more who puts only one hand". To count the fingers, the student initially tries to use the tens but after realizing that there is one extra hand, she starts again from the beginning using the fives.

Picture 41: Counting by tens and fives

9.10 Odd and even numbers

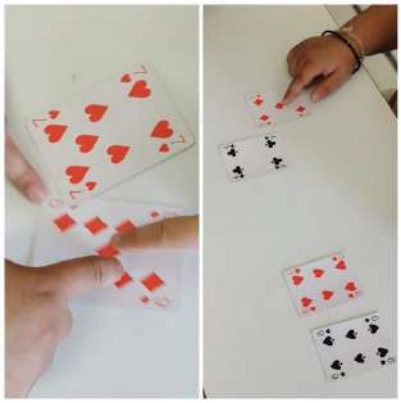
Based on the way in which the students count the fives or tens, we follow the course of the students' thinking and examine the meaning of odd and even numbers. Taking a walk in the neighborhood with the students, following a route where there are specific buildings and street numbering, the children notice that in one side of the street numbers end in 1,3,5,7,9 while in the other side of the street numbers end in 0,2,4,6,8.

Picture 42: Representation with coins

Then, going to the classroom, we approach certain concepts around even and odd numbers through familiar representations to the children, that is, with decks and coins. First, we place a group of students in a 2-1 formation. We ask them to understand if their group is odd or even and why this is happening. The same procedure is repeated with other formations such as 2-2 and 2-1-2. Students have clarified in their minds that a number is odd when something is left over.

Picture 43: Representation with bodies

Then, with the help of a deck, we create some pairs of numbers and ask them to explain whether their sums are odd or even. Indeed, the students easily manage this issue since they are familiar with it. As Marina typically states by showing the deck, "when there is one left, as in 7 and 9, we keep the leftovers, put them together and make them a pair. When we go with my grandfather to empty a certain house, if there is a piece that no one takes, we keep it and after a while you may go to another house that has another similar piece. You make them a couple and then they take them".



Picture 44: Representation with playing cards

9.11 Construction of number line

During the walk with the students in their neighborhood in order to observe the numbering of the houses on the left and right side of the street in order to discuss the meaning of odd and even numbers, the students were in a very good mood and made quite a few jokes with each other. At one point Panagos says, “If I take my bed and put it over here, in the middle of the street, between eight and nine (he shows between the two opposite houses that have this numbering) I will write as its number eight and a half”. This spontaneous mathematical situation was used as a motive for constructing at school a number line in collaboration with the students and placing some numbers on it in order to understand that between two integers there are other numbers.

Picture 45: Number line construction

Initially, the children paint a straight line on the floor of the schoolyard. Then, they are asked to place the numbers on this number line. A special discussion and disagreement arises between the students in order to decide if they need to mark the zero on the number line or if they should start directly from the number one. Most children agree, “We start straight from one because zero has no value” but Irene reacts strongly and tells them “Come here, dudes. In these wires here in the school, the columns they have are like a number line. Take a place each (she shows the children). You will be one, two, three and a half”. The rest of the students indeed place their bodies in the roles distributed to them by Irene and form a number line with their bodies on each pole of the school fence. Then, the researcher calls Voula to take the position requested by Irene that is to place her body at three and a half. Then Irene

Picture 46: Trying to sense the value of zero

leaves her position and shows that where Voula is sitting is not three and a half but two and a half and this happens because another extra child had to enter position zero.

After this process, we suggest that the children think of a utility of the number line that is important for our daily lives. The children, after a discussion with each other, suggest that we make a number line with the six classes of the school written on it, so that they can be gathered in separate places in order to keep their distance due to the measures for preventing the spread of covid19. Indeed, with floor chalk we ask the students to write down the letters that correspond to each of the school classes. At the same time, we observe that they calculate the distances correctly, since they leave about two and a half floor slabs of distance between each class. Kostas explains that each such slab is “about half a meter, so because we want one and a half meters we leave about two and a half slabs for the children to sit”. Through this incident, it is understood that mathematics acquires a different meaning and different substance depending on the situations which students are asked to face and interpret. On the other hand, the Roma students’ familiarity with constructions and building materials in general, functions as a mathematics vehicle for them.

Picture 47: Placing classes in the yard

Picture 48: Thinking mathematically outside school

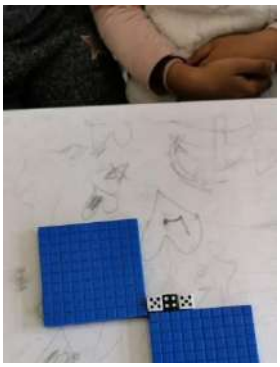
Confirming the above conclusion, as already mentioned, the researcher – teacher must at every opportunity build relationships with the students and listen to their real concerns and the real issues that concern them. In order to achieve this, regular walks with the students are organized at regular intervals because it is believed that it is important for Roma students to be often in a context outside their community because the interactions help them to overcome the existing socio-cultural

entanglements. In such a visit to the area of Piraeus, the children in a moment of carelessness as they jump on the concrete rocks of a jetty, report, “the two extreme students are one and two and I will jump in the middle to become one and a half as in the number line we made at school”. In other words, Roma students constantly have in mind mathematical activities that occur in the context of the present research and apply them at an unsuspecting time in their real life, thus creating a mathematical shift in the topics discussed in peer groups.

9.12 Dice in a corner

Students are asked to place three dice in a corner formed by two colored surfaces in any way they want. The only rule is that the surfaces of the dice that come into contact form the same number. The goal is to achieve the largest possible sum.

Dice are a mathematical tool that is very familiar to Roma students as they are daily used by the students’ social environment in traditional games (backgammon) and casino games (koumari, barbouti). Therefore, children have an increased interest in its use since it is something common for them and at the same time forbidden because young children are not allowed to gamble. In the following description, we find out how a cultural tool (dice game) is used as a problem-solving tool.



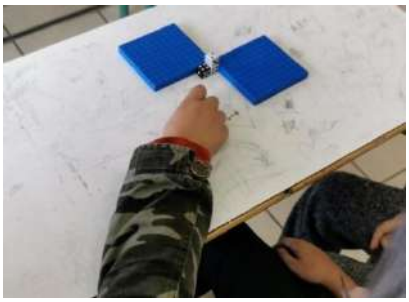
Picture 49:Trial with three dices

Picture 50: Different attempts

Students make many attempts to place the dice in different combinations as shown in the following pictures. They perform operations with small sums while they realize relatively soon, that is after the first two attempts that in whatever way I choose to place the three dice in the corner of the surfaces, I will

always have to add seven different numbers. That is, as Raphael states, “no matter how I roll the dice, I will always find seven sides that I will have to add”. “I always have something which is the same, every way the dice are rolled”.

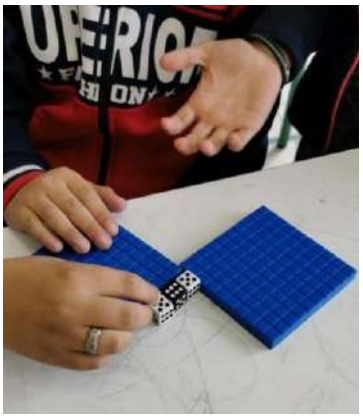
Initially, their thinking leads to the fact that the dice on the edge has a greater influence on the result, since Spyros mentions, “the above (meaning the vertical arrangement) and that on the edge (meaning the horizontal arrangement) we care about because they have three numbers (he means that three surfaces are shown for the sum).



Picture 51: Vertical or horizontal positioning

However, after several tests, the children participate actively and warmly and worry about the larger number. They think that in order to find the largest sum "I will join the smaller sides so that the big ones are free". Specifically, one team has found a maximum sum of 34 and no other can exceed this sum.

While this solution seems to be the best, one group of three boys decides to sacrifice the next hour of Physical Education to keep trying to get the maximum result. To the question, "Why do you think there is a greater result (sum) and you want to try more?" the students replied, "This operation here is not like the ones we do in the lesson (meaning vertical and horizontal additions with two numbers) and it can produce many results. There is not just one correct result".



Picture 52: Identifying the role of the middle dice

After about 15 minutes of effort, Spyros returned and replied, "The largest number is 36. I put the five in the middle, two sixes from here, one three from here and again a six from here and a five from here. The middle plays the most important role because when I turn it, it does not come out the same. That is, the middle commands what each dice will show ".

That is, the students through trial and error find out that while at first it seems that the dice with the three free sides mostly affects the result, in fact the middle dice is the one that indirectly determines the result. This happens because it also affects the values that the other two dice will get (since the surfaces of the dice that come in contact must have the same value).

9.13 Introduction to probabilities

Games of chance as well as dice games are a big part of children's daily lives. Roma adults as well as younger ones are accustomed to games of chance, dice games and card games. In this case, we will take as a starting point the existing familiarity of the students with the dice and we will deepen their knowledge of certain mathematical concepts by approaching them in an alternative way.

Picture 53: Playing during school breaks

The children make an improvised dice using the knowledge they have about the measurement as well as the development of the cube. This dice is used as shown in the picture for a game that takes place in the schoolyard. In this game, called snake, the use of the dice is necessary. Before making it, the students calculated how many boxes each would move as follows: They threw a stone from a certain distance into a fixed wall and they moved on the game board as many steps as the stone had gone. The distance between the child who throws the stone and the wall is about six steps, so the result that the child will bring will be up to a maximum of six. However, what can be the result of a throw?

Picture 54: Improvised dice

The above incident is the reason for approaching the concept of probability with students. In class, students are asked to roll the dice and record the

results. The process of recording the results acquires special interest since the children effortlessly decide together to create a bar chart on the board where the results will be shown. Euthalia says, "We will do better what we plan with the boxes because as we said it seems with the first one who is luckier". Meanwhile, Stella says, "Yes this should be done because if we have to remember what the dice brings “mia mouka vekou”. That means it will eat my life (meaning it is very tiring and difficult to remember the rolls of the dice using your memory). Indeed, we notice that the students draw improvised bar graphs on the classroom board as well as that they mark the units of measurement one by one on the vertical axis of the y´y.

Picture 55: Representing dice results with charts

Picture 56: Examining probabilities with coins

Students are then asked to estimate what the result will be when we toss a coin heads or tails too many times. They start doing some tests, but Ephraim says, "If I toss the coin a thousand times, let’s say, my father told me that heads and tails come straight. He had done it once." Spyros goes on saying, "both sides would come together because it is like putting your hand in the fridge in the store that has the strawberry and lemon granites. These are too many and if you put your hand in, once it will get a strawberry, once it will choose lemon, since he has put an equal amount of them and you get what falls on you every time ". At the same time, Irene laughs and says, "What are you looking for, teacher? This is also what it happens if you steal. Once you will be caught, whatever is about to happen time. What is written is what will happen”. Through this incident, the special influence that exists between the Roma culture and the metaphysical conceptions of fate and fortune is highlighted.

Although the students' contact with the concept of probabilities has a positive outcome and there is a positive response, nevertheless the students do not stop connecting simple and everyday issues of probability with the luck and the "written" of each person. Fatalism, beliefs and fate in metaphysical phenomena is a characteristic that is often found in societies and individuals who have limited scientific knowledge, something that is confirmed through this incident.

9.14 Venn diagrams

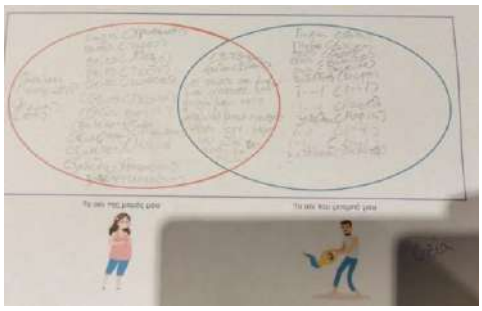
Quite often students discuss to determine the relationship between them. The kind of relationships between them is a constant topic of discussion. They also discuss how these relationships arise through their family's history and their family tree. In order to illustrate these kinship relations in a tangible way, we decided to negotiate the Venn diagrams in collaboration with the students. First, the children were presented with an image of items that can be purchased from a grocery store and items that can be purchased from a greengrocer. Thus, two distinct sets of objects were formed, but also some objects emerged that exist in both stores. These objects are written at the intersection of the two sets.

Picture 57: Representing family tree through Venn diagrams

In order for the students to understand the meaning of the intersection and the union of the sets, they were presented with a simple diagram, which consists of all the relatives of the father and all the relatives of the mother. The intersection of these two sets includes the students themselves as well as their siblings. Students, after extensively completing their parents' family members, understand the essence of the Venn diagram, their practical utility in depicting their family relationships, and discover family members belonging to both groups.

In the discussions that take place in this context, Evangelia wonders "My father has one or two second cousins (brothers among themselves) one of

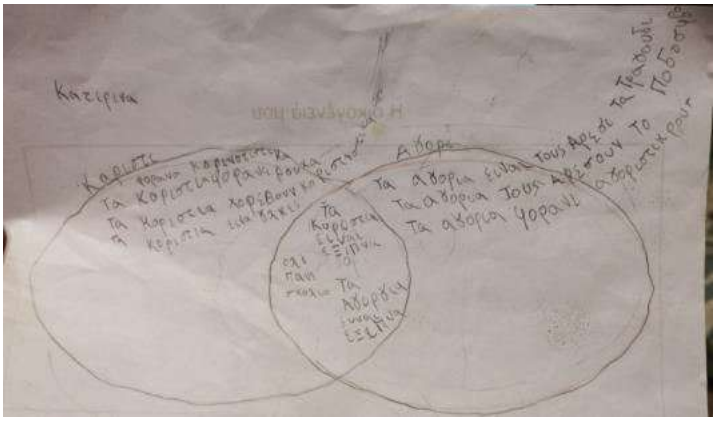
whom has married my mother's sister and the other has married my mother's first cousin. Will their children be enrolled in both circles?



Picture 58: Identifying persons who belong to the intersection

Spyros states, "My father and mother are somewhat related. That is, my grandfather's brother adopted my mother. Nevertheless, they are not of the same blood. "Shouldn't my parents belong to both circles as we children do?" At the same time, cultural issues emerge as the rest of the students realize that it is not "correct" to report publicly their family's incest issues. They are beginning to hide those written in the intersection of the two sets in the Venn diagram by erasing some names.

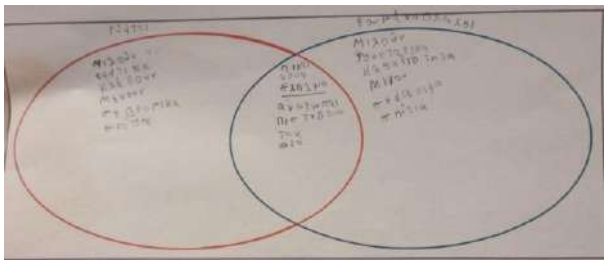
This math activity gives children the opportunity to realize incest issues that concern their families, to consider whether it is right or not that this happens and whether they should reveal their family's secrets during the lesson. It is common in Roma society for marriages to take place in a closed circle. This certainly does not happen because the Roma do not want to alter their race as the prevailing view claims. In reality, the cause is that the prevailing culture avoids associating with them, thus leading to their marginalization and isolation as a group.



Picture 59: Thoughts about sex discrimination

Zoe reports, "My godfather has married my mother's first cousin. My godfather has my father as his first cousin but I will not write him in the middle. I will write about my godfather, without you knowing that he is my father's cousin. Because if they see it, they will kill me because I told tales about it". Katerina (who is a child with older sisters who

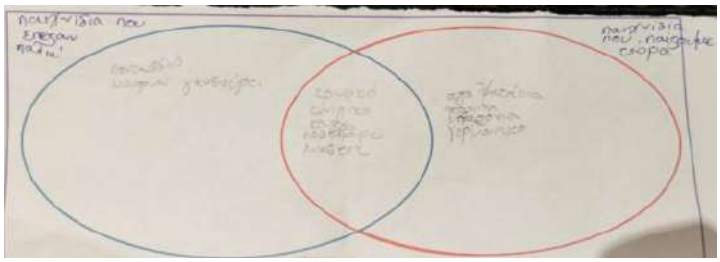
have dropped out of school at the age of 12 in order to get married) makes a Venn diagram with the differences between boys and girls. At the intersection of the two sets there are the phrases “girls and boys are smart, they both go to school”. In other words, we realize that the child is overwhelmed by thoughts about gender discrimination between boys and girls. The Venn diagram and mathematics become the occasion for her to be able to externalize these thoughts and to support her own point of view, that is, equality between boys and girls, in a more formal way.



Picture 60: Highlighting competing social groups forces

Vasilis thinks directly about the similarities and differences that exist between their own tribe (Romanian-Vlachs or Rundarides) and the competing Roma group (Chalkidians) that exist in the same area. It is worth noting that in the differences the personal element and the opinion of the important people of his social environment is strong since he mentions, “they steal, they live in dirty houses” while in the commons he states that “they also go to school and believe in God”. School and education therefore receive universal dimensions and are a common experience even for groups of people with conflicting interests. Education seems to bridge the gaps between rival social groups and be a common starting point for reconciliation.

Lakis compares the extracurricular activities that existed then and today. He finds that the most important difference between now and then is the existence of electronic games and the internet. Between the similarities, he mentions the elementary children's games such as hide and seek as well as hunting because “children always want to play in the countryside” He also mentions orally “In countries some do English, some German, some Greek but everyone does arithmetic (meaning Mathematics) because the numbers are the same for everyone. Everyone sells, buys, counts and makes transactions”. In other words, the student recognizes the universal dimension of Mathematics, that mathematics is potentially a universal language of



Picture 61: Comparing games of the past to modern games

communication that unites rather than separates people, cultures and civilizations.

This leads to a culturally oriented version of Venn diagrams. Children try to identify applications of Venn diagrams in their real life. At the same time, they touch on issues of their recent personal and family history as well as issues of racial discrimination. Such an approach to the mathematics lesson in school creates discursive plateaus, which create the opportunity for personal human stories to emerge.

In fact what is observed is that issues of incest are raised between the Roma people since the relations between them are of a special nature. From a legal nature, there is a question of the legality of their relationship and this fact is one of the reasons why Roma do not marry formally but formalize their relationship within the community with special procedures and traditions. However they cannot be accused of violating serious family relationships as they respect the family. Each one of their interpersonal relationships hides a personal story and this is also a consequence of social exclusion as they have the opportunity to interact only with people of the same social group. Isolation has become so strong through the years that it is now seen as a normal way of life for this particular social group.

9.15 Intersecting parallel lines.

Students are exposed to the concept of parallel lines but also of parallel lines intersected by another. The reason for approaching this mathematical subject arises from the frequent reference in the oral speech of Roma students of the terms "crooked line" and "straight line". Very often, simple concepts and everyday terms used by the Roma in their verbal contact with people as slang are ridiculed. Therefore, understanding and using the concepts of parallelism and intersections is especially important to remove this kind of targeting and discrimination.

Picture 62: Identifying usefulness of parallel lines in real life

Initially, they are asked to locate parallel lines around them but also lines that are not parallel. They mention the railway tracks, the banks of the stream that is adjacent to the school, the pencils that are placed in the pencil holder next to each other and the sides of the bridge that they have built to cross the torrent that passes next to their houses and separates them from school.

Then we look for ways in which parallel lines are useful in our daily lives. Through the discussion and dialogue between them the students distinguish that the game with the rope they play consists of two parallel lines and that “our feet that pass over the rope on one side and on the other side are like a line that cuts the extreme parallel lines ". That is, they understand the meaning of parallelism and the meaning of intersecting lines.

Then the students observe the lines that exist in the neighbouring stump that is being constructed and report that there are both parallel lines and lines that intersect. "The parallel lines are those we construct to prevent the house from falling. It is the same as the bridge, at the edge there are parallel lines that are the beams so that the bridge does not fall. We do not care about the other lines, they are constructed randomly", they report. However, "The roof has lines that rest on each other and does this to get the water out. If the lines are straight (meaning parallel) the water will stay up (meaning rainwater), it will not leave." In this case, we understand that students use the terms straight and crooked lines because they have a strong cultural background that gives meaning to this verbal representation of reality. They fully understand the reason for the existence of straight, that is, parallel lines and the reason for the existence of crooked lines and connect it with simple everyday phenomena such as the slope of the roof, which helps to remove rainwater.

Picture 63: Parallel and intersecting lines in building construction

Picture 64: Cultural representation of the mathematics reality

Picture 65: Solving a mathematical puzzle

In order to extend the above observation of the students with an activity that has practicality for the class, a small house is constructed on an improvised cardboard. Students are asked to place the string into the notches in such a way that the string does not pass through the same spot twice. Many tests are actually done to be able to solve this puzzle while at the same time distinguishing the parallel and intersecting

lines that exist in the figure. They discover ways in which they will place the string so that there are no intersections.

Then, during an educational visit where students would make bird food with recyclable materials, students were asked to place the tables in such a way that they were parallel to each other. What we observe is that although they perceive the difference between parallel and intersecting lines, they consider parallelism as related to continuity, the sequence of objects. As shown in the picture, they place the desks one after the other (in continuity) while they do not think of placing them next to each other, that is, in a parallel manner. This happens because it is very common to place the tables and the benches with the following layout on the street outside their home for family celebrations. They also place them respectively for the carnival school festival as shown in the following image.

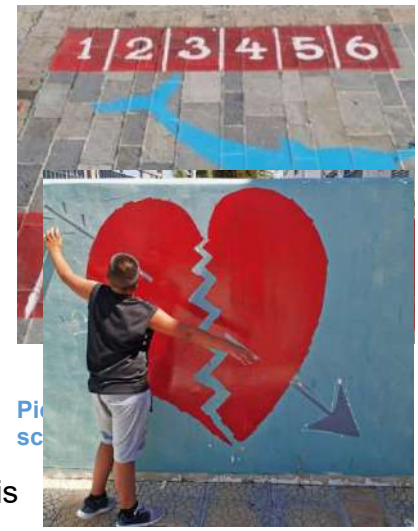
Picture 66: Placing tables in parallel layout

Picture 67: Similar layout of tables in school festival

In order to deal with this misconception of students that prevents the acquisition of new knowledge and stems from their socio-cultural context, the construction of a game in the schoolyard is organized. The game consists of some parallel lines, one next to each other. Children are asked to find out if there is a parallel between these lines.

The red sides resemble the banks of a river while in the middle there is the water where the fish swim. Children are asked to draw a bridge to cross the river. They divide the "bank" into equal parts with parallel lines. Thus, the students are exposed to an issue that is related to their daily life. Therefore, they realize that the parallel lines can be next to each other but also that the straight line continues even if it is not visible. That is, the straight line of number one continues over the "water" and ends at the opposite bank. Marina and Spyros report, "It is the line that goes from the other side. It is the rope that you put first to pull it and put the wood for the bridge over it. You grab the rope from one band; you grab it from the other band. However, in the middle it

falls into the water and is not visible. If it does not appear, it is not that it does not exist." That is, they realize that a straight line continues even if visually its continuity is not visible.



Picture 69: Sentiments, art and parallel lines

Afterwards, we ask the students to identify a drawing in which there are straight and zigzag lines. The children think a lot to find a plan that has a "broken line", as they typically say, while the next day they come to school and present their idea for the shape of a heart cracked from love. Roma society is a society characterized by strong expression of mental emotions. Love is an emotion that touches children from pre-adolescence. After all, it is known that Roma get married at a very young age because this is the only way to legitimize their intimate feelings towards their peers. Therefore, the children suggest that we draw a love-struck heart. Indeed, the heart is painted on a school wall by the students and has a zigzag line but also the straight line of the arrow that sometimes appears and sometimes disappears behind the heart. In other words, as a result of yet another meaningful activity, the students clearly understand the meaning of the continuity of a straight line even if visually the opposite is seen.

Picture 70: A loom

Examining the concepts of two or more parallel lines intersected by others, we prepare with the students a makeshift loom. This loom is a traditional textile machine where handmade textiles are made. These handmade textiles are familiar to students because they use them in their homes for handmade rugs. Thus, based on the so-called "rugs" that are the object of daily use in students' homes, we see how a loom works and how the parallel and intersecting lines are related to it. The loom consists of some parallel lines between which the students have to pass the colored thread (in a vertical layout) in order to form the handmade textile. Thus, they intuitively understand the value of parallelism but also the importance of intersecting lines.

Picture 71: Identifying a handmade rug in a Roma house

The students were impressed by this kind of approach to the patterns. These activities helped them to understand on the one hand what a pattern really means and on the other, how two parallel lines can be intersected by a third. Really, after a long time, as I was visiting a student's house, I noticed a piece of handmade carpet that seemed to be made on a loom. When we asked them where they got it from, they answered that Katerina had made it with her mother as a craftswoman.

In their wider area, there is an institution for the support of people with special needs. This institution provides, in cooperation with the local community, textile craft lessons. The two women reported, "Katerina really liked what you did in mathematics. After the lessons she was always looking for her book to find where it has such shapes with pictures-she means patterns-. One Sunday in the church, we were told that they have a loom and they also make things in a crate. We went one day together, they were fine and we were accepted. Then we picked up some rags and wool that was useless and we could do that". Starting from the approach of the parallel lines that are intersected by a

third line and giving it meaning through the frame of the Roma students' daily life, the opportunity is born for a student with her mother to engage in an activity in a social context outside their own community. This fact, although it seems simple, is a significant transcendence for the student and her mother. They overcome issues of racism and prejudice, join a social group where they voluntarily engage in traditional handicrafts, use

Picture 72: Activity in the laboratory

mathematical knowledge that the student has acquired at school school and they can thus change their daily routine by engaging in activities beyond their usual ones.

Raphael, finally, characteristically states, "The parallel lines are for beauty, they are to show something beautiful. We do them for a start. Then to make something with our hands we join them (meaning that we create intersecting lines). You have to join to make something happen. Otherwise, it does not help. See the bridge. If it has parallel lines only to the sides, you do not cross it. You have to join them to get the job done". Vasilis continues "So at home. If they are all parallel, the water stays on the roof. If in the joints they fall down, the house does not get wet (he means that if the roof is straight the water stagnates and makes the inside of the house wet while if the roof is tilting there is runoff of rainwater) ".

Picture 73: Beauty and functionality of lines

9.16 Patterns

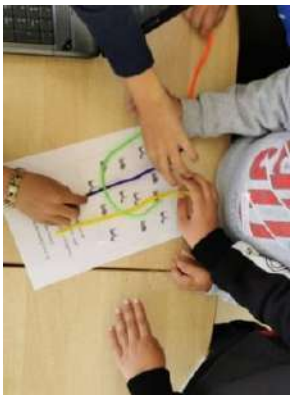
Students play improvised games with the plugs during the school breaks and in their daily lives in general. Based on their involvement with the plugs, we transform this game into a pattern. The pattern is a triangle as shown in the adjacent picture 74, which must change its vertex and invert with only three

Picture 74: Pattern with plugs

movements (movements of the plugs). Indeed, the students work in groups of five on this mathematical pattern and try to transform it for about fifteen minutes, but to no avail. Then, Vasilis with logical-mathematical thinking says, "Since we have to turn it upside down, the number of plugs must be opposite. Therefore, it is 1-2-3-4 and it should be 4-3-2-1" meaning that the rows that have a certain number of plugs should be reversed. As soon as he formulated this thought and showed with specific movements what should be done, immediately the group began to think differently. Thus, in a few seconds the requested pattern was found. Timos thought, "We have to take from the lines with the many and put in the lines with the few to turn it upside down". In the end, Maria said, "numbers and deeds are hidden behind it, that's why we didn't try for so long. If you do not do the deeds, it cannot be solved" meaning that the pattern hidden behind the shape must be found in order to find the right result.

Picture 75: Reverse of the triangle

Afterwards, students face a math riddle with lions and zebras. They must separate the lions from the zebras by four straight lines in order to protect the zebras so that the lions cannot eat them. The children are troubled but find the solution relatively quickly and separate the lions from the zebras. At first, they face difficulties in finding the solution because they try not to let one colored line pass over the other. Indeed, when the researcher tells the students that these colored wires can be like parallel lines, it is a matter of seconds to solve the problem. They all agree, “If they are like lines, they can touch each other”. Grigoris says, “Teacher, this is like the cops (meaning the police) who have to separate the gypsies from the “balamos” (meaning different tribes) or us when we quarrel



Picture 76: Trying to separate lions and

with each other. He wants to separate the Siskaious from the Kambourides (he mentions two rival family names). One police van does not fit on top of the other".

In other words, we observe that students face limited difficulties because, while solving a specific mathematical riddle, they nevertheless reduce what they solve to a familiar event, to a familiar environment. Valantis finds this exercise very useful because "it is like inside the prison where one wants to separate from the other, to enter other cells so that they are not quarreling" and Giannis thinks that "just like my father who makes the shelves, the boxes inside which you can find one thing or the other, to short out your things. The same happens in the bazaar. They put things in lines apart from each other ". Finally, Spyros shows us the work of laying tiles in his house and states, "So, when you lay the tiles you do not put them in a line so that the water can leave. You start from the edges (he shows the figure's edges) and you go slowly inwards for the water to leave from the inside. If that doesn't happen, it breaks».

Picture 77: Relating the puzzle to everyday life tasks

Picture 78: Thinking mathematically

After a few days, the municipal crews collect the useless building materials from an auxiliary building of the school that has been completely looted by the Roma. The building materials are gathered in a part of the schoolyard without being collected for a long time. The students refer to the activity with the lions and the zebras and Costas states "it is the same thing as trying to separate this rubble into construction carts to get them with the shovel".

When students are asked to suggest a way to calculate as accurately as possible the number of carts that will be needed to collect waste materials, Costas says again, pointing with his hand. "I will separate them so and so- he shows vertically and horizontally - and I will measure six steps in one cart, seven steps the other cart. So, some forty carts will be needed for everything".

Picture 79: Relating paces, surface and quantities

That is, we observe that the student calculates with his steps the area occupied by the unrequired building materials and then estimates that each square corresponds to a load, calculating with this technique the number of carts needed.

After a period of almost three months, when we return to school after the restrictive measures for the spread of Covid19 pandemic, we resume the activity with zebras and lions with the students. It is noteworthy that the students immediately place this riddle in the context of protection against the spread of the virus. Thus, they state that we could draw such colored lines in the yard to separate the groups of students so that they do not encounter each other, while Maria states, "my dad tells me that this disease is like a lion, if it falls on you it chews you".

Picture 80: Estimating people in a farm car

Finally, during these discussions with the students, a car with a trailer passes by in front of us on the road. It transports many people. The students parallel the situation and Irene says enthusiastically “Teacher, also here in the car this is how we get out (meaning we calculate) the people who fit. We calculate the trailer, six feet from one, three feet from the other, so eighteen. That is, about twenty people fit all together inside”. That is, we observe that the student parallels the way in which we calculate the collection of useless building materials with the way in which we calculate how many people can fit upright in the trailer of a farm car.

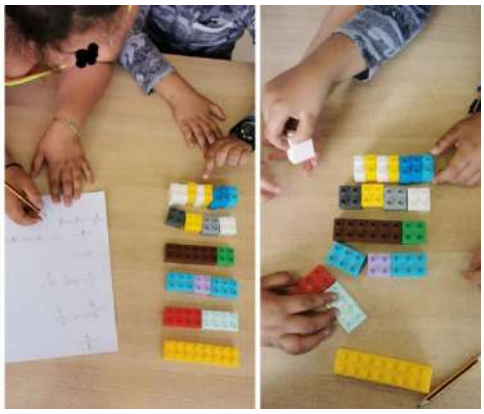
Through this activity that has nothing to do with the context of Roma students, it becomes obvious that the situation the students experience at each time gives a different color and different importance to their answers.

9.17 Introduction to fractions

Picture 81: Traditional party of Roma community

These introductory activities in fractions aim to activate children's pre-existing knowledge about fractions. Students have a range of knowledge and skills related to fractions that they use in their everyday language. Students already have a perception of fractions, which comes almost from the search of a whole's part.

In this case, we seek to approach the fractions with interdisciplinary activities aiming at the relationship of fractions to music. Music is an important part of the life of Roma students since festivals do not need any special reasons to be organised. Moreover, a child's talent is highly recognized when (s)he has the rhythm or when (s)he knows how to play a musical instrument, even if this musical instrument is limited to simply giving rhythm to a dancing wiggle. In order to find the occasion for discussion and connection of the fractions with the music, we participate in a traditional spree of the families of the Roma students and we look for simple ways in which we can give rhythm to a dance.



Picture 82: Lego bricks and equivalent fractions

In order to introduce the fractions, we take advantage of the help of Lego blocks. Specifically, the researcher gives the students a group of Lego blocks and asks them to make as many equal parts as possible by making the appropriate combinations. The goal is to have no Lego pieces left over. The children are very interested and manage to make six

different combinations. Then, they are asked to represent the combinations that I have made on the map by writing the fractions, which happens with great success.

We notice that students are quite familiar with the concept of the equivalent fraction in their daily lives. This fact works positively for understanding the concept of equivalent fraction as represented by numbers on paper. Irene states, “All these pieces are equal and there is no difference. It is like taking a package of spaghetti that has a lot together. If you split them one by one and get three packages, it is the same thing as getting a big triple. In addition, you economize.

The same goes for the money, five one euro coins give you a five euros note. (She means that five coins of one euro correspond to a five-euro banknote)”. Marina also reports, “It’s the same thing as with the puzzle. If you take all 45 pieces apart, it is the same as getting a whole. However, you have to make it to be the same as the whole. Like writing on the paper one by one to create the whole, the same happens with the pieces of the puzzle”. Spyros finally says, “Teacher, this with the bricks is also the same with the water. If we drink hookah, you put in a lot of water like the brown - he shows the brown brick - and after you put taste in the rest of it and all together make the fume”.

Picture 83:Boom-whackers and keynotes

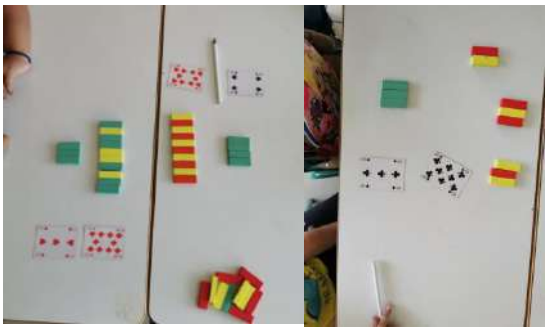
The next day we use some simple boom whackers, each one of which gives a musical note. Students are given seven tubes of different lengths, each corresponding to a different note on the pentagram. Students measure the length of each boom whacker with the measuring and then record these values on paper, thus identifying each note in the form of a fraction. The numerator is the length of each boom whacker while the denominator is the length of the largest boom whacker.

At the same time, we fill seven glasses with colored water in specific proportions and ask the students to hit the glasses with a pencil and compare the sound produced by each glass with the corresponding sound produced by each boom whacker. Children are impressed when they realize that sounds are the same and that objects of different materials and lengths produce the same sound.

Picture 84: Comparing sounds through boom-whackers and glasses

Then we ask the students to measure the length of the full part of each glass and record their results in the form of a fraction. The fraction's numerator is the length of the liquid in each glass and its denominator is the length of the largest glass. Finally, we ask the children to divide the numerator by the denominator with the help of a calculator. They notice that the results from the boom whacker and glass fractions are almost equal.

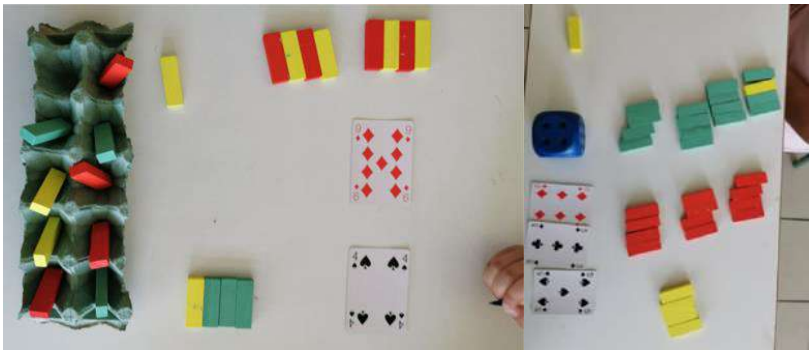
In addition, because students show great interest in approaching fractions, we seek to address a more demanding mathematical problem. That is, we discuss about abusive fractions and their conversion to mixed numbers. We thus create with the help of the deck, which is a familiar representation to the students, a fraction that is abusive and its numerator is greater than the denominator. Afterwards, students divide the fraction numerator into equal parts exactly as the denominator indicates each time. We observe that in this way students understand easily the meaning of the whole and the remainder that exists as a fraction each time and successfully perform the conversions of an abusive fraction into a mixed number.



Picture 85: Different representations of fractions

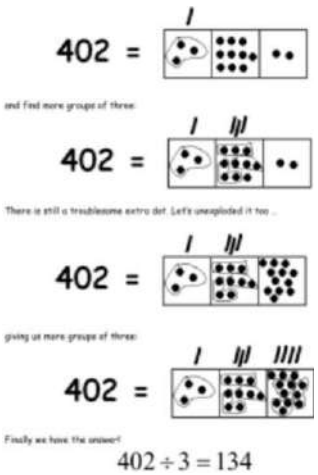
At the same time, Irene, in order to show even better what she is doing, places the wooden bricks in an egg case to show us how many whole pairs there are and how one of the two is left over at the end. Specifically, she

concludes by saying, “what we do, teacher, the fractions, are all around us; they are in our home, in our life. All the time we want to divide the food into equal pieces and we are left with a little more. We want to divide a chocolate into equal pieces and we are left with a little more. The same with the chewing gums, we are left with a little more. Also when we sell eggs for example one is left over and the rest we give as a whole and so on”. That is, with proper visualization and cultural meaning of mathematical activities it is possible to overcome existing difficulties, thus enabling students to understand even more complex mathematical processes.



Picture 86: Use of objects to explain the way of thought

Because there is a lot of discussion with the students about the concept of separation of quantities, the researcher deems that the ground is appropriate to proceed with the approach of the deed of division with the students. It is worth noting that the act of division is quite complicated for Roma students and in most cases, students complete the sixth grade of Primary School without even being taught division. We actually form a three-digit number and ask them to divide it by the number that the students bring to the dice. In fact, they represent each of the digits of the numbers with colored bricks (that is, the hundreds with a yellow brick, the tens with a red brick and the units with a green brick) that refer to the meaning of the euro banknotes. Then, they follow a procedure like the one shown in the adjacent picture and successfully perform the mathematical operation confirming their result with the calculator. Students feel very happy with this cognitive acquisition. During the school break, the children discuss



Picture 87: Explaining division alternatively

with the other students the fact that they have learned to divide successfully and that they have managed to achieve the same result the calculator shows.

Picture 88: Linking musical chairs to fractions

During the school break, the children play music chairs in order to relax and unwind. Through the mathematical situations that take place during the conduct of this research, the appropriate conditions have been created for students to think mathematically at any unsuspecting time. Indicative of this climate that has been formed is that during the musical chairs' game, Katerina states, "What we do is like fractions. That is, above we put how many children are playing and below we put how many all the chairs are. The chairs are always one less than the number of children. That is, we write it as a whole circle and ⅛. It will always be like that in all the rounds. It is always a whole circle and 1/7 and so on".

At the same time, the appropriate mathematical opportunity was created to approach the comparison of fractions. Students are asked to compare the fractions as they appear in each round of the musical chairs' game. The students realize that the fractions in each round of the game are different since, as Maria states, "They are different, for sure, because we see them. It is not as when they are written on the papers that you do not see (she means it is difficult to compare them due to the standard writing of the fractions that exist in the mathematical textbooks) to understand them". That is, in this case, Roma students, through an experiential game, discover mathematical knowledge.

Lakis continues, "The fractions are different. The fewer children who stay in the round, the bigger the fraction because the smaller the circle, the easier it is for you to get a position". Therefore, the student realizes that 1 ¼ is bigger than 1 ⅕ because in one case there are four competing players and it is easier to find a music chair than in the other case where there are five

players. This representation of fractions is quite interesting because students overcome mathematical obstacles that exist in the process of comparing fractions by transforming a simple game into a mathematical situation capable and appropriate for producing new knowledge.

Picture 89: Representing fractions with chairs and bodies

A little later, Kostas and Lakis play alone in the classroom and place chairs as shown in the adjacent picture. The students are alone in the classroom and the teacher asks them exactly what they are doing. The students continue the musical chairs' game and make unequal fractions. As they say together, "A child with one chair is more than a child with two chairs because that way you do not know where to sit and you have to sit in the middle, that is, to divide yourself in two". When asked to make equivalent fractions using the chairs, the students continue, "A child with two chairs is the same thing as two children with four chairs". Although visually, the picture does not clearly show the representation that they express verbally, the students use chalk and record on the chairs the mathematical representation of the two equivalent fractions.

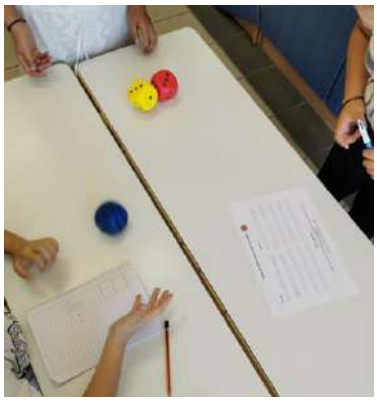
In the next school hour, many children from the older classes of the school gather in the room to have their classmates explain to them exactly how they do the division. The children are excited to find a way to divide and Valantis typically states, "The teachers in this school are not good and do not teach us the maths we need. Can we come to this class to do maths next year? Because we learn things and then your mind is sharper at home and at the bazaar. Everything we say does not work, but sometimes some of them help". Then, the researcher tries to create a conflict in what they say by telling them that if you need to make a division at home or in the bazaar, you cannot have the bricks as we have in the classroom. Then the students, almost with one voice, claim, "This is not the problem because you can find pebbles, you can find sticks, you can do it with a thousand things. The problem is to know the way, the trick is above all".

In fact, through the words of the students, an interpretive framework of the conflict that exists between the students and their families and the school emerges. They consider that the school is not able to provide them with knowledge necessary for their daily life, with knowledge that will enable them to improve their daily practices and solve their daily problems. Thus, it is understood that Roma students are interested in acquiring mathematical knowledge and consider mathematics valuable for their daily life and work. They realize that mathematics can be either a useful tool for their daily lives or an obstacle that creates difficulties in their daily lives. The school context for them only makes sense when it is able to provide them with cognitive weapons for their real life.

9.18 Numbers' deeds with the help of dice, the deck and dominoes

Roma students find it quite difficult to solve exercises with vertical mathematical deeds. This difficulty is due to two main reasons. On the one hand, they find it difficult to understand the position value of a digit in numbers. On the other hand, they find it difficult to represent a number in specific boxes. Roma students generally find it difficult to fill the appropriate digit in the appropriate box, as this process is abstract and lacks practical meaning for the children.

For this reason, we initially use three dice. Their color is suitable to represent each euro banknote and specifically the yellow corresponds to the banknote of one hundred euros and therefore to the hundreds, the red to the banknote of ten euros and therefore to the tens and the blue to the units. We encourage each child to roll the dice nine times, that is, three times each, to form three three-digit numbers that they then record on paper and make the vertical addition.

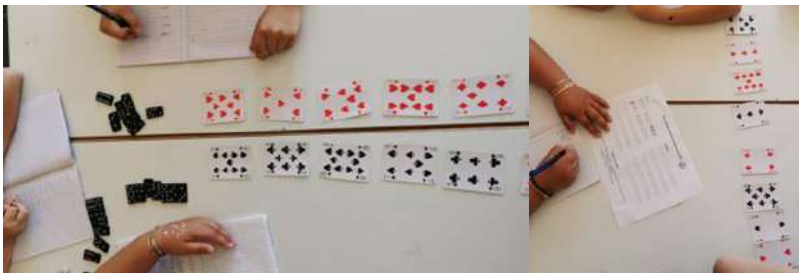


Picture 90: Understanding number digit value

Although this activity seems simple, it is very demanding for Roma students. Children have difficulty both understanding the value of hundreds, tens, and units, as well as representing numbers correctly by placing each digit in the appropriate place. In addition, they find it difficult to

record each number in the correct box, and finally they find it difficult to convert a horizontal arithmetic operation into a vertical one, placing the numbers in the correct order one below the other. The students are attracted by the way in which numbers are represented through the euros. They clearly understand the formation of numbers and they record each digit in the box without expressing any questions since as Lakis states “Every paper (means every banknote) is a separate piece, it is not confused as the numbers are confused and you do not know where to write them”. Then, they record the numbers vertically and perform the vertical additions without difficulty. At the same time, they apply a different way of thinking as far as what they have to carry from each deed is concerned.

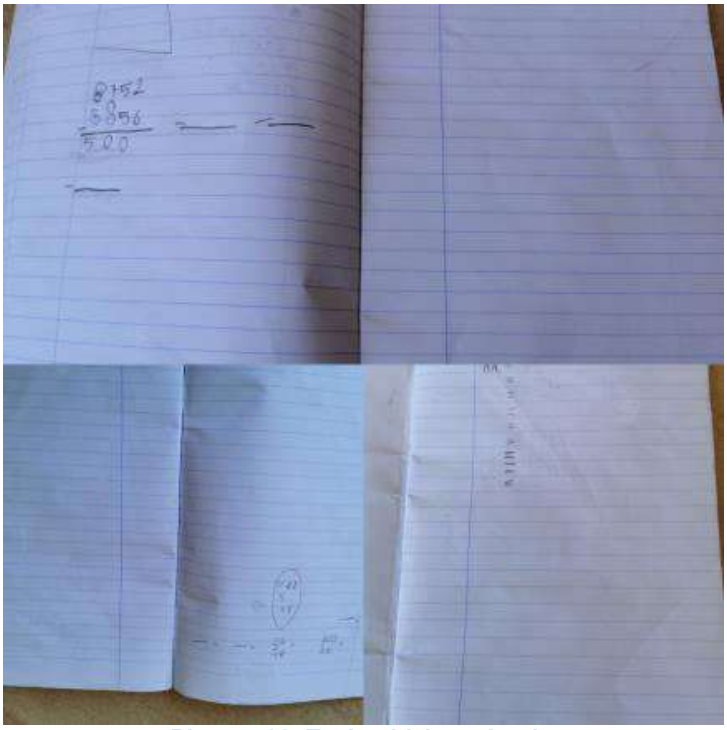
Because each digit corresponds to certain banknotes, when the banknotes exceed 10, such as when I have six, four and two units, they convert this amount into 12 euros, that is, “one tenner and two singles”. Therefore, they carry one to the digit of tens while holding the “two singles” as two in the units’ digit. Their familiarity with money and calculations around the euro is so great that by using a simple representation of numbers with colored dice, they overcome a number of mathematical obstacles that prevent them from gaining new knowledge. The mathematical obstacle of carrying in a deed is bypassed when the correct representation based on the students' pre-existing knowledge is used.



Picture 91: Multiplication

Then, using the deck and dominoes, students practice subtraction of numbers, vertical multiplication of two-digit numbers, and repetition of the multiplication table. We notice that the representation of the numbers with the deck and the domino tiles is of special interest to the students as they seek to actively participate and solve as many exercises as possible. It is worth mentioning at this point the case of a student, Taxiarchis. Taxiarchis is a student who persistently asked his teacher to come to the adjacent Mathematics class, while his teacher prevented him because “many

times he confuses even writing the numbers. It will ruin your research". Taxiarchis as a student participates little in the lesson, while specifically for mathematics the child is completely absent from the educational process, something that can be seen in the image of his notebook, where there are three pages recorded in the last 7 months.

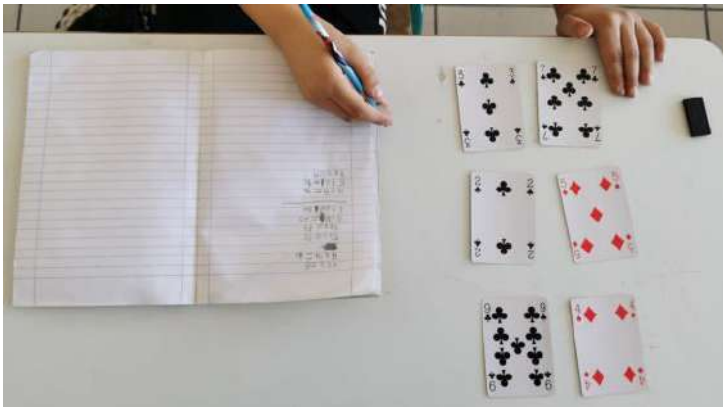


Picture 92: Taxiarchis' notebook

When Taxiarchis is treated equally by the researcher in relation to the other children and is given some cards and some Domino tiles so that he can repeat the multiplication table, the child initially hesitates. In a discussion with him about the reasons why he does not proceed with his exercises, Taxiarchis states, "in other words, what you put on me is done in a different way every time? Can I do many things with these six papers and the three bricks you have given me and fix them the way I want? Is it possible?" The answer is yes and the student continues, "What you give me is like when I go with my grandfather to work. If five people give me two euros or two people give me five euros, it is the same thing. If I give four eggs to nine people or if I give nine eggs to four people I will earn the same, it is possible. I know this, but the other mathematics, I do not want it. I do not want to do it. Here, if I can do it as I tell you, I do not care."

We first notice that the student talks about the commutative property in multiplication and represents the problems with the deck and the domino based on certain experiential situations of his daily life. The child refuses to participate in mathematical activities as they take place in school life, while he

is willing to try when he is going to do something alternative. The student in the next minutes works feverishly and records his actions in the notebook, sometimes making different combinations of numbers. It is obvious that the child in a few minutes has written more than he has written in the last seven months in the classroom and in fact, his exercises are solved correctly. The reason for this is that school mathematical knowledge is rigorous and structured in such a way that it prevents students from using their own representations and personal way of thinking. It requires compliance with the requirements of the textbook and the standard curriculum of mathematics and this fact disarms some students and marginalizes them.



Picture 93: Taxiarchis' effort

9.19 Exploiting symmetry for culturally meaningful mathematics with Roma students[35]

During the research, students seek to identify symmetrical patterns in their everyday life, learn the art of communication as expressed by road signs patterns, and perceive the intercultural connections between mathematics and everyday life. Some specific cases are presented in the pragmatological material below. In primary school mathematics curriculum, symmetry is approached at all grades from the first to sixth grade. Symmetry is an integral part of geometry, nature and human

Picture 94: Symmetry in everyday life

[35] Kyriakopoulos, G., & Chronopoulou, I, 18 Exploiting symmetry for culturally meaningful mathematics with Roma students, Quaderni di Ricerca in Didattica (Mathematics)", Numero speciale n. 7, 2020, G.R.I.M. (Departimento di Matematica e Informatica, University of Palermo, Italy).

construction. It creates patterns that help us organize the world around us conceptually. Symmetry overwhelms the world around us, but we often do not realize it.

Picture 95: Symmetry and art

Symmetry is culturally rooted because it is found in a diversity of Roma culture expressions such as painting, basket weaving, clothing, pottery, religion, art, carpet and rugs as well as architecture. Explorations of symmetry with Roma students can provide a unique opportunity to teach students to look at the world around them and find commonalities through the lenses of symmetry. By teaching mathematics through patterns and symmetry, students may not only learn mathematics, but they may also understand that mathematics is a component of everyday life. It is vital to share numerous examples of symmetry occurring in multicultural settings with students, teaching them a mathematical concept while simultaneously teaching them to develop an appreciation for the many cultures present in the world (Rosa & Orey, 2009). In several cases, students understand that in order to stretch the rugs in such a way that they do not fall, it is necessary to place the carpet symmetrically. Students identify that the symmetric roof and window construction offers a more harmonic result on the house and they identify symmetry in several road signs. Then, they identify symmetrical patterns in art as well, as students identify horizontal and vertical axis of symmetry in a floor mosaic pattern in the school.

Picture 96:Identifying symmetrical axis

Roma students are motivated to find information about the corresponding community in which mathematical ideas are met in traditional activities, and see in this way the connection between culture, mathematics cognition, and real-life context (Stathopoulou, 2007) thus, providing a powerful means to express the community's experience. Mathematics makes sense of the world and may become the vocabulary for students' intuition. Students after the

activities of approaching and understanding symmetry, suggest constructing their own soccer field. To do this, they use a measuring instrument to form the rectangle that makes up the soccer field and then realize that the soccer field is symmetrical and their axis of symmetry is the midfield line. In order to achieve the symmetrical result, they use the measuring tape and work with great precision while they try to use an improvised compass that consists of two brushes in order to make the two semicircles near the goalpost

Picture 97: Symmetry and soccer field

Chapter 10: Relating theories to findings

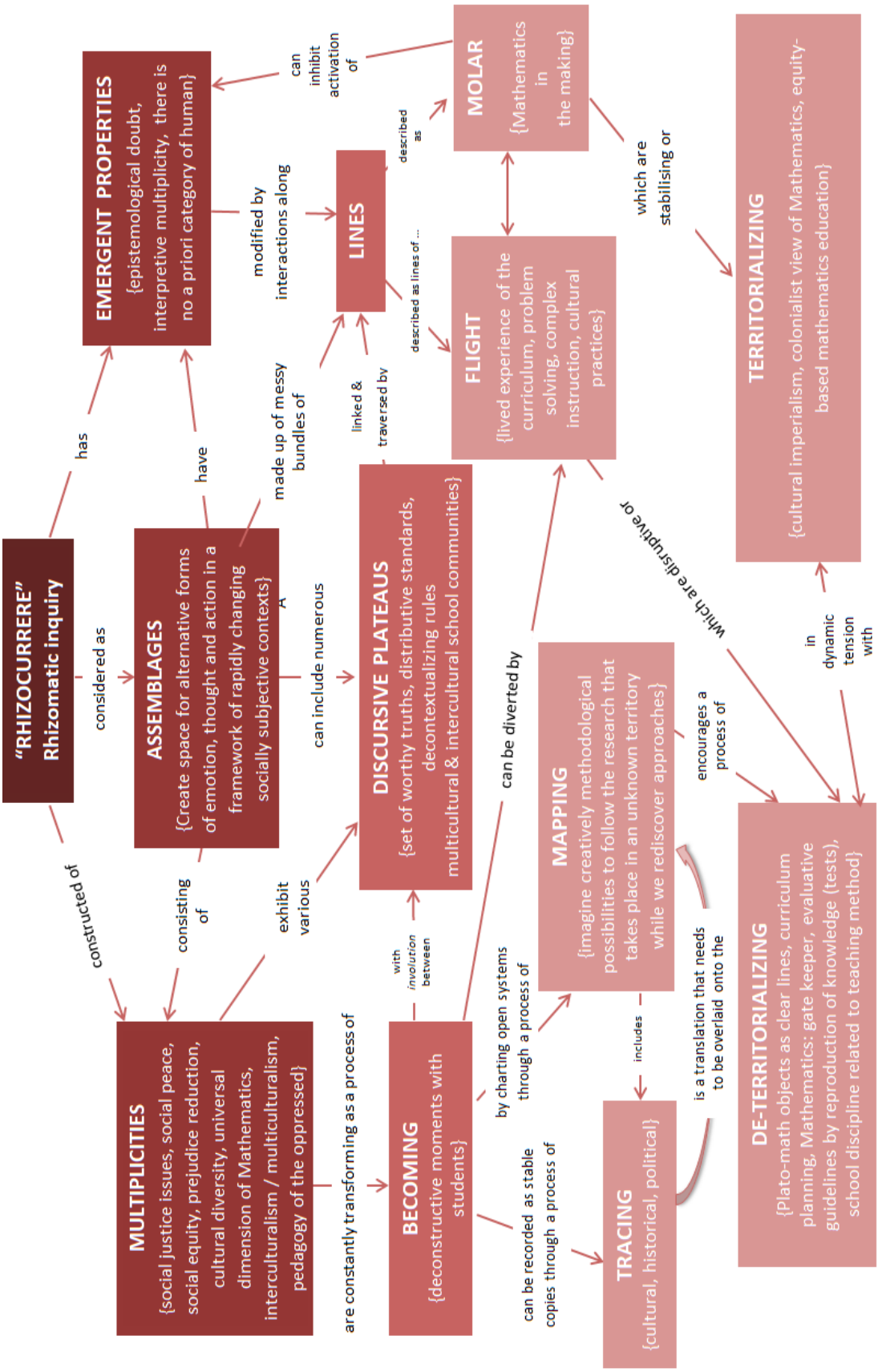
10.0 Summary

In this chapter, research findings will be related back to the theories, which inform the pedagogical and methodological positioning of this dissertation, in order to generate new knowledge relating to the focus of this research. The focus is on the challenge of mathematical epistemologies, on the development of student engagement, on the collaboration of the rhizomatic research and on Roma students' ability and attainment. Moreover, a number of rhizomatic systems which portray the procedure of development of the mathematical curriculum for Roma students and explain the way theoretical notions were used to stabilize the research process will be presented.

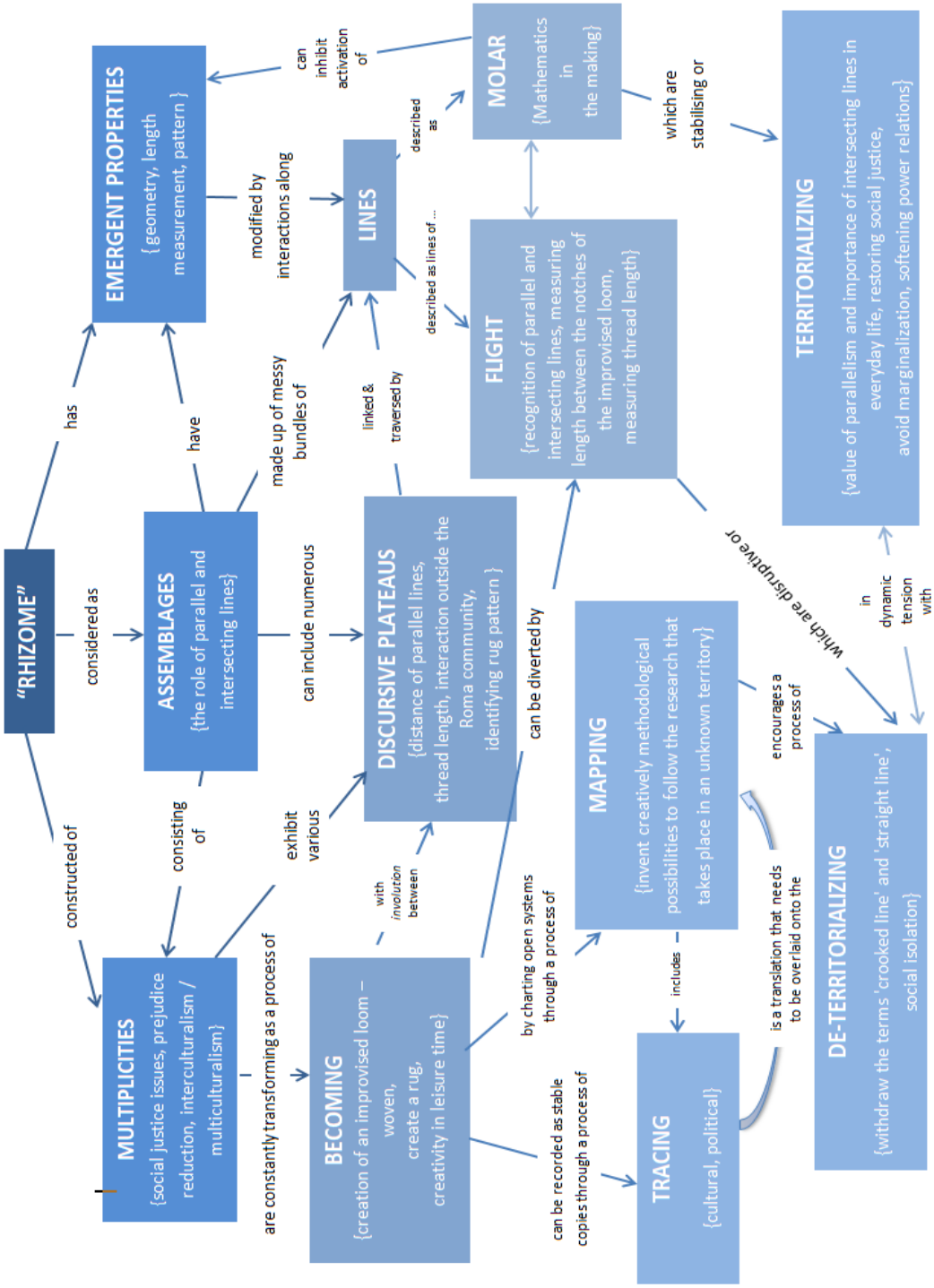
10.1 The research rhizomes

In rhizomatic thought, representation is a process of uncovering essential, deep, underlying structures or patterns in the world and transferring them, deprived of context, into another medium. It is finding the important and essential part that matters and having it stand, in some sense for the whole. Rhizomes are resistant to representation, and resistant to over-coding. The rhizomatic endeavour is mapping, open ended 'experimentation in contact with the real' (Deleuze and Guattari 1987, p. 12). In educational environments, rhizomatic mapping is required to understand how the various structures and forces of schooling experiences function together to manufacture particular kinds of citizen subjects and particular kinds of social-political learning spaces' (Martin & Kamberelis 2013; p. 672). The rhizomes which were applicable to mathematics curriculum development and informed by frameworks of critical features but also responsive to the conditions in which it is employed will be presented below.

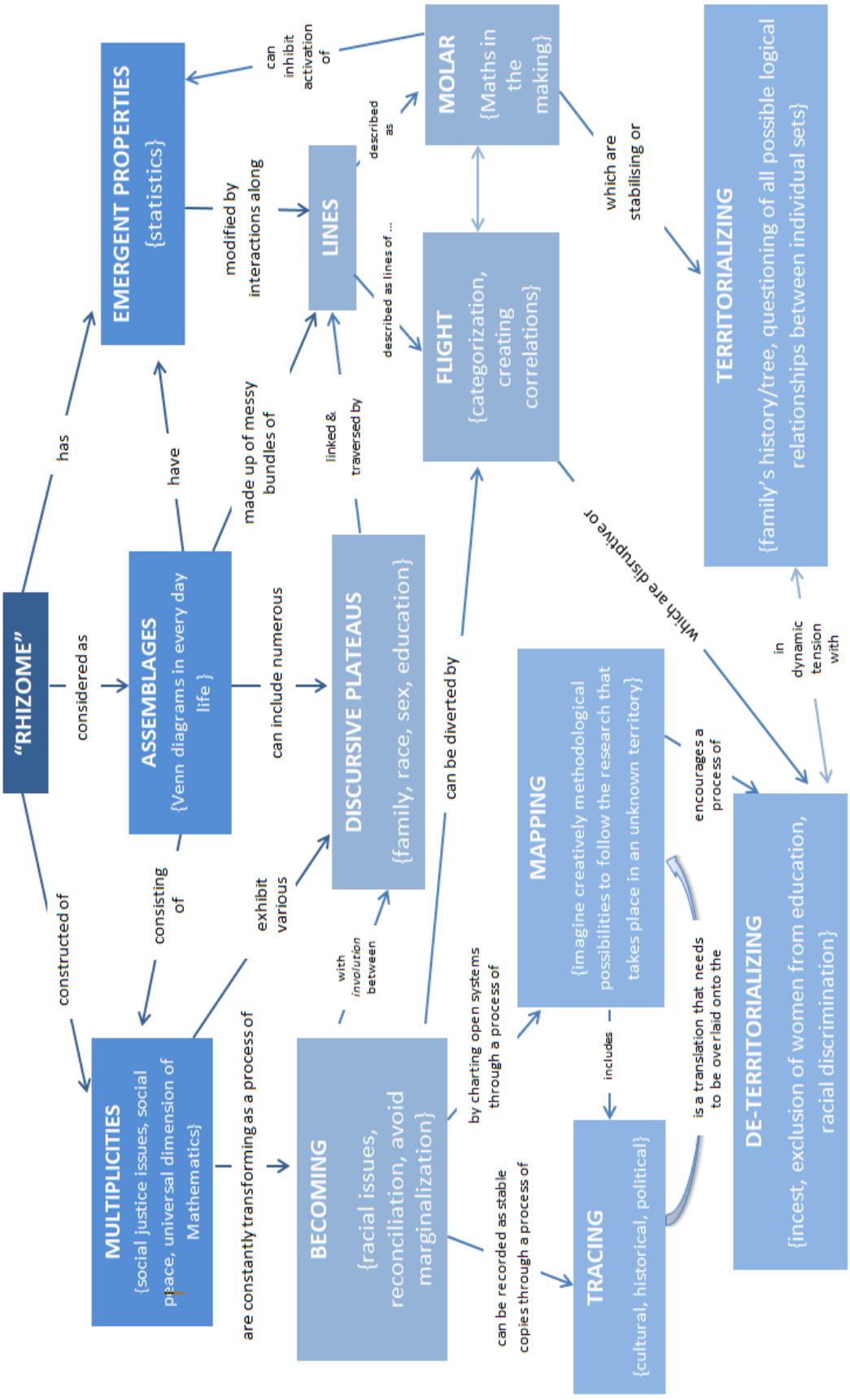
10.1.1 Making sense of theoretical notions in relation to the rhizomatic thinking

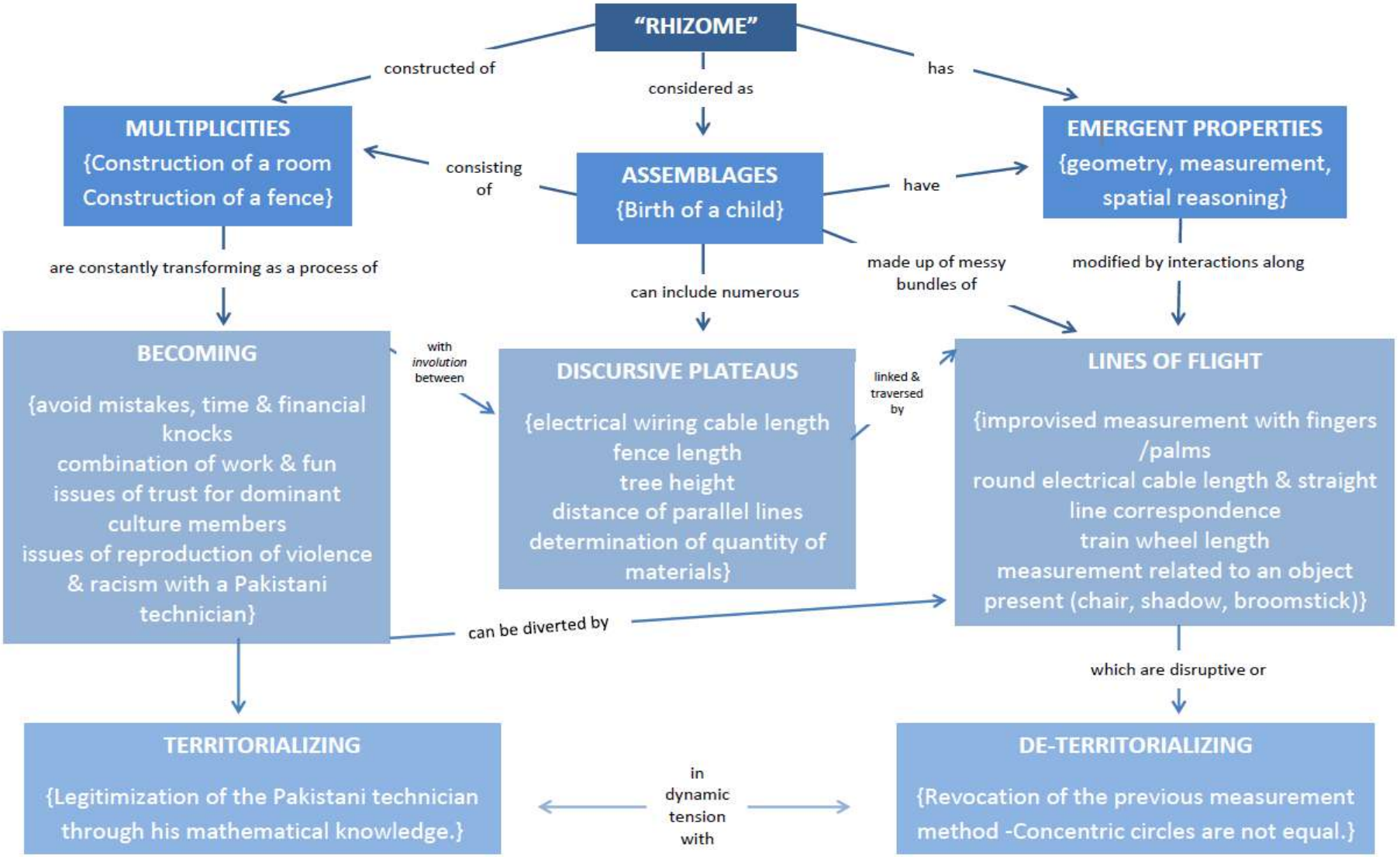


10.1.2 The indicative rhizocurrere[36]



[36] Rhizocurrere merges rhizome, a philosophical concept created by Deleuze and Guattari (1987), with currere, Pinar's (1975) autobiographical method for curriculum inquiry. Curriculum reconceptualised as currere places emphasis on the experience of the individual with/in education. Stewart's (2014) conception of rhizocurrere as a curriculum philosophy-method draws attention to some of the multiple connections between pedagogical and curriculum research and contexts that have informed and shaped research. Rhizocurrere has enacted several attempts to think differently about Roma students' mathematics education, mathematics curricula and pedagogy. Stewart (2014) states that the central question of this research is not 'what is rhizocurrere?', but rather 'how does/could rhizocurrere work?' and 'what does/might rhizocurrere allow me to do?'.





10.2 Challenging mathematical epistemologies

The present research project creates the dimension of intersection between theory and praxis. The Roma students' views and beliefs about their mathematics learning experiences as framed in the sociocultural, political and historical framework presented in the 9th chapter of (non) data, opens up to deconstructive implications from this research process. Theoretical socio-epistemological approaches arose in the late 1980s claiming achievement of significant mathematics knowledge by the majority of students in the classroom led to a "shift in approach from "cognition" to "cognition normalized by social practice." The notion of social practice is a singular construction of this theoretical approach to explain the role of practices in the construction of meaning. The practice nests have three elements, actions, activities, and socially shared practice; and they are regulated by reference practice (a cultural dimension) and social practice (a social dimension)" (Cantoral, 2020; p.1).

Fallibilism (see section 2.1) in mathematics education is strongly related with teachers' epistemological beliefs about mathematics teaching and learning affecting, thus, teaching approaches. Definitely teachers' underlying ideologies and relevant professional experience determine in large scale their pedagogical existence. Although the majority of teachers working with Roma students apply pedagogies which formulate a field of unequal distribution of opportunities for recognizing and exploiting the learning resources included in the linguistic and cultural capital (see section 2.4) of a diverse student body (Gana et al, 2020). Papachristou (2014) investigated student teachers' beliefs about learning conditions and the potential for Roma students in school setting and found that teachers: (a) do not recognize background knowledge of Roma students, (b) do not exploit Roma students' orality during teaching processes, and (c) are tenacious in maintaining stereotypical beliefs about Roma students' potential for school learning.

Gana et al. (2020; p.172) affirm that Greek school practices are guided by an assimilationist ideology (see section 4.2) and "seem to ignore or understate fundamental characteristics of children's cultural identities. Their culture is usually assessed as insubstantial and worthless, and most teachers presume

that non-Greek home languages do not contribute, or even stand as an obstacle to their school performance; teachers are furthermore unlikely to use the home language as a resource". In such an educational context, Roma children's poor school attendance and their dropout rate (see section 5.4) which is among the highest in the country could be strongly linked to the silence, marginalization and underestimation of their world that Roma children experience in classrooms (Gana et al., 2020; Lauritzen & Nodeland, 2018; Noula et al. 2015).

However, (non) data of this research widen our thinking about Roma student mathematical learning experiences as limits between epistemologies, ideologies and school mathematics (see section 2.2) are indistinguishably (non) organized as a rhizomatic system. Educational innovation proposed with the present thesis suggests and highlights the educational value of "successive variation, considering that learning is interested in explaining how it compares, how it is sequenced, and how successive variations are used in several contexts" (Cantoral, 2020; p.6). These variations handle the educational "tensions and inconsistencies with the way things are and the way things have been in order to open up that which Derrida (see section 9.3) refers to as the impossible-that which is yet to come" (Jackson & Mazzei, 2012; p. 34) and becomes accessibly exposed to (non) data and research haecceity (see section 9.2).

Mathematics curricular programming policies in Greece have formed a mathematics curriculum both with little concern for issues of equity, social justice, and consideration of implications for students' futures. Although a focus on examining the nature of mathematics is apparently affecting the way mathematics is taught in schools, teachers and students have limited flexibility to differentiate their teaching from the proposed one by the school activities book. Teachers working in school with Roma students rarely use the opportunities to provide a different dimension to mathematics education examining at the same time why Roma students should learn specific mathematical notions and what is the meaning of school mathematics depending on the lived experience of Roma students (see section 7.4).

Fullan and Quinn (2015) propose two different types of educational reforms formed by wrong and right drivers. The wrong drivers which are also considered from Greek educational policy to encompass school reforms are accountability, individual teacher and leadership quality, technology and fragmented strategies. The right strategies are capacity building, group work, pedagogy, and systemness. If we consider the dimensions that these correct strategies take in the education of Roma students, then we will realize that the critical understanding of mathematics is a vital element and has a dynamic that challenges the common myth that mathematics is neutral and value free subject (see section 2.5). However, there are many teachers who, although they recognize the social and cultural differences of a group such as Roma, nevertheless adhere to an absolutist view of mathematics.

During the implementation of this research, the researcher and the research interest shift the focus from the treatment of mathematics as a cognitive object that needs to be adapted to the school requirements of a teaching subject, to the approach of mathematics as a means of raising awareness about issues of social justice which have the potential to enrich school mathematics. The causal relationship between mathematics and social justice is indisputable (see section 2.5). However, enriching school mathematics with activities that cultivate empathy for social justice as well as with intercultural activities, the research would again end up in the common denominator of wrong drivers that fragment the reconceptualization of the mathematics curriculum.

This created a haecceity in the research process by focusing on the meaning of mathematics by applying skills to real-life situations in which students act rather than approach them individually and in isolation in the classroom. This element shifted the research (non) methodology from the early steps from a typical qualitative action research to a post-qualitative inquiry which is always in the middle of ‘plugging in’ individual theories and aspects of the Roma students’ lives (see section 9.5.2). The assemblages developed can include numerous discursive plateaus linked and traversed by lines of flight and helped students to develop a deeper understanding of specific mathematical concepts. Through this understanding the inner need of Roma students to

connect social justice issues that concern them with mathematical skills is highlighted.

This of course communicates with Freire's concept of conscientization (see section 9.4) which requires the development of real understanding through critical awareness among Roma students of their own situations as they can be related to mathematics education. It is a process that extends to multiple discursive plateaus, with assemblages, multiplicities and emergent properties. Students are really encouraged to think about mathematical concepts as they are found in everyday situations with the result that their attitude towards mathematics changes drastically after realizing the practicality of mathematics. Mathematics is no longer seen as a talent and an innate ability (see section 3.4) but gives the opportunity even to weak students to act and evolve as mentioned in the section 10.3.

10.3 Developing student engagement

The relevant literature highlights the issue of the reduced participation of Roma students in school or even the widespread school dropout that is observed. This phenomenon has multidimensional roots and must be addressed at its core as a child who is out of school or a child on the margins of the school learning process (see section 5.3) is deprived of basic rights and loses the opportunity to progress. This phenomenon, as already mentioned in the previous chapters of this research, is also found in the school where the researcher operates.

However, during the research, the researcher who also acts as a mathematics teacher observes a significant increase in the involvement of students with mathematics while increasing school attendance and interest in engaging in the learning school process. The fact that students' funds of knowledge are not utilized by formal education has a negative impact on the self-confidence of Roma students and becomes a source of negative attitudes and defensive behavior in school mathematics. (Non) data present a significant number of student views that highlight the usefulness and relevance of mathematical plateaus to the present and future lives of students and their families. This is

in direct contrast to the students' prevailing views on mathematics that characterize them as boring, pointless and devoid of meaning (see sections 2.2 & 5.1).

The teaching approaches that treat the mathematics curriculum as a lived experience make students enjoy the mathematical activities and the process of learning mathematics. At the same time, progressive pedagogical techniques are adopted which pave the way for teamwork, for the meaning of the voice even of the weakest students and for equal participation through a process of restoring social justice on two levels: at the school level we treat all Roma students equally even those they do not meet school standards and more specifically the standards someone else sets and measures based on them and at the social level where through mathematics we propose solutions to problems of everyday life and disturbing thus, the stagnant waters of discrimination and social prejudices.

Through the actions that approach the different mathematical concepts presented in the (non) data, the students become familiar with the use of mathematics to support a desired change that they want to take place at the individual level but also at the level of the Roma community. Students really read and write the world with mathematics (see section 1.3) participating in the process of creation of mathematics rhizocurrere. Mathematics rhizome makes students through their discourse appreciate the rationale and the need for learning particular mathematical skills. Research (non) data indicated that students responded efficiently to opportunities to decide for themselves which mathematical procedures to apply presenting mathematical arguments and interpretations of their lived experience.

Students developed high social skills in collaborative problem solving activities acting in familiar and unfamiliar contexts. Their interaction promoted student agency and they persevered in tasks as indicated by repeated attempts and multiple strategies. They adapted responsiveness as contributions or prompts of others were used to suggest possible solution paths. Contributions were then tailored to the students' group based on interpretation of the initial thoughts. Roma students assume group responsibility as indicated by

collaboration and equal participation of all students independently of their school performance. Possible solutions were systematically exhausted as students indicated an impressive interest to understand the way mathematics interacts with their real environment. Learning and knowledge building formulated patterns among multiple pieces of information (assemblages) and used understanding of cause and effect to plan or execute a sequence of actions.

One issue that arises in traditional qualitative research is that difficulties are encountered between high-achieving students and students who have difficulty coping with new learning situations and adhering to rules of conduct. Extensive reference has been made from the relevant literature for students who fall short of cultural capital and how this disadvantaged position in which they find themselves creates negative consequences for their mathematics and school success in general (see sections 3.5 & 4.3). In order to address this issue, relevant research advises teachers to avoid less structured teaching approaches and to follow clear and unambiguous rules and procedures so that such students are able to recognize what you expect of them.

On the contrary, through the process of conducting the present research, the rhizomatic inquiry and thinking, emerges a noticeable difference between the traditional qualitative research and the processing one, as we highlight that children who lag behind in cultural capital and are treated as outcasts of the educational process at school, are part of the educational process acting harmoniously with their classmates and in fact while in their classical class they fail, in the mathematics class are treated equally and experience success. What we are proposing is in favor of less - structured mathematics curriculum and in the subsequent transformation of the course of action of the teacher in order to create the appropriate conditions that will give the students the opportunity to be interested in the content of mathematics teaching and to gain knowledge which in addition to their mathematical content will also be a life lesson. Hegemonic and colonial ideologies of Western mathematics are based solely on the mechanism of cultural capital.

Within the proposed framework of the mathematics curriculum – the rhizocurrere-, students work for the restoration of social justice by turning the mathematical knowledge they receive at the school level into social action and a weapon for their integration, removing their marginalization and reducing the symbolic violence they experience. (see section 2.4.1). The activities developed are not only dictated by the culturally relevant curriculum reconceptualization but also give students the right to criticize the world around them through their learning experiences. The learning process of mathematics is adapted to the needs of Roma students. The deconstructive implications found in cultural capital provide a better understanding of reform efforts and the need to address the issues of power and knowledge that exist within the enactment of teaching (Mycyk, 2019; p. 134).

At times, concerns have been raised about programs that take into account only the cultural nature of mathematics and mathematics in cultural subjects. It has also been sharply criticized that such an orientation of mathematics education degrades the quality of the knowledge that students come in contact with. Several authors have questioned whether ethnomathematics challenges the colonial structures imposed by cultural imperialism on mathematics because of its dependence on comparison with Western mathematics.

Pais (2011) suggested that although learners can participate in a range of activities, these activities need to be recognized (by learners) as mathematical in order to become mathematical and therefore valuable. Labeling traditional activities as mathematics runs the risk of being considered to have no intrinsic value on their own, other than potential examples of Western mathematical knowledge (Roberts, 1997).

In the present study, learning can be intended as a process of constructing mathematical knowledge, involving children in classroom activities that require extensive use of culturally important objects in order to encourage them to develop a positive attitude towards school mathematics and some modifications to enable children to expand, reflect, generalize, and apply their knowledge. This is possible because there is a lot of math embedded in the

daily lives of Roma students. At this point the difference between the present research approach and constructivism arises as knowledge emerges as a product of interaction and not as an individual construct which is a noticeable difference and highlights the innovation on the reconceptualization of the mathematics curriculum.

Effective learning situations in the classroom can be accomplished by encouraging children to analyze some "math facts" that are embedded in situations of their daily lives through an ever-evolving and changing currere. In this way mathematical knowledge can be introduced into a common knowledge, students can be stimulated and mobilized and lead to a more conscious learning. The cultural objects that have been the subject of some of our experiences have made it possible to connect math activity in the classroom with real life, thus forming a rhizome that creates useful learning opportunities.

As students come into contact with activities such as those described in the (non) data they gain critical awareness opening up the learning experience of the students participating in the research. Critical pedagogy is applied in such a way that it is not limited to student directed learning approaches but conscientization has reached a level where students try to identify mathematics in everything around them as well as in seemingly irrelevant everyday situations resulting in learning and knowledge of mathematics taking place without relying on the content of a pre-structured curriculum. The oppressed and failed Roma students are the ones who become developers and organizers of the educational process.

10.4 Collaborative nature of the rhizomatic research

Teacher researcher becomes a nomad researcher through working collaboratively in a group with Roma students, sharing ideas and experiences with the Roma community, jointly planning, and interacting through mathematical activities and circumstances. This process had a significant impact on their thinking and classroom practice, apart from being a thoroughly enjoyable experience. Participants were encouraged to take risks, overcome

constraints, and experience the mathematical rhizocurrere, the vivid experience of the mathematics curriculum. There was general acknowledgement that the role the researcher played in the Roma group was crucial in promoting collaboration and facilitating the sharing of ideas, and that drawing on fieldwork is a form of inquiry that requires the researcher to be personally immersed in the ongoing social activities of an individual or group helped the development of the rhizomatic thinking in order to challenge previous views and assumptions about teaching mathematics.

The mutual support and the sense of common purpose developed with Roma students was essential for the establishment of a ‘community of inquiry’ in which the cultivation of critical understanding, and meta-cognitive awareness of the Roma students, serves to challenge, rather than perpetuate, the status quo. Teacher researcher described how the initial conceptualization of teaching mathematics for social justice and the discussions with the Roma community which preceded the research, helped participants and important others to develop their thinking and to broaden their perspectives. The initial interaction with the Roma community is seen as essential for encouraging participants to critically appraise their own practice in relation to the theories, in order to bring about effective change.

This suggests the rhizomatic research non-methodology facilitated a genuine interaction between research practice and the perception of what is really happening in Roma students' education as well as the extracurricular factors that influence it, a process Freire (1974) refers to as ‘praxis’, leading to a better understanding of their situations amongst researcher. During the course of the research, students recognised that their engagement in research had led to a greater understanding of mathematical knowledge. Their experiences of the research were in stark contrast to their previous limited or complete lack of engagement with mathematical tasks. The apparent willingness of students to engage in this research project challenges the notion that Roma students are naturally resistant to change and are indifferent to the educational process. Instead, it suggests that Roma students’ lack of engagement with mathematical education can be attributed to the constraints they face in the classroom, which can be overcome through the adoption of collaborative and

participatory research on methodologies of rhizomatic thinking. Through rhizomatic thinking the problem situation—that is, the one requiring mathematical learning—is by nature a real experience of Roma students that forms “an intrinsic genesis, not an extrinsic conditioning” (Deleuze, 1994, p.154).

In order to facilitate a Roma students to learn mathematics teacher researcher should encourage them to take a ‘do with me’ approach, and be able to show them how to modify and reproduce what they do in different and diverse situations, rather than only allow us to copy them (Deleuze, 1994; p. 23). In rhizomatic learning, knowledge can only be negotiated in an experience that is collaborative and contextual. The metaphor of the rhizome represents a reframing of knowledge in order to deal with the unavailability of canonical knowledge and disciplines on the bleeding-edge, where knowledge does not exist and needs to be discovered (Cormier, 2008). “Rhizomes grow and propagate in a nomadic fashion, the only restrictions to growth being those that exist in the surrounding habitat. Seen as a model for the construction of mathematical knowledge, rhizomatic processes hint at the interconnectedness of mathematical ideas as well as boundless exploration across many fronts from many different starting points” (Sharples et al., 2012; p.33)

Change to students’ life described how the research gave them the confidence to encourage others inside and outside school to think mathematically and change their lives trying out new ideas. They experienced a wave of interest in the research, with ideas adopted by students in the research context being transported, discussed and fermented in the community. There was enthusiasm amongst students for collating the ideas in a resource that could be shared with the Roma community who wished to develop their practice in a similar direction.

Just as the rhizome becomes a useful metaphor for describing a theory of learning, the nomad becomes an apt metaphor for the Roma students. If the rhizomatic theory of learning is a metaphor for the act or theory of learning in its natural state, the nomadic metaphor embodies that theory into a person (Bozkurt et al., 2016). Nomads exist only in becoming and in interaction

(Deleuze and Guattari, 1987; p.430). The rhizomatic nomad is intrinsically motivated toward the pursuit of mathematical knowledge. This pursuit is defined by the appropriation of authority often held over knowledge by some distant other figure by the nomad student himself (Bozkurt et al., 2016).

This is hard to understand if knowledge is thought of as a binary concept such as right/wrong, is/is not, or proven/unproven. To the Roma students, mathematical knowledge is not a static component to be obtained, but rather a flexible changing element to be alchemically interacted with, and the only goal of which is further pursuit. Roma students experience freedom by being unconstrained and through constant movement.

Nomadic wandering in the discursive fields of education is “not as ‘losing one’s way’ but as losing the way – as losing any sense that just one ‘way’ could ever be prefixed and privileged by the definite article. Like rhizomes, nomads have no desire to follow one path” (Gough, 2005, p.13). “The space of [nomad] thought is qualitatively different from State space. Nomad space is "smooth," or open-ended. One can rise up at any point and move to any other. Its mode of distribution is the nomos: arraying oneself in an open space (hold the street), as opposed to the logos of entrenching oneself in a closed space (hold the fort)” (Deleuze and Guattari, 1987; p. xiii).

10.5 Roma students’ skills and attainment

This research acknowledged how perspectives on mathematics for social justice should not be focused on raising attainment and aspirations of students from lower socio-economic backgrounds. Research challenged inequity by raising the mathematical attainment of Roma students.

Over the course of the project, Roma students’ perspectives broadened as they began to overcome structural inequities which disadvantage students from lower socio-economic backgrounds. It is realised that, while mathematics was generally perceived as boring and lacking in meaning and purpose, students who appreciated the value of learning mathematics for its own sake would be more motivated to learn. It is noticed that Roma students who were unable to conform to the expected norms of behaviour were the same

students who lacked the skills necessary to be successful in mathematics. When adopting progressive teaching approaches, and making mathematics more meaningful and purposeful, research observes the most significant increases in engagement and understanding amongst students who had previously been disaffected, often those in lower sets.

Roma students' and Roma people's poor behaviour, more common amongst disaffected students and in lower sets, was cited as one of the biggest disincentives to adopting progressive teaching approaches. Thus, through their own lack of motivation and poor behaviour, students lacking in cultural capital are complicit in their own failure in mathematics. Rhizomatic thinking and non-methodology research drew attention to the apparent contradiction between the desirability of promoting critical and conceptual understanding of mathematics, and ensuring students develop the cultural capital they need to succeed.

Inspired by Deleuze and Guattari's rhizomatic thinking, Cormier explains rhizomatic learning as follows: "[Rhizomatic learning] takes their view of knowledge as resilient, alinear, and uncertain and applies it to the learning process" (Cormier, 2015) Cormier uses the biological metaphor of the rhizome for this view of knowledge. As a metaphor the rhizome acts as a way to understand the branching and connecting of ideas that arises in the learning process, and the fact that there can be more than one conversation happening concurrently: "[t]his participatory view of learning has the advantage of allowing multiple narratives to exist around a given theme, while constantly running the risk of being subject to the normal push and pull of power that exists in any learning community" (Cormier, 2015). "In the rhizomatic model of learning, curriculum is not driven by predefined inputs from experts; it is constructed and negotiated in real time by the contributions of those engaged in the learning process. This community acts as the curriculum, spontaneously shaping, constructing, and reconstructing itself and the subject of its learning in the same way that the rhizome responds to changing environmental conditions." (Cormier, 2008).

Roma students recognised that the success of such strategies depended upon building relationships of trust with students and community detection. It is important in order to understand the external influence of networked learning communities through the research process. It is also important to see the local influence of Roma students within the networked community because learning is a social process This concurs with Bernstein's (2000) view that an education based on principles of social justice requires teachers to develop 'relational' authority, based on negotiation with students, rather than 'positional' authority, which exploits power relations existing between teachers and students.

Roma students generally believed they had agency in challenging the current situation, viewing mathematics as a means of promoting a more equitable and fair society. Through their involvement in the project, Roma students demonstrated that, by critically reflecting on their practice, in relation to the theories underlying the project, they were able to develop views contrary to the dominant discourses on ability and attainment.

10.6 Processes and characteristics of the research model

The methodological framework employed is post-structural rhizomatic research with elements of critical ethnography in that it seeks a critical ontology of 'how things are', problematizing the acritical status quo of everyday ideas in the educational research for reconceptualization of the mathematics curriculum-the rhizocurrere- and the rethinking of mathematics pedagogy. This post-qualitative research can be seen to challenge four elements of what Elizabeth St. Pierre (2011) calls conventional humanist qualitative inquiry. These are the nature of data, the role of methods, the quest for increasing clarity, and the idea of an individual voice.

The clarity of the research inquiry can be identified in the end product or the political implications and practical insights, rather than in the methodological design. A rhizomatic view on mathematics education provides fresh paths to understand and, possibly, explain the multiple facets of the process that prepares people-yet-to-come for life on a planet-yet-to-come (Le Grange,

2011). At the same time, Deleuze and Guattari's philosophy on education breaks free from the Procrustean bed type of approach, imposed on the educational systems by international organizations (be they concerned with educational matters or with political and economic implications of education) that regulate, rank, and herd all educational institutions and processes into rigid, hierarchical, and arborescent patterns. A rhizomatic approach in mathematics education for Roma students "creates or maps new possibilities for growth—new possibilities for knowing and being" (Le Grange, 2011).

Deriving from the work of Gilles Deleuze and Guattari (1987), this research presents a radical way of thinking differently about the world, emphasising becoming over being, enabling Roma students to benefit from possibilities for development. This educational research can be thought of as a continuous process of rethinking because rhizomatic thought has been used to offer new perspectives on Roma students learning and practicing mathematics, student classroom interaction, curriculum, equity through mathematical education and pedagogical coaching (Sherman *et al*. 2020).

For the purpose of this research three ideas of Deleuze and Guattari are brought to bear: The arborescent and the rhizomatic, assemblage, and mapping and tracing. These ideas, in turn, serve the respective purposes of:

i. breaking from traditional research paradigms that seek effective features of mathematics curriculum development as an end point;
ii. unraveling effective features of mathematics curriculum development in practice; and
iii. Returning to effective features of curriculum development procedure to weave a way forward.

Assemblages apparent in this research become a shifting entangled network of human and non-human, tangible and intangible, material and discursive elements that co-function in unity to produce a meaningful mathematics curriculum for Roma students. Assemblages can be nested and can share elements. Assemblages are not things so much as events occurring over time. Each circumstance in which mathematical knowledge is acquired in the research field is unique and unexpectedly sudden and makes sense for the

particular historical moment where the learning of mathematics takes place. The territories of assemblages can shift as new elements are incorporated, others are lost, or relationships between elements realign. Mathematical knowledge only becomes in relation to other elements within the assemblage.

The rhizome maps developed for the purposes of this dissertation express the identity of the journey. Every map is a redistribution of impasses and breakthroughs, of thresholds and enclosures, which necessarily go from bottom to top (Deleuze, 1997; p. 61–64).

10.7 Synopsis

The present research focuses on rhizomatic thought which considers representation a process of uncovering essential, deep, underlying structures or patterns in the world and transferring them, deprived of context, into another medium and considers rhizomatic mapping required to understand how the various structures and forces of schooling experiences function together to create reality. It also considers the overlap of theory and praxis. The Roma students' views and beliefs about their mathematics learning experiences allow for deconstructive implications. It has become apparent that the majority of teachers working with Roma students apply pedagogies which promote unequal distribution of opportunities, non-recognition of background knowledge and maintenance of stereotypical beliefs about Roma students' potential for school learning. In such an educational context, Roma children's poor school attendance and their dropout rate lead to marginalization and underestimation of the experiences Roma children have in the classroom environment.

During the course of this research a new perspective to our thinking of Roma student mathematical learning experiences is given. Thus, educational innovation proposed with the present thesis suggests and highlights the educational value of variations within the educational process which aim to cater for gaps and inequalities. Considering that mathematics curricular programming policies in Greece have formed a mathematics curriculum with little concern for issues of equity, social justice, and consideration of

implications for students' futures, the research interest shifts the focus from the treatment of mathematics as a cognitive object that needs to be adapted to the school requirements of a teaching subject, to the approach of mathematics as a means of raising awareness about issues of social justice which have the potential to enrich school mathematics.

Interestingly, during the research process, the researcher as a mathematics teacher observes a significant increase in student involvement with mathematics, increasing school attendance and engagement in the learning school process. It becomes evident that students' existing knowledge is not utilized by formal education, a fact that has a negative impact on the self-confidence of Roma students and leads to negative attitudes and defensive behaviour in mathematics class.

When the teaching model employed treats the mathematics curriculum as a live experience, it allows students to enjoy the mathematical activities and the process of learning mathematics. Analysis of the results of this approach indicate that students develop high social skills in collaborative problem-solving activities in familiar and unfamiliar contexts, perseverance in completing tasks through repeated attempts and multiple strategies and use of contributions or prompts of others to suggest possible solution paths.

Based on the observations during the research process, a less structured mathematics curriculum is proposed in accordance with the relevant shift in the teacher approaches to create the appropriate conditions that will intrigue the students in the content of mathematics. The aim is for the activities not only to be dictated by the culturally relevant curriculum reconceptualization but also to give students the opportunity to criticize the world around them through their learning experiences. In the present study, learning is viewed as a process of developing mathematical knowledge by involving children in classroom activities that require extensive use of cultural existing knowledge and support a positive attitude towards school mathematics. Unquestionably, a certain degree of modifications is required to enable children to expand, reflect, generalize, and apply their knowledge.

The findings of this research show that the rhizomatic research non-methodology facilitated a genuine interaction between research practice and the perception of what is really happening in Roma students' education as well as the extracurricular factors that influence it. Another noticeable point is the fact that the evident willingness of students to engage in this research contradicts the widespread belief that Roma students are naturally resistant to change and are indifferent to the educational process.

Over the course of the research, the students' perspectives were expanded as they were able to overcome structural inequities which disadvantage students from lower socio-economic backgrounds. Most importantly, the perception of mathematics as boring and lacking in meaning and purpose was changed and students appreciated the value of learning mathematics, became more motivated to learn and were able to understand the expected norms of behaviour and develop the skills necessary to be successful in mathematics.

Summarising the processes and the characteristics of the research model, emphasis should be placed on the post-structural rhizomatic research methodological framework with elements of critical ethnography. A rhizomatic view on mathematics education opens the avenues for better understanding and, possibly, more effective explanation of the multiple facets of the process that prepares people-yet-to-come for life on a planet-yet-to-come (Le Grange, 2011).

As explained, for the purposes of this research the ideas of the arborescent and the rhizomatic, assemblage, and mapping and tracing as presented by Deleuze and Guattari should be kept in mind as they are instrumental in moving away from the traditional research paradigms that seek effective features of mathematics curriculum development as an end point, unravelling effective features of mathematics curriculum development in practice, and returning to effective features of curriculum development procedure to weave a way forward.

Chapter 11: Final conclusions and implications

11.0 Summary

This final section starts with reviewing the initial research questions and continues with reviewing the research implications for mathematics teaching, mathematics curriculum and implications for further research. Finally, the research contribution to the knowledge and understanding of the field is presented in an attempt to highlight the importance for further relevant research and development.

11.1 Reviewing the aims of the research

The primary research question was:

Is it possible devotion towards education for social justice to be translated into a lived mathematics curriculum experience which supports cultural diversity and promotes social integration?

The present research process from its early stages of concept had identified the problems involved in the mathematics education of Roma students in primary school. Examining the issue comprehensively, it becomes apparent that the orientation towards the restoration of social justice and the alleviation of social inequalities is not only about the democratic confrontation of Roma students at school but also specializes even more in creating mathematical knowledge which becomes a vehicle for improving the daily life of Roma students. Through the mathematical knowledge produced in the present study, students perceive cultural diversity, examine relationships involving the interaction of different communities and different population groups, and break down the prejudices and stereotype about the Roma community themselves. The design of the research, which concerned an uncertain, unexplored and constantly changing research field, provided an effective model that allows the researcher to create a series of mathematical activities with high cognitive content and direct connection with students' experiences. Research creates a

new understanding of the concept of teaching mathematics as well as the restoration of social justice through school education bringing about significant changes in educational practice. These changes concern the cultivation of an experiential curriculum that strengthens the links between social justice awareness and mathematical understanding, enhances student involvement and participation, and makes mathematics a key part of the life and work of Roma students who, through thinking mathematically they seek to recognize implications of mathematics in their lives.

The research questions continue with:

How students' accounts for their learning experiences, competing forces and interests allow us to build alternative forms of mathematical knowledge if the curriculum could be more committed to their cultural, historical and political contexts?

We are accustomed to perceiving teaching and learning as two separate and distinct activities that have the environment of the mathematics classroom as a common framework. This separation as shown by the present research is unfortunate. There is reciprocity of the two terms and they should be treated as components of a body of socially established practice. Classroom practice concerns teaching methods that are not only skills development tools but also practices with which students learn to participate in the negotiation of mathematical meaning. Participating in the negotiation and renegotiation of mathematical meaning is not the means by which learning is achieved but it is learning itself. The participants in this negotiation talk from a different starting point and everyone has a different background of knowledge, skills, inclinations, motivations and value system and based on these characteristics is positioned in terms of goals and intentions of education while participating in the negotiation of mathematical meaning. At the same time there is a special place in the student community as determined by the way students participate in classroom practice.

How can students' existing knowledge when they come to the classroom can be transformed into relevant and valuable knowledge of mathematics with an impact on learners themselves?

How can the application of students' lived experiences by using cultural and historical rhizomatic systems make mathematical teaching and learning processes more admissible, applicable and purposeful?

The main impetus of the present research is to allow Roma students to think about and critique the dominant structure of the socio-cultural system and the ways in which the mathematics curriculum serves to perpetuate this structure. The mathematics curriculum cannot be created before the teacher has interacted with the student, his environment and his needs. It is common to emphasize what mathematical knowledge will be taught and not how it will be taught. That is, it is a didactic of the subject and not a didactic of the active subject since the learning and social profile of the student, his emotional and social needs, his experiences and interests are not taken into account.

By focusing print outs on these points we take the student into account while shaping the curriculum and providing authentic learning where learning has value in the real world. It is learning that is used to solve real problems and to bridge the gap between school education and professional life. Curriculum concepts are born out of the students' experience, real-world problems and utilize multiplicities as they arise at any given time. It is a pedagogical approach that allows students to explore, discuss, and construct mathematical scenarios and relationships around issues that concern them in order to structure a curriculum so that students learn better by restructuring the cognitive subjects to include areas that make sense to students.

Through the present research, students are guided in how they should learn and become able to choose on their own what the content of mathematical knowledge is. We can never know in advance what one will learn, what one thinks or how one will respond. The curriculum is the framework of the plan of an upcoming event and is characterized by a lack of students' prognosis and predetermination and must be offset by the immediacy of the realization in the research process.

How can we inspire students to search for mathematics in their everyday life?

The moment students begin to realize that mathematics has the power to change situations in their daily lives, to shake the barriers of social isolation and to enable students to reinterpret stereotypes of everyday life, they are inspired by an inner motivation to search for mathematical situations in real life. Mathematics for Roma students is emerging as an integral part of thought and action. Mathematics becomes a source of inspiration, creation and solution of everyday problems.

11.2 Implications for mathematics teaching

The fundamental reasoning concerning the teaching of mathematics in order to restore social justice for Roma students is a valuable tool for the development of relevant mathematical activities. Research has shown that mathematics can be used as a means to help students improve, understand social justice issues and create the conditions for a better society. These elements are the key objectives of global education. In order to achieve this, it is important to develop strong links between mathematical activities and crucial and emerging elements of students' everyday life which acquire mathematical meaning through choosing which specific knowledge should be at the heart of the curriculum and choose which mathematical procedures to apply.

Through the development and presentation of their own arguments, Roma students understand how mathematics can be used as a vehicle that can support a change in daily life. Roma students take on the characteristics of independent and critical minded students as math becomes essential and relevant to the students' real experiences greatly increasing the levels of school and mathematics 'classroom' participation. Students who were on the margins of school education take strategic positions and cultivate a positive attitude towards the educational process and the subject of mathematics.

Such a radical and progressive structure of the mathematics curriculum is appeared useful to be adopted by all teachers and especially by those who interact with students who are supposed to lack cultural capital and who are less likely to engage with the subject matter. The research process has shown

that although mathematics has a privileged place in the school curriculum, it is rare for students to be asked to think about how much mathematics can be linked to real life. This fact feeds the myths surrounding the mathematical subject by making mathematical success dependent on the innate ability and talent of a group of students. The present study directly challenges such perceptions and encourages Roma students to reflect on the nature of mathematics by bringing everyday life interests and history to the forefront of the mathematics curriculum.

The rhizomatic learning is based on Deleuze Guattari's (2004) term of rhizome, which has neither beginning nor end, providing a dynamic, open, personalized learning network created by Roma students themselves that meets their perceived and real needs. The consequences of rhizomatic learning show that this could be applied successfully in educational science as learning foreign languages in various learning forms. The scientific analysis revealed that rhizomatic learning develops through Deleuze and Guattari concepts, especially through becoming learner and occurs in lifelong learning of mathematics.

11.3 Implications for the development of mathematics curriculum

Deleuze (1990/1995) discussed the importance of creativity in the replacement of reflection in order for the production of new mathematical knowledge consisting of new relationships and assemblages to occur. In that sense reflexivity in this research was transformed into a becoming process. Even the writing of this dissertation which contradicts the rhizomatic philosophy involves reading both the Roma students' world and the specific characteristics of each individual and could be named immanent reflexivity.

Such an approach to the mathematics curriculum becomes an experiment in the territory of finding difference and creates new ways of thinking. Deleuze puts forth ontology of problems, 'an ontology that faces us neither as an explanation of the world nor as a solution to a philosophical question (p. 172)'. In this context, the present research adopts as a critical aspect of the planning the questioning of the existing situation in the part of mathematics education

of Roma students and focuses on the relationship between theory and practice. The combination of rhizomatic thinking with the development of a vibrant mathematics curriculum has a significant impact on the development of students' thinking and the enhancement of mathematics ability.

The research highlights the importance of students' participation in mathematics education since their involvement and contribution has a decisive role that enriches the curriculum and creates conditions for the restoration of social justice and in understanding their own practice and how it relates to mathematics education. Roma students thus gain a critical awareness of the structural causes of inequality and injustice in mathematics education but at the same time experience ways in which social stereotypes are broken down and the daily practices and beliefs of the community are re-examined with a more rational logic.

11.4 Implications for further educational research

The whole process proved that the adopted research design offers a research model that produces relevant knowledge while having the ability to bring about positive social change. The research was based on the funds of knowledge of Roma students and adapted the mathematics curriculum with appropriate starting points which led to unexpected results, creating a rich mathematics curriculum that covers large parts of the mathematics knowledge for this level of education. At the same time the rhizocurrere has meaning and substance for the students themselves as it is part of their life and themselves. Undoubtedly the mathematical knowledge and the participation of the students were promoted to a great extent through the research process that was followed.

The rhizomatic approach to a mathematics curriculum for older children would be of particular interest for future research. However, it would be interesting to repeat a similar research with the same students, with corresponding pieces of material which is expected to yield as a final result a completely different mathematics curriculum since students are evolving personalities and dynamically adapt to their changing environment.

11.5 Contribution to knowledge and understanding of the field

Research non-data states that once a child first acquires a new mathematical meaning or terminology that carries a scientific concept, the formation of this mathematical concept is not complete but at initial stages. This assumption stems from the fact that in an early mathematical activity you are constantly receiving extensions creating links that allow the educational process to deepen students' mathematical knowledge, generalize as well as linking to other vital parts of the mathematics curriculum.

It should be noted that Vygotsky was the main exponent of the view that cultural context seems to influence a child's behavior to such an extent that it should be taken into account in the educational process. The researcher supports the idea that Roma students internalize the rules, norms and situations that constitute their social environment, as a result of which they become cultural capital and common spaces for mathematics learning. The students' participation in school is important because through playful relevant mathematical activities students understand social rules and how the real world works through the perspective of mathematical knowledge.

According to the theory of the cultural context, the socio-cultural environment of the students, which consists of his friends and family, pushes the student to interact with them. In every culture there are situations and observable sequences of behaviors in which the student is involved in order to create mathematical representations and through them to develop his mathematical knowledge. The rhizomatic non-methodology with which this research was conducted provides students with the opportunity to develop mathematics discourse with their community as it legitimizes mathematical knowledge emerging from everyday life and creates opportunities for thought and interaction.

It is worth mentioning that the social factor becomes increasingly important from the moment the child begins to leave the house and socialize with other children. 'Scaffolding' with Roma students in the field of mathematics education is supported by social interaction among students. In other words, the researcher functions like this important nomad who instead of possessing

a higher level of knowledge helping students to obtain new mathematical knowledge within the zone of proximal development of Roma students, he adapts a rhizomatic view where the causal questions of effectiveness and sequence at the heart of mathematics curriculum reconceptualization have the potential to generate something entirely different: non-linear, defined by unpredictable, even riotous, multiplicity.

This research through rhizomatic thought (Deleuze & Guattari, 1987) offers a contrast to the predominant linear research paradigm. The main idea of rhizomatic learning is to acknowledge that learners come from different contexts, that they need different things, and that presuming you know what those things are is similar to developing a colonialist position within the field of intercultural education. Rhizomatic thought in mathematics education for Roma students is a commitment to multiple paths. Organizing a conversation with Roma students to be rhizomatic is realized by creating a context, maybe some boundaries, within which a conversation can grow with unpredictable results. The Roma community acts as the desired mathematics curriculum.

Mathematics learning is based on the interaction between Roma students' daily practice and mathematical meanings. In fact, the process of acquiring mathematical meanings follows the experience that Roma students have. During informal discussions with teachers who first come into contact with the environment of Roma students, their question is almost always expressed about the inability of Roma students they meet by chance on the street to explain where the school building is located. The specific issue concerning the spatial orientation is incorrectly treated as a language issue and as an inability of children to express in Greek the instructions for their school location while it is clearly not related to reduced perceptual ability of Roma children.

In trying to interpret this paradoxical subject through the research perspectives provided by rhizomatic thinking, it is worth emphasizing that Roma children, since they use an informal way of thinking and expression, face insurmountable difficulties in giving instructions regarding the orientation of space to a stranger who asks them, as there is no common code that will allow them to communicate.

The information that Roma students will give for instructions is unknown and completely incomprehensible to a person who has no contact with their context. On the contrary, when someone is familiar with the context in which they live, they can use the information they give and even observe that their instructions vary depending on the person they are talking to and the knowledge they know that person has. This differentiation confirms their increased critical ability and adaptability to situations.

The thinking of the mathematical problems in different groups during this research and the development of a collective view of the individual mathematical knowledge focused on was a key factor in how Roma students learned to speak and "do" mathematics with an approach that is within its own everyday life. The fact is that the proximal development zone allowed all participants to engage in what Lerman (2001) calls a symbolic space in which Roma students had the opportunity to develop mathematical thoughts and reasoning as well as to expand them, finding substantial connections with real life. In many cases, in fact, this knowledge seemed strong enough to change simple things in everyday life which, however, improve the way of life of the Roma community.

As a result, students interacted with mathematical concepts observing them emerge through everyday life itself and also had the opportunity to renegotiate them and reconstruct their reasoning in ways that can be accepted as school mathematical knowledge. Thus Roma students expand their thinking through rhizomatic research inquiry, play with mathematics and try to define mathematics in their environment while the researcher realizes the need and necessity not to focus strictly on the development of mathematical knowledge but to focus on the process of constructing it together with students through dialogue and collaboration.

In order for the learning of mathematics with Roma students to acquire meaning and substance, the ‘lesson’ in terms of its content and purpose must be oriented towards the learning process even if the result differs from the initially expected. In these circumstances, Roma students need to develop their mathematical thinking and the researcher should adjust his role from that

of traditional teaching and become a mediator and mentor, thus responding to the development of students' thinking and their transition from the real ability towards the potential ability to construct mathematical knowledge. In order to achieve this successfully, full acceptance of the identity and diversity of the Roma students is required, as well as a further positive disposition of the researcher to discover the important elements hidden in the special life style of the Roma community.

The development of skills required by mathematical thinking are followed by the establishment of a mathematical disposition and desire to engage with the subject, the awareness of Roma students and a strong commitment to the student to learn the mathematics and perform various mathematical activities. The individual areas in which mathematical thinking with Roma students s approached include comprehension, problem solving, reasoning, the development of cognitive links between new mathematical knowledge and its practical value, and the application of knowledge to everyday situations.

Consequently it is a step in the wrong direction to think that mathematical concepts are acquired only by teaching. Instead, Roma students develop their mathematical knowledge in an independent and spontaneous way while exploring the various discursive plateaus and traveling through the line of flights as these were occurring during the educational process. It is emphasized that the student’s way of thinking related to mathematics is greatly influenced by his experiences. Mathematics learning is interpreted as a process of socialization in the mathematical meanings and techniques of the wider society (social constructivism).

Research results focus on the fact that mathematics has managed to be recognized in recent years as a tool that can contribute both to students' literacy and to the development of many skills, such as critical analysis and reflection as well as problem solving (Stathopoulou, 2003). Learning becomes an integral part of social practice and the acquisition of knowledge and skills reveals multiplicities which territorialize mathematical knowledge as an aspect of participation in the community of practice concluding that "understanding

mathematics presupposes the understanding of the practice of people who produce or use mathematics" (Sakonidis, 2008).

This research non-methodology meets the requirements to include the largest ethnic minority in Europe, the Roma people and offers an initiative for the modern educational system to be equitable, inclusive and sustainable. In order to fulfill this goal, social, gender and cultural inequalities were systematically being tackled through individual mathematical tasks which allowed Roma students to re-examine elements of their lives, to challenge fixed situations and seek solutions that would improve their lives.

Discrimination either based on socio-economic status, gender or cultural heritage are meeting points underlying situations of exclusion and oppression. These elements, although not the subject of discussion in the Roma community, are not overlooked and the negative consequences are experienced as a form of oppression by Roma students. This research reveals such forms of oppression which have passed into the consciousness and have become experiences for the Roma community and in fact in many cases manages to inflict a severe blow on them, leading the students to think critically about their social becoming.

Inequalities between socioeconomic groups are often associated with unequal school attainment, which cannot be separated with the segregation of Roma students according to their cultural and social background, frequently observed in European schools. Reaching the United Nations goal of inclusive education and moving towards a sustainable educational becoming entails not only preventing Roma students' segregation according to their individual, cultural, social, or ethnic identity but also ensuring equity in learning opportunities and achievement for all, to ultimately limit social exclusion.

As mentioned in a previous chapter of this doctoral dissertation during the researcher's first steps in the paths of Roma students' education, a school categorized same age students in two different classrooms according to their Roma or non-Roma background. Teachers, school administration, the school counselor and the education quality supervisor of the respective district did not even contemplate the idea that this approach to education could be unfair.

The main argument was that the separation was acceptable on the one hand because the parents are happy and do not complain and on the other because educators do not offer limited learning opportunities to non-Roma children who come to school for learning. The perception of Roma students as a problem had for many years and in many countries led the educational policy in the channel of the effort to "compensate the deficit" of these students. The aim was, therefore, to "solve" the problem and to ensure, in the classroom, a "balance" in which linguistically and culturally different students would no longer "disturb" the majority of the students who came from the dominant group, with the possible poor performance and the difficulties of adapting them to the dominant school. Is there a way to bridge this gap and avoid such manipulation of education without focusing on the quality and style of curricula?

In the case of Roma students who come to school with a generally considered disadvantaged background, an education based on high expectations and rich curricula become an obstacle to overcoming educational inequalities. Relevant research suggests that Roma students as a cultural group face a conflict between the legitimated educational discourse and their particular cultural heritage. Schools produce a habitus, in Bourdieu’s terms, excluding Roma students from the mainstream discourse. This fact, alongside socio-cultural stereotypes against the Roma heritage, produces a situation of poor expectations about what Roma students may learn in school.

Research managed to change this situation arguing for the need to develop dialogic practices to include the voices of Roma students within the educational process. This research identifies pathways to success when learning mathematics that would help Roma people to overcome educational exclusion. These paths include:

I. developing a growth mindset which facilitates the Roma students’ academic identity based on values such as effort, the attractiveness of schooling, and motivation for learning because school knowledge stems from everyday life and is strong enough to bring about change in various aspects of everyday life;

II. the importance of the teacher role in being open to challenging curricular activities in a rhizomatic way of thinking, increasing the opportunities for learning, based on high-expectations rather than social stereotypes about Roma people, and avoiding negative practices;

III. the role of the family and community who support and empower Roma students about their capacity to perform successfully in the school which is achieved due to their involvement in the educational process and in shaping the reconceptualized mathematics curriculum;

IV. peer-to-peer interaction based on valuing schooling, establishing supportive “networking”; and

V. evaluating the mathematical knowledge acquired through the educational process, and through the changes it brings to the lives of students. The success and dynamism of the educational process is confirmed by the improvement of the living conditions of the Roma family as well as by the overthrow of strong perceptions about the Roma and their education.

Research non-data also suggest that it is an arduous task to link mathematics curriculum directly to Roma student learning when other confounding variables are involved in the complex setting of a classroom. Students and teachers interact with curricula in unique ways in creating the classroom milieu. These interactions are shaped in a rhizome by many conditions including but not limited to teacher and student beliefs, teachers’ content and pedagogical knowledge, students’ prior achievement, classroom resources, professional development experiences, and how curricula are implemented.

While determining curricular effectiveness is a complex problem, answers regarding curricular effectiveness are demanded by policy-makers and the public. Rather than seeking a binary determination of whether a curriculum is effective or ineffective in these complex settings, the real questions should be what works, for whom, and under what conditions?

Our attention during the conduct of the present research is attired by perceptions which give priority to the action of the Roma students in their community and to the internal emergence of a mathematical meaning as an epistemological framework for the reconceptualization of the mathematics curriculum.

Curriculum development policies however, have as problem point the fact that the student is considered as a person who tries to give meaning to his experiences without examining his relationship with the teacher, with the other students in the class, with the socio-cultural environment as well as with the historical moment in which the educational process takes place. In other words, mathematical knowledge is developed without examining the phenomenon of the student's communication with persons and situations, ignoring that the student is integrated in an environment in which communication phenomena develop that affect him.

The present research process brings to the fore communicative and cultural aspects that attempt to interpret the development of mathematical concepts on the basis of communicative phenomena in the classroom and in the interaction between the student and his environment.

Mathematical processes that take place in the real world, with real people who bring in the educational process the uncertainties, hesitations, mistakes, omissions should not follow specific problem-solving scenarios which usually are unmoved and completely prescribed. Each student evolves dynamically in relation to their environment; the structure and function of their consciousness as well as the process of shaping their personality which are identified as key factors that determine to a great extent the learning process of mathematics.

Cultures exist because of the ability to communicate and the commitment to or provision for knowledge and values from generation to generation. At the same time, language is a cultural tool, a special communication instrument that is related to thought.

Thinking critically about the role of language in everyday educational practice, we are faced with the fact that the meaning of a word, a concept or a

mathematical concept is in its use. For example when during the research process Roma students are asked “what do you really mean”, in practice what we ask them is how they use this particular expression or even more in which framework does the exact phrase the student use fit. Knowledge is therefore considered more of an activity than a social practice where the meanings of the phrases are signaled by the way we use them. Thus, it is more useful and substantial to try to understand Roma students' ‘language’ during mathematical situations than to point out their logical errors and demand that they be corrected. Research non-data reflect phrases used by students which are phrases that produce original meanings and direct the research process. These phrases relate to dialogues between a Roma student and an adult, interaction between a Roma student and the rest of the students in the group or the researcher as well as interactions between people who are treated equally.

In fact, before the Roma student is able to formulate a mathematical concept, he is introduced to a microcosm of interactions, some of which are triggered by teacher-researcher although the further forms depend on the student's initiatives and on the random and spontaneous situations of social life. The form of interactions sets the boundaries and rules for what the student or researcher will say and how they will say it. However, all these rules have a negotiation as they are formed through some clear and direct negotiations between people interacting.

The path to mathematical thinking leads through allusions to mathematical negotiation as we gradually understand what the intentions behind specific expressions are and what the common conditions that will bring about mathematical knowledge are. Roma students, although they make mistakes during expressions of a mathematical concept, do not need to correct them according to the teacher's instructions but negotiate their way of saying something and their way of thinking by exchanging arguments with their classmates in a respective educational environment. The researcher is linked to his participants; the stories of those on the margins are connected with the ones of those at the center; and the lives of the researcher are connected with

those of their different students being always in relation to one's 'self' (Pinar, 1993).

Researching the mathematics curriculum with Roma students becomes a pluralistically oriented model of managing multiculturalism in school. Research respects and utilizes the cultural difference, while it goes hand in hand with a specific perception of the society, according to which, the smooth integration of people with different linguistic and cultural backgrounds and, consequently, the required social cohesion will occur if all members, regardless of origin, have the opportunity to interact.

During this research process this interaction leads to intercultural respect, tolerance, recognition and acceptance of the different, as well as the osmosis created by the coexistence of individuals and groups with cultural differences. Researching rhizomatically for curriculum reconceptualization overcomes the negative consequences and limitations of assimilative strategies of managing multiculturalism in modern schools, as well as the difficulties arising from the application of other pluralist-oriented models of minority education which are blamed for overemphasising the difference.

Rhizomatic thinking for curriculum reconceptualization takes advantage of the linguistic and cultural differences that exist within the classroom to the benefit of all students. Having this starting point, intercultural education treats the multiculturalism that is created in the classroom as a challenge and as a rich source for curriculum development, while promoting, as noted earlier, the interaction of students who are carriers of different cultural backgrounds.

In general, the benefit of this research is to formulate theoretical principles and to propose practices, which contribute to the development of Roma students' intercultural consciousness and ability for "intercultural communication. Intercultural consciousness refers to the development of a sense of belonging to a wider community. This collective consciousness that transcends group boundaries of races and on the basis of which all people have the same value can potentially have the same problems and it is logical and expected to support each other. Effective educational communication with Roma students presupposes the knowledge of the cultural reality of the new

and unexplored, as well as the differences, which exist in comparison with the relevant cultural context.

Considering the intercultural expansion of curricula, this research states that intercultural orientation of the mathematics curriculum means moving away from either the obsession with the ethnocentric curriculum or treating minority cultures as deficient subcultures. It also means the representation of Roma cultural elements in the curriculum, thematization of their relationship with history, culture and the sociopolitical system.

This is in contrast to a possible superficial approach to Roma culture which demands to address phenomena such as xenophobia and attacks against Roma people. The relationship between the dominant group and Roma community in Greece, the living conditions of Roma families as well as the institutional racism are issues that have a strong political dimension and that are being challenged through the mathematics curriculum which creates the conditions for reviewing the social stereotype and contributes to finding sustainable solutions which lead to the improvement of the quality of life and relations with other social groups.

Through the rhizomatic thinking and the development of the mathematics curriculum in multiple discursive plateaus, this research avoids the risk of equating the introduction of intercultural education and school life with a folklore dimension in relation to Roma culture focusing on food, music and traditional dances of other cultures thus degrading the content of the mathematics curriculum and limiting the range of knowledge that Roma students can acquire through a customized rhizocurrere process. The cultural capital of Roma students which is the core of the mathematics curriculum ensures for a greater emotional security developed by Roma students and consequently their smoother psychosocial development, as they realize that they are accepted by the educational process. Roma students' socio-cultural elements acquire substance and can be a source of mathematical knowledge.

This fact enhances school performance, since Roma students have the ability to build knowledge effectively on their own educational background and their own conditions. In addition, intercultural awareness and the capacity for

effective intercultural communication were developed because Roma students through the mathematics rhizocurrere were helped to understand that the world is neither self-evident nor one-dimensional and that views and judgments are relevant. It is also important that they learn to deal with opposing views and to take a multidimensional view of things, especially when it comes to issues of everyday life. It is necessary for them to be able to show interest in otherness and to realize that it is what makes virtually every person interesting and unique.

Understanding the characteristics of the group to which Roma students belong, leads to the development of self-knowledge, self-confidence and to a degree of pride, elements particularly important for the smooth development of an individual's identity. Another element that should be emphasized is that a rhizomatic thinking educational process should aim at avoiding generalizations because each person should be treated as a unique individual who does not necessarily have the same views, values and behaviors as other members of their team.

It is important to clarify at this point that the starting point of the goals and contents of the proposed reconceptualized mathematics curriculum for Roma students is the recognition that cultural differences, which are essential to learn to manage, exist. This contradicts a simplistic logic, according to which all the problems that arise in intercultural encounters can be solved by emphasizing the similarities that characterize cultures and not the differences.

The research non methodology proposed, leads us to some further principles. It is clear that the expansion of the curriculum aimed at the development of intercultural awareness requires the application of flexible students-centric methods which give an active role to students. A prerequisite for this is for the research focus to have as its starting point the students and not exclusively the interests of the educational policy makers or science. This research activates all students who usually do not participate, are distanced or even negative about what happens in the educational process. The process of mathematisation of real life elements contributes greatly to the change of students' perspective and becomes a basic condition for understanding and to

effective communication inside and outside the classroom. In this way, this research enables students to move away from the monopoly of their own culturally defined perspective.

References

1. Abacioglu, Ceren C. Su, Monique M. Volman, and Agneta A. H. Fischer, (2020). "Teachers' multicultural attitudes and perspective taking abilities as factors in culturally responsive teaching." *British Journal of Educational Psychology* 90.3 (2020): 736-752.

2. Abdulrahim, N. A., & Orosco, M. J. (2020). Culturally responsive mathematics teaching: A research synthesis. *The Urban Review*, *52*(1), 1-25.

3. Abreu, G. d. (2000). Relationships between macro and micro socio-cultural contexts: Implications for the study of interactions in the mathematics classroom. Educational Studies in Mathematics, 41, 1-29.

4. Abreu, G. d. (2007). Social valorisation of mathematical practices: the implications for learners in multicultural schools. In N. Nassir & P. Cobb (Eds.), Improving Access to Mathematics: Diversity and Equity in the Classroom (pp. 118-131). New York: Teachers College Press.

5. Adam, S., Alangui, W., & Barton, B. (2003). A comment on Rowlands and Carson: where would formal academic mathematics stand in a curriculum informed by ethnomathematics? A critical review. *Educational Studies in Mathematics, 52*(3), 327-335.

6. Adler, Paul & Borys, Bryan. (1996). Two Types of Bureaucracy: Enabling and Coercive. Administrative Science Quarterly. 41. 10.2307/2393986.

7. Afonso, A. J., Loureiro, A., & Lúcio, J. (2018). Inequalities and (in) justices in education: A dialogue with Sally Power. Revista Portuguesa de Educação, 31(ESPECIAL), 92-102.

8. Ainscow, M.; Sandill, A., (2010). Developing inclusive education systems: The role of organisational cultures and leadership. Int. J. Incl. Educ. 2010, 14, 401–416. [CrossRef]

9. Aitken, A., & Radford, L. (2018). Curriculum Theorists in the Classroom: Subjectivity, Crises, and Socio-environmental Equity. Internationalizing Curriculum Studies, 125–138. doi:10.1007/978-3-030-01352-3_8

10. Alan, S., Duysak, E., Kubilay, E., & Mumcu, I. (2020). Social Exclusion and Ethnic Segregation in Schools: The Role of Teacher's Ethnic Prejudice. *Unpublished manuscript, EUI*.

11. Alfaro, C. (2019). Preparing critically conscious dual-language teachers: Recognizing and interrupting dominant ideologies. *Theory into Practice*, *58*(2), 194-203.

12. Aline Abassian, Farshid Safi, Sarah Bush & Jonathan Bostic (2020) Five different perspectives on mathematical modeling in mathematics education, Investigations in Mathematics Learning, 12:1, 53-65, DOI: 10.1080/19477503.2019.1595360

13. Allen, N. L., Carlson, J. E., & Zelenak, C. A. (1999). The NAEP 1996 Technical Report. Institute of Educational Science, US Department of Education.

14. Alrø, H., Skovsmose, O., & Valero, P. (2008). Inter-viewing foregrounds: Students' motives for learning in a multicultural setting. In M. César & K. Kumpulainen (Eds.), Social Interactions in Multicultural Settings (pp. 13-37). Rotterdam: Sense.

15. Altugan, A. S. (2015). The effect of cultural identity on learning. *Procedia-Social and Behavioral Sciences*, *190*, 455-458.

16. Amber Hughes (2020) Positioning Indigenous knowledge systems within the Australian mathematics curriculum: investigating transformative paradigms with Foucault, Discourse: Studies in the Cultural Politics of Education, DOI: 10.1080/01596306.2020.1715345

17. Anand, Pranit & Liu, Byron (2019) Developing 21st century intercultural and collaborative competencies through transformative internationalisation projects: A post neo-colonialism approach. In *6th International Conference on Educational Technologies 2019*, 8-10 February 2019, Hong Kong, China.

18. Ananiev, J. (2019). Marginalization of Roma Children through Segregation in Education in Macedonia. *Balkan Social Science Review*, *14*(14), 157-178.

19. Anyon, J. (1995). Inner city school reform: Toward useful theory. Urban Education, 30, 56 –70.

20. Appelbaum, P., & Stathopoulou, C. (2015). 13 Critical Issues in Culture and Mathematics Learning. Handbook of International Research in Mathematics Education, 336.Publisher: RutledgeEditors: Lyn D. English, David Kirshner

21. Appelbaum, P., & Stathopoulou, C. (2020). The taking of Western/Euro Mathematics as reappropriation/repair. *Revemop*, *2*, e202003-e202003.

22. Appelbaum, P., & Stathopoulou, C. (2021). FUTURE PASTS & PRESENT FUTURES. APEduC Revista-Investigação e Práticas em Educação em Ciências, Matemática e Tecnologia, 2(2), 27-39.

23. Apple, M. W. (1992). Do the standards go far enough? Power, policy, and practice in mathematics education. *Journal for research in mathematics education*, *23*(5), 412-431.

24. Apple, M.W. (2013) Can Education Change Society? Routledge: New York, NY, USA; London, UK, 2013; ISBN 978-0-41-58753-2.

25. Apple, M.W. Can Education Change Society? Routledge: New York, NY, USA; London, UK, 2013; ISBN 978-0-41-58753-2.

26. Arneback, E., & Jämte, J. (2021). How to counteract racism in education–a typology of teachers' anti-racist actions. *Race Ethnicity and Education*, 1-20.

27. Arnold, I. J., & Versluis, I. (2019). The influence of cultural values and nationality on student evaluation of teaching. *International Journal of Educational Research*, *98*, 13-24.

28. Artigue, M. (2008). ICMI: A century at the interface between mathematics and mathematics education. In M. Menghini, F. Furinghetti, L. Giacardi & F. Arzarello (Eds.), The first century of the International Commission of Mathematical Instruction (1908-2008). Reflecting and shaping the world of mathematics education (pp. 185-198). Roma: Istituto della Enciclopedia Italiana fondata da Giovanni Treccani.

29. Ascher, M. (2002). *Mathematics elsewhere: An exploration of ideas across cultures*. Princeton, NJ: Princeton University Press

30. Aubert, A. (2011). Moving beyond social exclusion through dialogue. International Studies in Sociology of Education, 21, 63 –75.

31. Aubert, A. Amaya.:, (2015) Dialogic literary gatherings evoking passion for learning and a transformation of the relationships of a Roma girl with her classmates. Qual. Inq. 2015, 20, 858–864. [CrossRef]

32. Avcı, Bülent. (2018). Critical Mathematics Education: Can Democratic Mathematics Education Survive Under Neoliberal Regime? Boston, USA: Brill-Sense.

33. Babak Dadvand & Hernan Cuervo (2020) Pedagogies of care in performative schools, Discourse: Studies in the Cultural Politics of Education, 41:1, 139-152, DOI: 10.1080/01596306.2018.1486806

34. Baker, L. R., Phelan, S., Woods, N. N., Boyd, V. A., Rowland, P., & Ng, S. L. (2021). Re-envisioning paradigms of education: towards awareness, alignment, and pluralism. *Advances in Health Sciences Education*, 1-14.

35. Bakhtin, M.M., (2021) The Dialogic Imagination: Four Essays; University of Texas Press: Austin, TX, USA, 2010; Volume 1, ISBN 978-0-292-71534-2.

36. Bakker, S. A. (1999). Educational Assessment in the Russian Federation. Assessment in Education, 6 (2), 291-303.

37. Balacheff, N., & Kaput, J. (1996). Computer–based learning environments in mathematics. In A. J. Bishop, K. Clements, C. Keitel, J. Kilpatrick & C. Laborde (Eds.), International handbook of mathematics education (pp. 469-501). Dordrecht: Kluwer.

38. Balfanz, R.; Herzog, L.; Mac Iver, D.J. Preventing student disengagement and keeping students on the graduation path in urban middle-grades schools: Early identification and effective interventions. Educ. Psychol. 2007, 42, 223–235. [CrossRef]

39. Balfanz, R.; Herzog, L.; Mac Iver, D.J., (2007) Preventing student disengagement and keeping students on the graduation path in urban middle-grades schools: Early identification and effective interventions. Educ. Psychol. 2007,, 42, 223–235. [CrossRef]

40. Balidemaj, A. (2021). Working with marginalized groups: towards more holistic strategies for social exclusion reduction of the Roma community in Kosovo. *Safer Communities*.

41. Bandeira, F., (2016). A proposal for curriculum reorientation for teaching mathematics in basic education under the light of ethnomathematics. RIPEM, V.6, N.1, 2016

42. Bangou, F. (2019). Experimenting with creativity, immigration, language, power, and technology: A research agencement. *Qualitative Research Journal*.

43. Barad, K. (2007).. *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Duke University Press.

44. Barden, T (2010), "Exploring the concept of Hegemony and Counter-Hegemony within the modern world and how, as a designer, I can influence for the better", Theoretically Interesting Publications

45. Baroud, J. (2020). *Engaging the Intersections of Equity and Technology in Teacher Education Instruction, Curriculum and*

Pedagogies (Doctoral dissertation, Université d'Ottawa/University of Ottawa).

46. Barroso P.M., (2019). The Reality of the Virtual in Deleuze's Transcendental Empiricism. In: Braga J. (eds) Conceiving Virtuality: From Art To Technology. Numanities - Arts and Humanities in Progress, vol 11. Springer, Cham

47. Barton, B. (2017). Mathematics, education, and culture: A contemporary moral imperative. In Proceedings of the 13th international congress on mathematical education (pp. 35-43). Springer, Cham.

48. Bass, H., (2008). Moments in the life of ICMI. In M. Menghini, F. Furinghetti, L. Giacardi & F. Arzarello (Eds.), The first century of the International Commission of Mathematical Instruction (1908-2008). Reflecting and shaping the world of mathematics education (pp. 924). Roma: Istituto della Enciclopedia Italiana fondata da Giovanni Treccani.

49. Bature, I., (2020). The Mathematics Teachers Shift from the Traditional Teacher-Centred Classroom to a More Constructivist Student-Centred Epistemology. *Open Access Library Journal*, 7, 1-26. doi: 10.4236/oalib.1106389.

50. Baucal, A., Pavlović-Babić, D., Plut, D. & Gvozden, U., (2004). Nacionalno testiranje obrazovnih postignuća učenika III razreda osnovne škole (interni izveštaj). Beograd, Zavod za vrednovanje kvaliteta obrazovanja i vaspitanja.

51. Begg, A.J.C., (2001),). 'Ethnomathematics: Why, and What Else?', Zentralblatt für Didaktik der Mathematik 33(3), 71–74.

52. Bel Parnell-Berry & Alan Lawton, (2019). Citizenship for All? Mobility and the "Right" Way to Live, Administrative Theory & Praxis, 41:1, 35-59, DOI: 10.1080/10841806.2018.1512335

53. Benjamin C. Ingman & Christy McConnell Moroye, (2019). Experience-Based Objectives, Educational Studies, DOI: 10.1080/00131946.2018.1544900

54. Bernstein, B. (2003) Structuring of Pedagogic Discourse; Routledge: London, UK, 2003; ISBN 0-203-01126-0.

55. Bernstein, B. Structuring of Pedagogic Discourse; Routledge: London, UK, 2003; ISBN 0-203-01126-0.

56. Beverly, J. Testimonio, (2005). subalternitySubalternity, and narrative authority. In The SAGE Handbook of Qualitative Research, 3rd ed.

57. Bhopal, K. (2004). Gypsy travellers and education: Changing needs and changing perceptions. British Journal of Educational Studies, 52, 47 –64.

58. Bhopal, K. (2011). 'This is a school, it's not a site': Teachers' attitudes towards Gypsy and Traveller students in schools in England, UK. British Educational Research Journal, 37, 465–483.

59. Bhopal, K., & Myers, M., (2009). Gypsy, Roma and Traveller students in schools in the UK: Inclusion and 'good practice'. International Journal of Inclusive Education, 13, 299– 314.

60. Blausten, H., Gyngell, C., Aichmayr, H., & Spengler, N., (2020). Supporting Mathematics Teaching for Mastery in England. In Empowering Teachers to Build a Better World (pp. 29-49). Springer, Singapore.

61. Blevins-Knabe, B., (2016). Early mathematical development: How the home environment matters. In Early childhood mathematics skill development in the home environment (pp. 7-28). Springer, Cham.

62. Block, A., (2009). Ethics and teaching: A religious perspective on revitalizing education. Springer.

63. Blomhøj, M., (2008). ICMI's challenges and future. In M. Menghini, F. Furinghetti, L. Giacardi & F. Arzarello (Eds.), The first century of the International Commission of Mathematical Instruction (1908-2008). Reflecting and shaping the world of mathematics education (pp. 169-180). Roma: Istituto della Enciclopedia Italiana fondata da Giovanni Treccani.

64. Blumer, H., (1969). Symbolic Interactionism. Perspective and Method; Prentice Hall: Englewood Cliffs, NJ, USA, 1969; ISBN 0520056760.

65. Boaler, J., (1997). Experiencing school mathematics. Teaching styles, sex and setting. Milton Keynes: Open University.

66. Boaler, J., (1999). Participation, knowledge and beliefs: A community perspective on mathematics learning. *Educational studies in mathematics*, *40*(3), 259-281.

67. Bornedal, P., (2019).: Deconstructive vs Pragmatic: A Critique of the Derrida–Searle Debate, The European Legacy, DOI: 10.1080/10848770.2019.1652039

68. Bourdieu, P., (2016). La Distinction: Critique Sociale du Jugement; Minuit: Paris, France, 2016; ISBN 978-2-70-233721-4.

69. Boyd, P., & Ash, A., (2018). Mastery mathematics: Changing teacher beliefs around in-class grouping and mindset. Teaching and Teacher Education, 75, 214–223. doi:10.1016/j.tate.2018.06.016

70. Bozkurt, A., Honeychurch, S., Caines, A., Maha, B. A. L. I., Koutropoulos, A., & Cormier, D., (2016). Community tracking in a cMOOC and nomadic learner behavior identification on a connectivist rhizomatic learning network. *Turkish Online Journal of Distance Education*, *17*(4).

71. Brandon Sherman & Annela Teemant, (2020):). Unravelling effective professional development: a rhizomatic inquiry into coaching and the active ingredients of teacher learning, Professional Development in Education, DOI: 10.1080/19415257.2020.1825511

72. Brantefors, L., (2015). Between culture and cultural heritage: curriculum historical preconditions as constitutive for cultural relations–the Swedish case. Pedagogy, Culture & Society, 23(2), 301-322.

73. Brantlinger, A. M., (2007). *Geometries of inequality*: teaching and researching critical mathematics in a low-income urban high school. Unpublished doctoral dissertation. Department of the Learning Sciences. Evanston, IL: Northwestern University.

74. Breinholt, A., & Jæger, M. M., (2020). How does cultural capital affect educational performance: Signals or skills?. *The British journal of sociology*, *71*(1), 28-46.

75. Brinkman, S., (2015). “GOFQI and the Phoenix of Qualitative Inquiry.” Qualitative Inquiry 21 (7): 620–622.

76. Brooks, M., (2021). We Know Better and Must Do Better. *Public Education: Defending a Cornerstone of American Democracy*, 149.

77. Brown, S. P., McKesson, L. D., Robinson, J., & Jackson, A. Y., (2020). Possibles and Post Qualitative Inquiry. *Qualitative Inquiry*, 1077800420922266.

78. Brüggemann, C., (2012). Roma education in comparative perspective. Analysis of the UNDP/World Bank/EC regional Roma Survey. Roma Inclusion Working Papers. Bratislava: UNDP Regional Bureau for Europe and the CIS.

79. Brüggemann, C., and Škobla, D., (2012). Roma integration and special schools in Slovakia.

80. Bruner, J., (1990). Acts of Meaning; Harvard University Press: Cambridge, MA, USA, 1990; ISBN 0-674-00360-8.

81. Bulent, A., (2020.) Research methodology in critical mathematics education, International Journal of Research & Method in Education, DOI: 10.1080/1743727X.2020.1728527

82. Burman, E., & Miles, S., (2020). Deconstructing supplementary education: from the pedagogy of the supplement to the unsettling of the mainstream. *Educational Review*, *72*(1), 3-22.

83. Burnett, N., Darvas, P., Kovač-Cerović, T., Ringold, D., Gillsater, C., Stevens, J., McLaughlin, M. & Varallyay, J., (2005). Need Assessment Summary Report: A background document for the Roma Education Fund donors' conference. Washington, DC, World Bank. Retrieved April 23, 2006 from: http://www. romaeducationfund.org/documents.htm.

84. Callahan, K. C., (2019). Design Thinking in Curricula. The International Encyclopedia of Art and Design Education, 1-6.

85. Callens, M.-S., Meuleman, B., & Marie, V., (2018). Contact, Perceived Threat, and Attitudes Toward Assimilation and Multiculturalism: Evidence From a Majority and Minority Perspective in Luxembourg. Journal of Cross-Cultural Psychology, 002202211881765.doi:10.1177/0022022118817656

86. Carlin, M., Wallin, J., (2014). In Deleuze & Guattari, Politics and Education; Carlin, M., Wallin, J. (2014), Eds.; Bloomsbury: London, UK, 2014; pp. 49–75.

87. Caruso, S. J., (2017). A foundation for understanding knowledge sharing: organizational culture, informal workplace learning, performance support, and knowledge management. Contemporary Issues in Education Research, 10(1), 45.

88.

89. Catarci, M., (2014). Intercultural education in the European context: Key remarks from a comparative study. Intercult. Educ. 2014, 25, 95–104. [CrossRef]

90. Cavalli-Sforza, L.; Cavalli-Sforza, F., (1995) The Great Human Diasporas: The History of Diversity and Evolution; Addison-Wesley: New York, NY, USA, 1995; ISBN 978-0-20-144231-1.

91. Cenoz, J., & Gorter, D. (2020). Teaching English through pedagogical translanguaging. World Englishes, 39(2), 300–311. https://doi.org/10.1111/weng.12462 [Crossref], [Web of Science ®], [Google Scholar]

92. Cenoz, J., & Gorter, D., (2020). Teaching English through pedagogical translanguaging. World Englishes, 39(2), 300–311. https://doi.org/10.1111/weng.12462 [Crossref], [Web of Science ®], [Google Scholar]

93. César, M., Kumpulainen, K., (2008) Eds Interactions in Multicultural Settings;.; Sense Publishers: Rotterdam, The Netherlands; Taipei, Taiwan, 2008; pp. 117–144, ISBN 978-9-08-790716-7.

94. Chassapis, D., (2002). Social groups in mathematics education research. An investigation into mathematics education-related research articles published from 1971 to 2000. In P. Valero & O. Skovsmose (Eds.), Proceedings of the Third International Conference on Mathematics Education and Society (2nd ed., pp. 229-237). Copenhagen: Center for research in learning mathematics.

95. Childers, S., (2013). "The Materiality of Fieldwork: An Ontology of Feminist Becoming." International Journal of Qualitative Studies in Education 26 (5): 599–609.

96. Childs, K., (2017). Integrating multiculturalism in education for the 2020 classroom: Moving beyond the "melting pot" of festivals and recognition months. *Journal for Multicultural Education*.

97. Chisholm, L., and Sujee, M., (2006). Tracking racial desegregation in South African schools. Journal of Education 40: 141–159.

98. Christensen, O. R., Stentoft, D., & Valero, P., (2008). A landscape of power distribution. In K. Nolan & E. De Freitas (Eds.), Opening the research text. In(ter)ventions in mathematics education (pp. 147-154). New York: Springer.

99. Christiana Karousiou, C., , Christina Hajisoteriou, C., & Panayiotis Angelides, P., (2018): Teachers' professional identity in super-diverse school settings: teachers as agents of intercultural education, Teachers and Teaching, DOI: 10.1080/13540602.2018.1544121

100. Christopher Hanley (2018): Thinking with Deleuze and Guattari: An exploration of writing as assemblage, Educational Philosophy and Theory, DOI: 10.1080/00131857.2018.1472574

101.

102. Chronaki, A., (2005). Learning about 'learning identities' in the school arithmetic practice: The experience of two young minority Gypsy girls in the Greek context of education. Eur. J. Psychol. Educ. 2005, 20, 61–74. [CrossRef]

103. Chronaki, A., (2008). An entry to dialogic in the Maths classroom: Encouraging hybrid learning identities. In Social Interactions in Multicultural Settings; César, M., Kumpulainen, K., Eds.; Sense Publishers: Rotterdam, The Netherlands; Taipei, Taiwan, 2008; pp. 117–144, ISBN 978-9-08-790716-7.

104. Chzhan, Y., (2016). «Multicultural person» in modern multicultural society. *Инновации в образовании (Казахстан)*, (1), 57-60.

105. Civil, M., (2007). Building on community knowledge: An avenue to equity in mathematics education. In N. Nassir & P. Cobb (Eds.), Improving access to mathematics: Diversity and equity in the classroom (pp. 105-117). New York: Teachers College Press.

106. Clarke, D., & Roche, A., (2018). Using contextualized tasks to engage students in meaningful and worthwhile mathematics learning. *The Journal of Mathematical Behavior*, *51*, 95-108.

107. Cobb, P., McClain, K., Silva Lamberg, T. d., & Dean, C., (2003). Situating Teachers' Instructional Practices in the Institutional Setting of the School and District. Educational researcher : a publication of the American Educational Research Association, 32(6), 13-25.

108. Cobb, P., Wood, T., & Yackel, E., (1992). Interaction and learning in classroom situations. Educational Studies in Mathematics, 23, 99-122.

109. Colebrook, C., (2021). Rhizome. In *Oxford Research Encyclopedia of Literature*.

110. Commission of Mathematical Instruction (1908-2008). Reflecting and shaping the world of mathematics education (pp. 277-288). Roma: Istituto della Enciclopedia Italiana fondata da Giovanni Treccani.

111. Confrey, J., (2000a). Improving research and systemic reform toward equity and quality. In R. Lesh & A. E. Kelly (Eds.), Handbook of research design in mathematics and science education (pp. 87-106). Hillsdale: Lawrence Erlbaum Associates.

112. Confrey, J., (2000b). Leveraging constructivism to apply to systemic reform. Nordic Studies in Mathematics Education, 8(3), 4-27.

113. Constanta Olteanu, C., (2020): Programming, mathematical reasoning and sense-making, International Journal of Mathematical Education in Science and Technology, DOI: 10.1080/0020739X.2020.1858199

114. Cornelius Castoriadis, “Democracy as Procedure and Democracy as Regime,” Constellations, no.1 (1997): 1.

115. Craig, Jeffrey, and Lynette Guzmán, (2018). "Six Propositions of a Social Theory of Numeracy: Interpreting an Influential Theory of Literacy." Numeracy 11, Iss. 2 (2018): Article 2. DOI: https://doi.org/10.5038/ 1936-4660.11.2.2

116. Cummins, J., (2008). Teaching for transfer: Challenging the two solitude assumptions in bilingual education. In N. Hornberger (Ed.), Encyclopedia of language and education (pp. 1528–1538). Springer. [Crossref]., [Google Scholar]

117. D'Ambrosio, U. & Rosa, M., (2008). Um diálogo com Ubiratan D'Ambrosio: uma conversa brasileira sobre etnomatemática. Revista Latinoamericana de Etnomatemática, 1(2). 88-110 http://www.etnomatematica.org/v1-n2-julio2008/DAmbrosio-Rosa.pdf

118. D'Ambrosio, U., & D'Ambrosio, B. S., (2013). The role of ethnomathematics in curricular leadership in mathematics education. Journal of Mathematics Education at Teachers College, 4, 19–25.

119. D'Ambrosio, U., & Rosa, M., (2008). A dialogue with Ubiratan D'Ambrosio: a Brazilian conversation about Ethnomathematics. Revista Latinoamericana de Etnomatemática, 1(2). 88-110.

120. D'Ambrosio, U., (1990). *Etnomatemática [Ethnomathematics]*. São Paulo, SP, Brazil: Editora Ática.

121. D'Ambrosio, U., (2001). What is ethnomathematics and how can it help children in schools?. *Teaching Children Mathematics, 7*(6), 308-310

122. D'Ambrosio, U., (2006). Ethnomathematics: link between traditions and modernity. ZDM, 40(6), 1033-1034.

123. da Ponte, J. (2008). Research and practice: Bridging the gap or challenging the focus? Reaction to J. Boaler's plenary talk. In M. Menghini, F. Furinghetti, L. Giacardi & F. Arzarello (Eds.), The first century of the International Commission of Mathematical Instruction (1908-2008). Reflecting and shaping the world of mathematics education (pp. 106-112). Roma: Istituto della Enciclopedia Italiana fondata da Giovanni Treccani.

124. Dafermos, M., (2006) Marginalisation and Educational Inclusion; Atrapos: Athens, Greece, 2006.

125. Daka, H., Chipindi, F. M., & Mwale, M., (2020). The Relationship between Assessment Practices and Students' Academic Performances. *Zambian Journal of Educational Management,*

Administration and Leadership (ZJEMAL)(ISSN-Print: 2706-7416, Online: 2709-1864), *1*(1), 143-156.

126. Darling-Hammond, L., (1996). The right to learn and the advancement of teaching: Research, policy, and practice for democratic education. Educational Researcher, 25,5 –17.

127. Darling-Hammond, L., (2000). Teacher quality and student achievement. Educ. Policy Anal. 2000, 8. [CrossRef]

128. De Wit, F. R. C., & Greer, L. L., (2008). The black-box deciphered: A meta-analysis of team diversity, conflict, and team performance. In Academy of Management best paper proceedings, Anaheim.

129. Dearing, E., Kreider, H., Simpkins, S., & Weiss, H. B., (2006). Family involvement in school and low-income children's literacy: Longitudinal associations between and within families. Journal of Educational Psychology, 98, 653–664.

130. Deci, E. L., & Ryan, R. M., (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. Psychological Inquiry, 11, 227-268.

131. Deleuze, G., & Guattari, F., (1980). Capitalisme et schizophrénie. *Paris: Les*.

132. Deleuze, G., (1983). Nietzsche & philosophy (H. Tomlinson, Trans.). New York: Columbia University Press.

133. Deleuze, G., (1989). Cinema II (H. Tomlinson & R. Galeta, Trans.). Minneapolis: University of Minnesota Press.

134. Deleuze, G., and Guattari, F,. (1987). A Thousand Plateaus: Capitalism and Schizophrenia. London: Continuum.

135. Deleuze, G., and Guattari, F., (1987), A Thousand Plateaus: Capitalism and Schizophrenia, Univ. of Minnesota Press, Minneapolis, MN.

136. Deleuze, GillesG., and Felix GuattariG., (1987). *A Thousand Plateaus: Capitalism and Schizophrenia* . trans. Brian Massumi. Minneapolis : University of Minnesota Press, 1987.

137. Delgado-Baena, A., Vela-Jiménez, R., López-Montero, R., & Sianes, A., (2021, March). A CRITICAL ANALYSIS OF EDUCATION IN THE TIME OF GLOBALIZATION FROM A HUMAN RIGHTS PERSPECTIVE: FIGHTING SOCIAL EXCLUSION IN VULNERABLE

URBAN CONTEXTS. In *Proceedings of INTED2021 Conference* (Vol. 8, p. 9th).

138. Denzin, N.K., Lincoln, Y., (2009). Eds.; Sage: Thousand Oaks, CA, USA; London, UK; New Delhi, India, 2005; pp. 547–557, ISBN 0-7619-2757-352. Mertens, D.M. Transformative Research and Evaluation; Guilford Press: New York, NY, USA, 2009; ISBN 978-1-59385-302-0.

139. Derrida, J., (1967). La structure, le signe et le jeu dans le discours des sciences humaines. *L'écriture et la différence*, 409-428.

140. Derrington, C. (2005). Perceptions of behaviour and patterns of exclusion: Gypsy Traveller students in English secondary schools. Journal of Research in Special Educational Needs, 5, 55 –61.

141. Derrington, C. (2007). Fight, flight and playing white: An examination of coping strategies adopted by Gypsy Traveller Adolescents in English secondary schools. International Journal of Educational Research, 46, 357–367.

142. Díez-Palomar, J., Sanmamed, A. F. F. D., García-Carrión, R., & Molina-Roldán, S., (2018). Pathways to equitable and sustainable education through the inclusion of roma students in learning mathematics. Sustainability, 10(7), 2191.

143. Dillon, A., Craven, R. G., Kaur, G., & Yeung, A. S., (2020). Support for Aboriginal and non-Aboriginal Australian students' wellbeing at school. International Journal of Educational Research, 99, 101520.

144. Doran, E. E., & Singh, A., (2018). "It's all about the ganas": Incorporating a Multicultural Curriculum in Developmental Education. Community College Journal of Research and Practice, 42(7-8), 476-488.

145. Douglas, D., & Attewell, P., (2017). School mathematics as gatekeeper. *The Sociological Quarterly*, *58*(4), 648-669.

146. Dowling, P., (2020). Recontextualization in mathematics education. *Encyclopedia of mathematics education*, 717-721.

147. du Plessis, A. E., Hobbs, L., Luft, J. A., & Vale, C., (2019). The out-of-field teacher in context: The impact of the school context and environment. In Examining the Phenomenon of "Teaching Out-of-field" (pp. 217-242). Springer, Singapore.

148. Duarte, C. G., (2004). *Implicações curriculares a partir de um olhar sobre o mundo da construção civil* [Curricular implications concerning the world of civil construction]. In G. Knijnik, F. Wanderer, & C. J.

Oliveira (Eds.). *Etnomatemática: currículo e formação de professores* [Ethnomathematics: curriculum and teacher education] (pp. 195-215). Santa Cruz do Sul, RS: EDUNISC.

149. Duarte, C., (2008). A "realidade" nas tramas discursivas da educação matemática. Unpublished Prequalification project to the Ph.D. degree. Universidade do Vale do Rio dos Sinos.

150. Duque, E., (2016). Inventing the Mathematician. Gender, Race, and Our Cultural Understanding of Mathematics. REDIMAT 2016, 5, 205–207. [CrossRef]

151. Duque, E., (2016). Inventing the Mathematician. Gender, Race, and Our Cultural Understanding of Mathematics. REDIMAT 2016, 5, 205–207. [CrossRef]

152. Durrani, N., & Nawani, D. (2020). Knowledge and curriculum landscapes in South Asia: An introduction. Handbook of Education Systems in South Asia, 1-31.

153. Dweck, C.S. Mindset, (2014),: The New Psychology of Success; Ballantine Books: New York, NY, USA, 2014; ISBN 978-0-345-47232-8.

154. Eastern Europe: Survey of patterns of segregated education of Roma in Bulgaria, the Czech

155. Educational Attainment. Available online: http://ec.europa.eu/eurostat/statistics-explained/index.php/ accessed on November 12th 2020.

156. Eglash, R., (2000). Anthropological perspectives on ethnomathematics. In Mathematics across cultures (pp. 13-22). Springer, Dordrecht.

157. Elias, A., & Mansouri, F., (2020). A systematic review of studies on interculturalism and intercultural dialogue. Journal of Intercultural Studies, 41(4), 490-523.

158. Elihami, E., & Ibrahim, I., (2020). Teaching to Variation in Learning for Non Formal Education Department. *Jurnal Edukasi Nonformal*, *1*(1), 29-40.

159. Eminovska, E., and Spasovski, O., (2012). Roma Education Fund Country Assessment Macedonia. Budapest: Roma Education Fund.

160. English, L. D., (2008). Handbook of international research in mathematics education (2nd ed.). New York, NY: Routledge.

161. Ensher, E. A., Grant-Vallone, E. J., & Donaldson, S. I., (2001). Effects of perceived discrimination on job satisfaction, organizational commitment, organizational citizenship behavior, and grievances. *Human resource development quarterly*, *12*(1), 53-72.

162. Epstein, J. L., (1991). Effects on student achievement of teachers practices of parent involvement. Advances in Reading/Language Research, 5, 261–276.

163. Epstein, M. (2019). The Possible in Jean Derrida. In A Philosophy of the Possible (pp. 157-161).

164. equality legal regime. http://www.errc.org/cikk.php?cikk=2163 (accessed January 16, 20162017).

165. Ernest, P., (1998). A postmodern perspective on research in mathematics education. In A. Sierpinska & J. Kilpatrick (Eds.), Mathematics Education as a research domain: A search for identity (Vol. 1, pp. 71-85). Dordrecht: Kluwer.

166. Ernest, P., (2018). The Ethics of Mathematics: Is Mathematics Harmful?. In The philosophy of mathematics education today (pp. 187-216). Springer, Cham.

167. Ernest, P., (2019). PRIVILEGE, POWER AND PERFORMATIVITY: THE ETHICS OF MATHEMATICS IN SOCIETY AND EDUCATION. Philosophy of Mathematics Education Journal, (35).

168. European Commission,, (2011),). Progress Towards the Common European Objectives in Education and Training: Indicators and benchmarks 2010/2011. Retrieved from http://ec.europa.eu/education/lifelong-llearning-ppolicy/indicators10_en.htm (Accessed 21.07.2012).

169. European Commission. (2010). Europe 2020. A strategy for smart, sustainable and inclusive growth. Brussels: European Commission.

170. European Commission. (2011). Tackling early school leaving: A key contribution to the Europe 2020 agenda. Brussels: European Commission.

171. European Commission. (2012). Strategic framework for education and training. Retrieved from http://ec.europa.eu/ education/lifelong-learning-policy/framework_en.htm (Accessed 21.07.2016).

172. European Commission. (2013) Ethics for Researchers. Facilitating Research Excellence in FP7; Directorate-General for Research and

Innovation. Directorate B—European Research Area; Publications Office of the European Union: Luxembourg, 2013.

173. European Roma Rights Center, (2003),). EU Roma Integration Directive – Filling the gap in the

174. European Roma Rights Center, (2005). Stigmata: Segregated schooling of Roma in Central and

175. Eurostat. Statistics explained. Quality of Life Indicators—Education. Main Statistical Findings. Level of Educational Attainment. Available online: http://ec.europa.eu/eurostat/statistics-explained/index.php/Quality_of_life_indicators_-_education (accessed on 8 June 2018).

176. Evans, J., (2021). Reflections on the Idea of "Context" in the Transfer of Research Knowledge. In *Transfer of Learning* (pp. 405-415). Springer, Cham.

177. Fairclough, N., (1995). Critical discourse analysis : the critical study of language. London ; New York: Longman.

178. Fayzullaev, J., (2020). MATHEMATICAL COMPETENCE AS THE BASIS FOR IMPROVING THE QUALITY OF STUDENTS MATHEMATICAL EDUCATION. *European Journal of Research and Reflection in Educational Sciences Vol*, *8*(3).

179. Felix, G., & Guattari, D. (1987). A thousand plateaus: Capitalism and schizophrenia. *Trans. by Massumi, B.)., University of Minnesota, Minneapolis*.

180. Flecha, A., (2012). Family Education Improves Student's Academic Performance: Contributions from European Research. Multidisciplinary Journal of Educational Research, 3, 301–321.

181. Flecha, A., García, R., Gómez, A., & Latorre, A., (2009). Participación en escuelas de éxito: Una investigación comunicativa del proyecto INCLUD-ED. Cultura y Educación, 21, 183–196.

182. Flecha, R., (2011). The dialogic sociology of education. Int. Stud. Soc. Educ. 2011, 21, 7–20. [CrossRef]

183. Flecha, R.; Gómez, J. (2012) Participatory paradigms: Researching 'with' rather than 'on'. In Researching Widening Access to Lifelong Learning; Osborne, M., Gallacher, J., Crossan, B., Eds.; Routledge: London, UK, 2002; pp. 129–140, ISBN 0203338723.

184. Flecha, R.; Soler, M., (2013). Turning difficulties into possibilities: Engaging Roma families and students in school through dialogic learning. Camb. J. Educ. 2013, 43, 451–465. [CrossRef]

185. Flick, U. (2014). Design and process in qualitative research. In A Companion to Qualitative Research; Flick, U., von Kardorff, E., Steinke, I., Eds.; Sage: Thousand Oaks, CA, USA; London, UK; New Delhi, India, 2004; pp. 146–152, ISBN 0761973745.

186. Foucault, M., (2000). Power (P. Rabinow, Ed.; R. Hurley et al., Trans.). Essential works of Foucault 1954–1984 (Vol. III). New York: The New Press.

187. Foucault, M., (2000). So is it important to think? In J. Faubion (Ed.), Power. New York: New Press. (Original work published 1981).

188. Fox, J. (2001) Patterns of discrimination, grievances and political activity among Europe's Roma: A cross-sectional analysis. JEMIE J. Ethnopolitics Minor. Issues Eur. 2001, 1, 1–25. Sustainability 2018, 10, 2191 15 of 16

189. Kalabasis, F., & Stathopoulou, C., (2012). In-Between Critical Mathematics Education and Ethnomathematics. A Philosophical Reflection and an Empirical Case of a Romany Students' Group Mathematics Education. *Journal for Critical Education Policy Studies (JCEPS)*, *10*(1).

190. Freire, P., (1970). Pedagogy of the oppressed. New York: Continuum.

191. Freire, P., (1997). Pedagogy of the heart. New York: Continuum.

192. Fullan, M., (1995). The school as a learning organization: Distant dreams. Theory into practice, 34(4), 230-235.

193. Fundación Secretariado General Gitano. Statistical Data. Available online: https://www.gitanos.org/quehacemos/areas/educacion/index.html (accessed on 15 May 2018).

194. Galton, M., Hargreaves, L., & Pell, T., (2009). Group work and whole-class teaching with 11 to 14 year-olds compared. Cambridge Journal of Education, 39, 119 –140.

195. Gana, E., Stathopoulou, C., & Govaris, C., (2020). Expanded Pedagogical Spaces: Enhancing Roma Students Involvement in School. In *Language Diversity in Greece* (pp. 169-181). Springer, Cham.

196. García, R., (2012). Out of the ghetto psychological basis of dialogic learning. International Journal of Educational Psychology, 1, 51 –69.

197. García-Carrión, R.; Díez-Palomar, J., (2015). Learning Communities: Pathways for educational success and social transformation through interactive groups in mathematics. Eur. Educ. Res. J. 2015, 14, 151–166. [CrossRef]

198. Garfinkel, H., (1967). Studies in Ethnomethodology; Prentice-Hall: Englewood Cliffs, NJ, USA, 1967; ISBN978-0-74-560005-5.

199. Gellert, U., (2008). Validity and relevance: comparing and combining two sociological perspectives on mathematics classroom practice. ZDM, 40(2), 215-224.

200. Gemmink, M. M., Fokkens-Bruinsma, M., Pauw, I., & van Veen, K., (2020). Under pressure? Primary school teachers' perceptions of their pedagogical practices. European Journal of Teacher Education, 1-17.

201. Gergen, K. J., (1973). Social psychology as history. *Journal of personality and social psychology*, *26*(2), 309.

202. Gerrard, J., Rudolph, S., & Sriprakash, A., (2017). The politics of post-qualitative inquiry: History and power. *Qualitative inquiry*, *23*(5), 384-394.

203. Gershon, W. S., (2021). Sensuous Curriculum. In *Oxford Research Encyclopedia of Education*.

204. Girbés, S.; Macías, F.; Álvarez, P., (2015). De la escuela gueto a una comunidad de aprendizaje: Un estudio de caso sobre la superación de la pobreza a través de una educación de éxito. Int. Multidiscip. J. Soc. Sci. 2015, 4, 88–116. [CrossRef]

205. Gladyshev, V., Miliaeva, E., Meniaeva, M., & Neveleva, V., (2019). Yes-tradition and no-tradition in the reproduction of cultural forms and cultural identity in conditions of globalization. In *SHS Web of Conferences* (Vol. 72, p. 03035). EDP Sciences.

206. Glaser, B.G.; Strauss, A.L., (2017) Discovery of Grounded Theory: Strategies for Qualitative Research; Routledge: New York, NY, USA, 2017; ISBN 978-0-202-30260-7.

207. Gómez, A., Racionero, S., & Sordé, T., (2010). Ten years of critical communicative methodology. International Review of Qualitative Research, 3, 17 –43.

208. Gómez, J., & Vargas, J., (2003). Why Romà do not like mainstream schools: Voices of a people without territory. Harvard Educational Review, 73, 559–590.

209. Gómez, P., & Perry, P. (Eds.)., (1996). La problemática de las matemáticas escolares. Un reto para directivos y profesores. México: una empresa docente y Grupo Editorial Iberoamérica. Hart, K. (1998). In A. Sierpinska & J. Kilpatrick (Eds.), Mathematics Education as a research domain: A search for identity (Vol. 1, pp. 71-85). Dordrecht: Kluwer.

210. Gómez, P., (2000). Investigación en educación matemática y enseñanza de las matemáticas en países en desarrollo. Educación Matemática, 12(1), 93-106.

211. González, C., Varela, J., Sánchez, P. A., Venegas, F., & De Tezanos-Pinto, P., (2021). Students' Participation in School and its Relationship with Antisocial Behavior, Academic Performance and Adolescent Well-Being. *Child Indicators Research*, *14*(1), 269-282.

212. Goodchild, S., (2020). Book Review: The philosophy of mathematics education today. Paul Ernest (Ed.)(2018). *Educational Studies in Mathematics*, *103*(1), 109-119.

213. Goodwin, DawnD., Nicholas Mays, N., (2020). and Catherine Pope. "Ethical Issues in Qualitative Research." *Qualitative Research in Health Care* (2020):, 27-41.

214. Goos, M., O'Donoghue, J., Ríordáin, M. N., Faulkner, F., Hall, T., & O'Meara, N., (2020). Designing a national blended learning program for "out-of-field" mathematics teacher professional development. *ZDM*, 1-13.

215. Gorard, S., (2019). School choice in an established market. Routledge.

216. Gorard, S.; Smith, E., (2007). Do barriers get in the way? A review of the determinants of post-16 participation. Res. Post Compuls. Educ. 2007, 12, 141–158. [CrossRef]

217. Gough, N., (2005). Geophilosophy and methodology: Science education research in a rhizomatic space. Methodologies for researching mathematics, science and technological education in societies in transition.

218. Greenberg, J., (2010). Report on Roma education today: From slavery to segregation and beyond. Columbia Law Review, 110, 919–1001.

219. Greenfields, M., & Ryder, A., (2012). Research with and for Gypsies, Roma and Travellers: Combining policy, practice and community in action research. In J. Richardson & A. Tsang (Eds.), Gypsies and Travellers (pp. 151–167). Bristol: The Policy Press.

220. Griffiths, T. G., & Imre, R., (2013). Educating Critical Citizens for an Alternative World-System. In Mass Education, Global Capital, and the World (pp. 67-98). Palgrave Macmillan, New York.

221. Gruber, H. E. & Vonèche, J. J., (1995). The Essential Piaget. New Jersey, Aronson.

222. Guerin, C., (2013). Rhizomatic research cultures, writing groups and academic researcher identities. *Interna-tional Journal of Doctoral Studies, 8,* 137-150. Retrieved from http://ijds.org/Volume8/IJDSv8p137- 150Guerin0400.pdf

223. Guilherme, M., (2020). Intercultural responsibility: Transnational research and glocal critical citizenship. In *The Routledge Handbook of Language and Intercultural Communication* (pp. 343-360). Routledge.

224. Gurzó, K., (2014). Does the SEN Category Discriminate Roma Children (only)? Procedia Soc. Behav. Sci. 2014, 116, 5030–5035. [CrossRef]

225. Gutiérrez, K.D.; Baquedano-López, P.; Tejeda, C., (1999) Rethinking diversity: Hybridity and hybrid language practices in the third space. Mind Cult. Act. 1999, 6, 286–303. [CrossRef]

226. Gutiérrez, K.D.; Baquedano-López, P.; Tejeda, C., (1999). Rethinking diversity: Hybridity and hybrid language practices in the third space. Mind Cult. Act. 1999, 6, 286–303. [CrossRef]

227. Gutting, Gary and Oksala, Johanna, (2019). "Michel Foucault", *The Stanford Encyclopedia of Philosophy* (Spring 2019 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/spr2019/entries/foucault/>.

228. Guttorm, H.; Hohti, R.; Paakkari, A., (2015). 'Do the Next Thing': An Interview with Elizabeth Adams St. Pierre on Post-Qualitative Methodology. Reconcept. Educ. Res. Meth. 2015, 6, 15–22.

229. Habermas, J.. (1984). The Theory of Communicative Action; Beacon: Boston, MA, USA, 1984; Volume I, ISBN 978-0-80-701506-3.

230. Hackenberg, A. J., Creager, M., & Eker, A., (2020). Teaching practices for differentiating mathematics instruction for middle school students. *Mathematical Thinking and Learning*, 1-30.

231. Hamukwaya, S. T., & Haser, Ç., (2021). "It does not Mean that They Cannot Do Mathematics": Beliefs about Mathematics Learning Difficulties. *International Electronic Journal of Mathematics Education*, *16*(1), em0622.

232. Hancock, I., (1988). Reunification and the role of international Romani union. Roma, 29,9 –19.

233. Hancock, I., (1988). Reunification and the role of the international Romani Union. Roma 1988, 29, 9 19.

234. Hardman, J., (2021). Vygotsky's decolonial pedagogical legacy in the 21st century: back to the future. *Mind, Culture, and Activity*, 1-15.

235. Harvey, J.-F., Johnson, K. J., Roloff, K. S., & Edmondson, A. C., (2019). From orientation to behavior: The interplay between learning orientation, open-mindedness, and psychological safety in team learning. Human Relations. https://doi.org/10.1177/0018726718817812

236. Hattie, J. (2018). Teachers Make a Difference, What is the Research Evidence? In Building Teacher Quality: What Does the Research Tell Us? Australian Council for Educational Research (ACER). ACEReSearch. Available online: https://bit.ly/2KV4dBT (accessed on 15 May 2018).

237. Hauk, S., Toney, A. F., Brown, A., & Salguero, K., (2020). Activities for Enacting Equity in Mathematics Education Research. *International Journal of Research in Undergraduate Mathematics Education*, 1-16.

238. Hayden P., Saunders N., (2019). Solidarity at the Margins: Arendt, Refugees, and the Inclusive Politics of World-Making. In: Hiruta K. (eds) Arendt on Freedom, Liberation, and Revolution. Philosophers in Depth. Palgrave Macmillan, Cham

239. Heimans, S., & Singh, P., (2016). Re-presenting, performing critical/post-critical research realities. *Research in Education*, *96*(1), 93-109.

240. Hellgren, Z., & Gabrielli, L., (2021). The Dual Expectations Gap. Divergent Perspectives on the Educational Aspirations of Spanish Roma Families. *Journal of Intercultural Studies*, *42*(2), 217-234.

241. Herrera, L., Al-Lal, M., & Mohamed, L., (2020). Academic achievement, self-concept, personality and emotional intelligence in

primary education. analysis by gender and cultural group. *Frontiers in psychology*, *10*, 3075.

242. Hickey, D. T., Moore, A. L., & Pellegrino, J. W., (2001). The motivational and academic consequences of elementary mathematics environments: Do constructivist innovations and reforms make a difference?. *American Educational Research Journal*, *38*(3), 611-652.

243. Hill, N. E., & Taylor, L. C., (2004). Parental school involvement and children's academic achievement: Pragmatics and issues. Current Directions in Psychological Science, 13, 161 –164.

244. Honneth, A., Whitebook, J., Alford, C. F., Ferrera, A., Hulatt, O., Martel, J., & Beardsworth, S., (2019). Transitional Subjects: Critical Theory and Object Relations. Columbia University Press.

245. Hooley, N., (2020). Reconstructing curriculum as philosophy of practice. Curriculum Perspectives, 40(2), 123-130.

246. Hoover-Dempsey, K.V.;Walker, J.M.; Sandler, H.M.;Whetsel, D.; Green, C.L.;Wilkins, A.S.; Closson, K., (2005). Why do parents become involved? Research findings and implications. Elem. School J. 2005, 106, 105–130. [CrossRef]

247. Howell, J., (2018). The unstudied reference neighborhood: Towards a critical theory of empirical neighborhood studies. Sociology Compass, e12649.

248. Hoy, Wayne & Sweetland, Scott., (2001). Designing Better Schools: The Meaning and Measure of Enabling School Structures. Educational Administration Quarterly - EDUC ADMIN QUART. 37. 296-321. 10.1177/00131610121969334.

249. Hroch, P., Deleuze, Guattari, and Environmental Pedagogy and Politics: Ritournelles for a planet-yet-to-come.

250. https://www.un.org/sustainabledevelopment/education/ (accessed on 15May 2018).

251. Huang, H.-C., Cheng, T. C. E., Huang, W.-F., & Teng, C.-I., (2018). Who are likely to build strong online social networks? The perspectives of relational cohesion theory and personality theory. Computers in Human Behavior, 82, 111–123.doi:10.1016/j.chb.2018.01.004

252. Huber, M., & Karaali, G., (2021). Seeing Mathematics in the World. *Journal of Humanistic Mathematics*, *11*(2), 1-4.

253. Hudley, C. Achievement and Expectations of Immigrant, Second Generation, and Non-immigrant Black Students in U.S. Higher Education. Int. J. Educ. Psychol. 2016, 5, 223–248. [CrossRef]

254. Hudley, C., (2016). Achievement and Expectations of Immigrant, Second Generation, and Non-immigrant Black Students in U.S. Higher Education. Int. J. Educ. Psychol. 2016, 5, 223–248. [CrossRef]

255. Hurst HannumH., (2016). Reinvigorating Human Rights for the Twenty-First Century, Human Rights Law Review, Volume 16, Issue 3, September 2016, Pages 409–451

256. Idris, F., Hassan, Z., Ya'acob, A., Gill, S. K., & Awal, N. A. M., (2012). The role of education in shaping youth's national identity. *Procedia-Social and Behavioral Sciences*, *59*, 443-450.

257. Inhelder, B., Sinclair, H. & Bovet, M., (1974). Learning and the Development of Cognition. London, Routledge & Kegan Paul.

258. Jablonka, E., (2009). Mathematics for all. Why? What? When? In C. Winsløw (Ed.), Nordic research in mathematics education. Proceedings from NORMA08 (pp. 293-305). Rotterdam: Sense.

259. Jablonka, E., (2020). Critical thinking in mathematics education. *Encyclopedia of mathematics education*, 159-163.

260. Jackson, A. Y., & Mazzei, L. A., (2012a). Thinking with theory in qualitative research: Viewing data across multiple perspectives. London: Routledge.

261. Jackson, A. Y., & Mazzei, L. A., (2012b). In the threshold: Writing between-the-two. International Review of Qualitative Research, 5(4), 449–458.

262. Jackson, A. Y., & Mazzei, L. A., (2016). Thinking with an agentic assemblage in posthuman inquiry. In C. Taylor & C. Hughes (Eds.), Posthuman research practices in education (pp. 93–107). Basingstoke, UK: Palgrave MacMillan.

263. Jamie Mcphie, J., (2020):). Speculative fabulatations in the ruins of colonial topographies: a (messy) review of 'developing place-responsive pedagogy in outdoor environmental education: a rhizomatic curriculum autobiography', Journal of Adventure Education and Outdoor Learning, DOI: 10.1080/14729679.2020.1819833

264. Jasmine B. Ulmer, J., (2017). Posthumanism as research methodology: inquiry in the Anthropocene, International Journal of

Qualitative Studies in Education, 30:9, 832-848, DOI:10.1080/09518398.2017.1336806.

265. Jason, K. E., (2020). Dismantling the pillars of white supremacy: Obstacles in eliminating disparities and achieving racial justice. *CUNY L. Rev.*, *23*, 139.

266. Jessica Walton, J., & Joan Parker Webster, J., (2019):). Ethnography and multicultural/intercultural education: uncovering the unforeseen complexities, practices and unintended outcomes, Ethnography and Education, DOI: 10.1080/17457823.2019.1584861

267. Johnson, E. G., (1992). The Design of the National Assessment of Educational Progress. Journal of Educational Measurement, 29(2), 95-110.

268. Jordan, A., (2018). The supporting effective teaching project: 1. Factors influencing student success in inclusive elementary classrooms. *Exceptionality Education International*, *28*(3).

269. Juha, Hämäläinen, and Pasi, Matikainen, (2018). Mechanisms and Pedagogical Counterforces of Young People's Social Exclusion: Some Remarks on the Requisites of Social Sustainability, Sustainability 2018, 10(7), 2166; doi:10.3390/su10072166

270. Kafoussi, S., Chaviaris, P., & Moutsios-Rentzos, A., (2019). Investigating Parental Influences on Sixth Graders' Mathematical Identity in Greece: A Case Study. International Electronic Journal of Mathematics Education, 15(2), em0572.

271. Kai Ostwald, K., , Elvin Ong, E., & Dimitar Gueorguiev, D., (2017): Language politics, education, and ethnic integration: the pluralist dilemma in Singapore, Politics, Groups, and Identities

272. Kaiser, G., (2020). Mathematical modelling and applications in education. *Encyclopedia of mathematics education*, 553-561.

273. Kalantzis, M., & Cope, B. (2020). Multiculturalism and education policy. In *Ethnicity, class and gender in Australia* (pp. 82-97). Routledge.

274. Kalantzis, M., & Cope, B., (2020). Multiculturalism and education policy. In *Ethnicity, class and gender in Australia* (pp. 82-97). Routledge.

275. Karakos, H.L., Fisher, B.W., Geller, J., Lunn, L., Palmer, N.A., Perkins, D.D., Mihaylov, N., Partridge, W.L., & Shields, S., (2016). The Field School in Intercultural Education as a model for international

service-learning and collaborative action-research training. In S.L. Barnes, L. Brinkley-Rubinstein, B. Doykos, N. C. Martin & A. McGuire (Eds.), Academics in Action! A Model for Community-Engaged Research, Teaching, and Service (pp. 167-190). New York: Fordham University Press.

276. Karolina Barglowski, K., (2018):. Migrants' class and parenting: the role of cultural capital in Migrants' inequalities in education, Journal of Ethnic and Migration Studies, DOI: 10.1080/1369183X.2018.1476130.

277. Kassis, D., (2020). Underachievement of Roma Children in Greece. In *Language Diversity in Greece* (pp. 183-192). Springer, Cham.

278. Kavanagh, A. M., & Dupont, M. (2021). Making the invisible visible: managing tensions around including Traveller culture and history in the curriculum at primary and post-primary levels. *Irish Educational Studies*, 1-17.

279. Kellaghan, T. & Greaney, V. (2001). The Globalisation of Assessment in the 20th Century. Assessment in Education, 8(1), 87-102.

280. Kertesi, G.; Kézdia, G., (2011). The Roma/non-Roma test score gap in Hungary. Am. Econ. Rev. 2011, 101, 519–525. [CrossRef]

281. Kertesi, G.; Kézdia, G., (2011). The Roma/non-Roma test score gap in Hungary. Am. Econ. Rev. 2011, 101, 519–525. [CrossRef]

282. Khalfaoui, A., García-Carrión, R., & Villardón-Gallego, L., (2020). Bridging the gap: engaging Roma and migrant families in early childhood education through trust-based relationships. *European Early Childhood Education Research Journal*, *28*(5), 701-711.

283. Kilpatrick, J., (1992). A History of Research in Mathematics Education. In D. A. Grouws (Ed.), Handbook of Research on Mathematics Teaching and Learning (pp. 3-38). New York: Macmillan.

284. Kilpatrick, J., (2006). A History of Research in Mathematics Education. In D. A. Grouws (Ed.), Handbook of Research on Mathematics Teaching and Learning (pp. 3-38). Greenwood: IAP.

285. Kilpatrick, J., (2008). The development of mathematics education as an academic field. In M. Menghini, F. Furinghetti, L. Giacardi & F. Arzarello (Eds.), The first century of the International Commission of Mathematical Instruction (1908-2008). Reflecting and shaping the world of mathematics education (pp. 25-39). Roma: Istituto della Enciclopedia Italiana fondata da Giovanni Treccani.

286. Kim, S., & Dorner, L. M., (2021). School district responses to cultural and linguistic change: Competing discourses of equity, competition, and community. *Journal of Language, Identity & Education*, *20*(4), 255-270.

287. Kinchin I.M., (2016) Implications for Student Feedback. In: Visualising Powerful Knowledge to Develop the Expert Student. SensePublishers, Rotterdam. https://doi.org/10.1007/978-94-6300-627-9_7

288. Kirshner D.H., Meng L., (2012) Enculturation and Acculturation. In: Seel N.M. (eds) Encyclopedia of the Sciences of Learning. Springer, Boston, MA. https://doi.org/10.1007/978-1-4419-1428-6_773

289. Knapp, A., Landers, R., Liang, S., & Jefferson, V., (2017). We all as a family are graduating tonight: a case for mathematical knowledge for parental involvement. Educational Studies in Mathematics, 95(1), 79-95.

290. Knijnik, G., (2008). Landless peasants of Southern Brazil and mathematics education: a study of three different language games. In J. F. Matos, K. Yasukawa & P. Valero (Eds.), Proceedings of the Fifth International Mathematics Education and Society Conference (pp. 312-319). Lisbon: Centro de Investigação em Educação, Universidade de Lisboa; Department of Education, Learning and Philosophy, Aalborg University.

291. Knijnik, G., Wanderer, F., & Duarte, C., (2008). Das invenções pedagógicas: a importância do uso de materiais concretos na educação matemática. Universidade do Vale do Rio dos Sinos.

292. Kokorudz, M., (2020). TALES OF RE-ENTRY TO ADULT HIGH SCHOOL PROGRAMS: A RHIZOMATIC (DE)(RE)TANGLING, University of Regina, Regina, Saskatchewan.

293. Kools, M. and L. Stoll, (2016), "What Makes a School a Learning Organisation?", OECD Education Working Papers, No. 137, OECD Publishing, Paris, https://doi.org/10.1787/5jlwm62b3bvh-en.

294. Koren, S., (2020). History, Identity, and Curricula: Public Debates and Controversies Over the Proposal for a New History Curriculum in Croatia. In *Nationhood and Politicization of History in School Textbooks* (pp. 87-112). Palgrave Macmillan, Cham.

295. Krainer, K., (2007). Individuals, Teams, Communities and Networks: Participants andWays of Participation in Mathematics Teacher Education: An Introduction. In K. Krainer & T. Wood (Eds.), The

international handbook of mathematics teacher education (Vol. 3. Participants in mathematics teacher education: Individuals, teams, communities and networks, pp. 1-10). Rotterdam: Sense.

296. Krastev, G., Ivanova, E. I., & Krastev, V., (2019). GYPSIES/ROMA IN BULGARIA PROFESSING ISLAM-ETHNIC IDENTITY (RETROSPECTIONS AND PROJECTIONS). Research & Science Today, (2).

297. Kubaník, P., (2021). School, Languages and Power in Pretend Play of Romani Children. *Social and Economic Vulnerability of Roma People*, 53.

298. Kumm, Brian., E., and Lisbeth A. Berbary, L., (2018). "Questions for post qualitative inquiry: Conversations to come." *Leisure Sciences* 40.1-2 (2018): 71-84.

299. Kuntz, A. M., (2019). Qualitative inquiry, cartography and the promise of material change. Routledge.

300. Ladhani, S., & Sitter, K. C., (2020). The revival of anti-racism. *Critical Social Work*, *21*(1), 54-65.

301. Ladson-Billings, G. It doesn't add up: African American students' mathematics achievement. J. Res.

302. Ladson-Billings, G., & Tate, W. F., (2016). Toward a critical race theory of education. In *Critical race theory in education* (pp. 10-31). Routledge.

303. Lather, P., & St. Pierre, E., (2013). Post-qualitative research. *International Journal of Qualitative Studies in Education, 26*(6), 629-633.

304. Lather, P., (1991). *Getting smart: Feminist research and pedagogy with/in the postmodern.* New York, NY: Routledge.

305. Lather, P., (1993). Fertile obsession: Validity after poststructuralism. *Sociological Quarterly, 34*(4), 673-693.

306. Lather, P., (2004). This *is* your father's paradigm: Government intrusion and the case of qualitative research in education. *Qualitative Inquiry, 10*(1), 15-34.

307. Lather, P., (2016). Top Ten+ List: (Re) Thinking Ontology in (Post) Qualitative Research. *Cultural Studies? Critical Methodologies*, *16*(2), 125-131.

308. Lauritzen, S. M., & Nodeland, T. S., (2018). “What is the problem represented to be?” Two decades of research on Roma and education in Europe. Educational Research Review, 24, 148–169.

309. Law, J. and Urry, J., (2004), “Enacting the social”, Economy and Society, Vol. 33 No. 3, pp. 390-410.

310. Le Grange, L.L.L., (2011). Sustainability and higher education: From arborescent to rhizomatic thinking. Educ. Philos. Theory 2011, 43, 742–754.

311. Le, P.T. & Matias, C.E., (2019). Cultural Studies of Science Education, (2019) 14: 15. https://doi.org/10.1007/s11422-017-9854-9

312. Lerman, S., (2000). The social turn in mathematics education research. In J. Boaler (Ed.), Multiple perspectives on mathematics teaching and learning (pp. 19-44). Westport (USA): Ablex Publishing.

313. Lerman, S., (2006). Cultural psychology, anthropology and sociology: the developing 'strong' social turn. In J. Maasz & W. Schloeglmann (Eds.), New mathematics education research and practice (pp. 171-188). Rotterdam: Sense.

314. Lerman, S., Xu, G., & Tsatsaroni, A., (2002). Developing Theories of Mathematics Education Research: The ESM Story. Educational Studies in Mathematics, 51(1/2), 23-40.

315. Lester, F. (Ed.). .), (2007). Second Handbook of Research on Mathematics Teaching and Learning. Charlotte, USA: NCTM – IAP.

316. Levinson, M.P., and A.C. Sparkes, (2005), Gypsy children, space, and the school environment. International Journal of Qualitative Studies in Education 18: 751–72.

317. Liegeois, J. P. & Gheorge, N., (1995). Roma/Gypsies: A European Minority. London, Minority Rights Group International

318. Liégeois, J.P., 2007. Roma education and public policy. European Education 39, no. 1: 11–31

319. Lin, Y. C., (2021). Using a drawing method to investigate pre-service teachers’ beliefs, knowledge and emotions about mathematics teaching and learning. Asia-Pacific Journal of Teacher Education, 1-24.

320. Linda Darling-Hammond, Lisa Flook, Channa Cook-Harvey, Brigid Barron & David Osher, (2020) Implications for educational practice of the science of learning and development, Applied Developmental Science, 24:2, 97-140, DOI: 10.1080/10888691.2018.1537791

321. Lingard, B., (2011),). “Policy as numbers: ac/counting for educational research”, The Australian Educational Researcher, Vol. 38 No. 4, pp. 355

322. Lipka, J., (2002),). ‘Connecting Yup’ik elders knowledge to school mathematics’, in M. de Monteiro (ed.), Proceedings of Second International Conference on Ethnomathematics (ICEM2), CD Rom, Lyrium Comunicação Ltda, Ouro Preto, Brazil.

323. Lithner, J., (2017). Principles for designing mathematical tasks that enhance imitative and creative reasoning. *Zdm*, *49*(6), 937-949.

324. Lumadi, M. W., (2019). Curriculum reform in disadvantaged communities: a critical pedagogy. *Africa Education Review*, *16*(6), 1-3.

325. Maba, W., (2017). Teacher's Perception on the Implementation of the Assessment Process in 2013 Curriculum. *International Journal of Social Sciences and Humanities (IJSSH)*, *1*(2), 1-9.

326. Makarova, I., Duarte, J., & Huilcán, M. I., (2021). Experts’ views on the contribution of language awareness and translanguaging for minority language education. *Language Awareness*.

327. Malone, K., Truong, S., Gray, T., (2017). Reimagining sustainability in Precarious Times, Springer, 2017.

328. Mandinach, Ellen B., and Edith S. Gummer. "What does it mean for teachers to be data literate: Laying out the skills, knowledge, and dispositions." *Teaching and Teacher Education* 60 (2016): 366-376.

329. Manning, E., & Massumi, B., (2014). Thought in the act. Minneapolis: University of Minnesota Press.

330. Mărgărit, Emilian. , (2012). Deleuze Transcendental Empiricism as Exercise of Thought: Hume’s Case. Meta: Research in Hermeneutics, Phenomenology and Practical Philosophy. 4. 377-403.

331. Martin, D. B., (2000). Mathematics success and failure among African-American youth: the roles of sociohistorical context, community forces, school influence, and individual agency Available from http://books.google.com/books?id=tLPvUQYNajAC&printsec=frontcover

332. Masny, D., (2016). Problematizing qualitative research: Reading a data assemblage with rhizoanalysis. *Qualitative Inquiry*, *22*(8), 666-675.

333. Massumi, B., (2015). *Politics of effect*. Cambridge, England: Polity Press.

334. Mazana, Y. M., Suero Montero, C., & Olifage, C. R., (2019). Investigating students' attitude towards learning mathematics.

335. McDermott, J. C., Chapel, F. M., Drahokoupil, Š. V., Bakšić-Muftić, J., Daniel, S., Hancock, I., & Symeou, L., (2017). The Education of Roma Children: Challenges and Promises. In R. Gordon, T. Akutsu, J. McDermott, & J. Lalas (Eds.), Challenges Associated with Cross-Cultural and At-Risk Student Engagement (pp. 74-99). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-1894-5.ch005

336. McDermott, R. P., (1996). The acquisition of a child by a learning disability. In S. Chaiklin & J. Lave (Eds.), Understanding practice. Perspectives on activity and context. Cambridge: Cambridge University Press.

337. McHoul, A., & Grace, W., (1993). A Foucault primer: Discourse, power and the subject . New York, NY: New York University Press.

338. McKnight, A., (2017). Singing up country in Academia: Teacher education academics and preservice teachers' experience with Yuin Country.

339. Mead, G.H.Mind, (1934). Self and Society; University of Chicago Press: Chicago, IL, USA, 1934; ISBN 978-0-22-651660-8.

340. Medina, M. A., Murtadha, K. H., & Grim, J., (2020). Community Schools as a Vehicle for Social Justice and Equity. In Emerging Perspectives on Community Schools and the Engaged University (pp. 80-97). IGI Global.

341. Melissa Andrade, M.M., (2017)-Melina. Incepted neoliberal dreams in school mathematics and the 'Chilean experi- ence'. CERME 10, Feb 2017, Dublin, Ireland. hal-01937456

342. Mendes, M. M., Magano, O., & Toma, S., (2021). Social and Economic Vulnerability of Roma People: Key Factors for the Success and Continuity of Schooling Levels.

343. Menghini, M., Furinghetti, F., Giacardi, L., & Arzarello, F. (Eds.). .), (2008). The first century of the International Commission of Mathematical Instruction (1908-2008). Reflecting and shaping the world of mathematics education. Roma: Istituto della Enciclopedia Italiana fondata da Giovanni Treccani.

344. Merkens, H., (2004). Selection procedures, sampling, case construction. In A Companion to Qualitative Research; Flick, U., von Kardorff, E., Steinke, I., Eds.; Sage: Thousand Oaks, CA, USA; London, UK; New Delhi, India, 2004; pp. 165–171, ISBN 0761973745.

345. Mertens, D.M., (2010). Transformative mixed methods research. Qual. Inq. 2010, 16, 469–474. [CrossRef]

346. Michaeli, T., & Romeike, R., (2021, April). Developing a Real World Escape Room for Assessing Preexisting Debugging Experience of K12 Students. In *2021 IEEE Global Engineering Education Conference (EDUCON)* (pp. 521-529). IEEE.

347. Miguéis, V. L., Freitas, A., Garcia, P. J., & Silva, A., (2018). Early segmentation of students according to their academic performance: A predictive modelling approach. *Decision Support Systems*, *115*, 36-51.

348. Mihajlović, M., (2004). Needs Assessment Study for the Roma Education Fund – Serbia (without Kosovo). Budapest, REF.

349. Miles, M. L., Buenrostro, P. M., Marshall, S. A., Adams, M., & McGee, E. O., (2019). Cultivating Racial Solidarity Among Mathematics Education Scholars of Color to Resist White Supremacy. The International Journal of Critical Pedagogy, 10(2).

350. Mills, C.W., (2000). The Sociological Imagination;OxfordUniversity Press: NewYork,NY,USA, 2000; ISBN978-0-19-513373-8.

351. Mimeo. de Laat, J., Ali, R., Illieva, V., Sykora, C., and Lepeshko, N., (2012). Toward and Equal Start: Closing the Early Learning Gap for Roma Children in Eastern Europe. Washington, DC: World Bank.

352. Mitchell, R. M. (2020). Enabling School Structure. *Oxford Research Encyclopedia of Education*.

353. Modi, K., Kasana, S., Azam, A., & Madhavan, L., (2021). Education, poverty and social exclusion: assessment of youth leaving care. *SN Social Sciences*, *1*(4), 1-19.

354. Molderez, I., & Fonseca, E., (2018). The efficacy of real-world experiences and service learning for fostering competencies for sustainable development in higher education. *Journal of Cleaner Production*, *172*, 4397-4410.

355. Moll, L.C.; Amanti, C.; Neff, D.; Gonzalez, N., (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. Theory Pract. 1992, 31, 132–141. [CrossRef]

356. Mølstad, C. E., Prøitz, T. S., & Dieude, A., (2021). When assessment defines the content—understanding goals in between teachers and policy. *The Curriculum Journal*, *32*(2), 290-314.

357. Montero M., (2014). Conscientization. In: Teo T. (eds) Encyclopedia of Critical Psychology. Springer, New York, NY

358. Morgan, C., (2009). Questioning the mathematics curriculum: A discursive approach. In L. Black, H. Mendick & Y. Solomon (Eds.), Mathematical Relationships in Education: Identities and participation (pp. 97-106). New York: Routledge, Taylor and Francis.

359. Morrow, Raymond AllenR.A.,, and Carlos Alberto Torres. , C.A., 2002. Reading Freire and Habermas: Critical Pedagogy and Transformative Social Change. New York: Teachers College Press.

360. Moscovici, S., (1981). On social representations. Soc. Cogn. Perspect. Everyday Underst. 1981, 8, 181–209. 64. Csepeli, G.; Simon, D. Construction of Roma identity in Eastern and Central Europe: Perception and self-identification. J. Ethn. Migr. Stud. 2004, 30, 129–150. [CrossRef]

361. Mosely, G., Harris, J. & Grushka, K., (2020). Design education in schools: an investigation of the Australian Curriculum: Technologies. Int J Technol Des Educ (2020). https://doi.org/10.1007/s10798-020-09572-3

362. Moutsios-Rentzos, A., & Kalavasis, F. (2012). The interrelationships of mathematics and the school unit as viewed by prospective and in-service school principals: a systems theory approach. *FACILITATING ACCESS AND PARTICIPATION: MATHEMATICAL PRACTICES INSIDE AND OUTSIDE THE CLASSROOM*, 293.

363. Mukhopadhyay, S., Powell, A. B., & Frankenstein, M., (2009). An ethnomathematical perspective on culturally responsive mathematics education. In B. Greer, S. Mukhopadhyay, A. B. Powell, & S. Nelson-Barber (Eds.). Culturally responsive mathematics education (pp. 65-84). New York, NY: Routledge.

364. Muller, J., & Young, M., (2019). Knowledge, power and powerful knowledge re-visited. *The Curriculum Journal*, *30*(2), 196-214.

365. Muntoni, F., Wagner, J., & Retelsdorf, J., (2020). Beware of Stereotypes: Are Classmates' Stereotypes Associated With Students' Reading Outcomes?. *Child development*.

366. Murad Jurdak M., , Renuka Vithal , R., Elizabeth de Freitas, E., , Peter Gates, P., and David Kollosche, D., (2016). Social and Political Dimensions of Mathematics Education ICME-13 Topical Surveys 10.1007/978-3-319-29655-5_1

367. Nakpodia, E. D., (2010). Culture and curriculum development in Nigerian schools. African Journal of History and culture, 2(1), 1.

368. Nasir, N. S., Hand, V., & Taylor, E. V., (2008). Culture and mathematics in school: boundaries between cultural and domain knowledge in the mathematics classroom and beyond. Review of Research in Education, 32, 187-240.

369. Neupane, R., (2016). Teaching and learning mathematics in a cultural context: ping as a project. Paper accepted for presentation at TSG35 - Role of Ethnomathematics in Mathematics Education at ICME13. Hamburg, Germany: ICME13.

370. New, W.; Merry, M.S., (2012). Learning who they 'really' are: From stigmatization to opportunities to learn in Greek Romani education. In International Handbook of Migration Minorities and Education; Bekerman, Z., Geisen, T., Eds.; Springer: New York, NY, USA, 2012; pp. 623–639, ISBN 978-9-40-071465-6.

371. Nicolau, L., (2021). Roma at School: A Look at the Past and the Present. The Case of Portugal. *Social and Economic Vulnerability of Roma People*, 153.

372. Nunes, T., Carraher, D., & Schliemann, A., (1993). Street mathematics and school mathematics. Cambridge: Cambridge University Press.

373. Oakes, J., (1990). Multiplying inequalities: The effects of race, social class, and tracking on opportunities to learn mathematics and science. Santa Monica, CA: Rand Corp.

374. OECD, (2017). Education at a Glance 2017. OECD Indicators; OECD Publishing: Paris, France, 2017.

375. Okely, J. (1983). Changing Cultures: The Traveller-Gypsies; Cambridge University Press: Cambridge, UK, 1983; ISBN 0-521-24641-5.

376. Okely, J., (1987). Some political consequences of theories of Gypsy ethnicity: The place of the intellectual. In After Writing Culture: Epistemology and Praxis in Contemporary Anthropology; James, A.,

Hockney, J., Dowson, A., Eds.; Routledge: London, UK, 1997; ISBN 0-203-45098-1.

377. Oliver, E., & Gatt, S., (2010). De los actos comunicativos de poder a los actos comunicativos dialógicos en las aulas organizadas en grupos interactivos. Signos, 43, 279–294.

378. Orey, D. C., & Rosa, M., (2015). Three approaches in the research field of ethno modeling: emic (local), etic (global), and dialogical (glocal). Revista Latinoamericana de Etnomatemática, 8(2), 364-380.

379. Osterkorn, P., & Vetter, E., (2015). Le Multilinguisme en Question? The case of minority language education in Brittany (France). In C. Kramsch & U. Jessner (Eds.), The multilingual challenge: Cross-disciplinary perspectives (pp.115–139). Mouton de Gruyter. [Crossref], [Google Scholar]

380. Owens, K., Edmonds-Wathen, C., & Bino, V. (2015). Bringing ethnomathematics to elementary school teachers in Papua New Guinea: a design-based research project. Revista Latinoamericana de Etnomatemática, 8(2), 32-52.

381. Padros, M., Garcia, R., de Mello, R., & Molina, S. (2011). Contrasting scientific knowledge with knowledge from the lifeworld: The dialogic inclusion contract. Qualitative Inquiry, 17, 304–312.

382. Panthi, R.K.; Luitel, B.C.; Belbase, S., (2018) Teachers' perception of social justice in mathematics classrooms. REDIMAT 2018, 7, 7–37. [CrossRef]

383. Parker, P.D.; Marsh, H.W.; Ciarrochi, J.; Marshall, S.; Abduljabbar, A.S., (2014). Juxtaposing math self-efficacy and self-concept as predictors of long-term achievement outcomes. Educ. Psychol. 2014, 34, 29–48. [CrossRef]

384. Parlo Singh, P., (2017). Pedagogic governance: theorising with/after Bernstein, British Journal of Sociology of Education, 38:2, 144-163

385. Parson, L., & Weise, J., (2020). Postcolonial approach to curriculum design. In *Teaching and Learning for Social Justice and Equity in Higher Education* (pp. 93-116). Palgrave Macmillan, Cham.

386. Pedersen, H., (2010). Education policymaking for social change: A post-humanist intervention. *Policy Futures in Education*, *8*(6), 683-696.

387. Pederson, Rod., (2019). A theoretical analysis of how critical literacy may support the progressive goals of the Korean national curriculum. *English Teaching, 74*(4), 51-74.

388. Perry, P., Valero, P., Castro, M., Gómez, P., & Agudelo, C., (1998). Calidad de la educación matemática en secundaria. Actores y procesos en la institución educativa. Bogotá: una empresa docente.

389. Peterson, B., (2006). Teaching math across the curriculum. In E. Gutstein & B. Peterson (Eds.). Rethinking mathematics: teaching social justice by the numbers (pp.19-28). Milwaukee, WI: Rethinking Schools.

390. Petrík, J., & Popper, M., (2020). Contact Based School Intervention Program: Enhancing Cooperation Intention and Reducing Prejudice toward Roma. *Studia Psychologica*, *62*(3), 232-245.

391. Petrokou, E.; Dimitrakopoulos, (2002). I.N. Racism and Local Authorities: The Case of Roma in Nea Kios; ANTIGONE RAXEN National Focal Point: Athens, Greece, 2002.

392. Philip, T. M., Souto-Manning, M., Anderson, L., Horn, I., J. Carter Andrews, D., Stillman, J., & Varghese, M., (2019). Making justice peripheral by constructing practice as "core": How the increasing prominence of core practices challenges teacher education. *Journal of Teacher Education*, *70*(3), 251-264.

393. Piaget, J., & Inhelder, B., (1962). The psychology of the child . New York: Basic Books.

394. Piaget, J., (1969). Science of Education and the Psychology of the Child. New York, Viking Compass Book.

395. Pinar, W. F. (Ed.)., (2013). *International handbook of curriculum research*. Routledge.

396. Pinar, William F. and Irwin, Rita L. eds., (2005). Curriculum in a New Key: The Collected Works of Ted T. Aoki . Mahwah, NJ: Lawrence Erlbaum.

397. Pinar, William F., (2004). What Is Curriculum Theory? Mahwah, NJ: Lawrence Erlbaum.

398. Pinnock, K., (2001). Denied a future: The education of Roma/Gypsy traveller children in Europe. London, Save the children UK.

399. Poddiakov, Alexander N., (2020). Learning Intransitivity: From Intransitive Geometrical Objects to 'Rhizomatic' Intransitivity (January 4, 2020). Available at SSRN: https://ssrn.com/abstract=3513861 or http://dx.doi.org/10.2139/ssrn.3513861

400. Polya, G., (1973). How to solve it. Princeton: Princeton University Press

401. Popkewitz, T. S., (2004). School subjects, the politics of knowledge, and the projects of intellectuals in change. In P. Valero & R. Zevenbergen (Eds.), Researching the socio-political dimensions of mathematics education : issues of power in theory and methodology (pp. 251267). Boston: Kluwer Academic Publishers.

402. Popoviciu, S., & Tileagă, C. (2021). ROMA PREJUDICES IN THE EUROPEAN UNION. *The Routledge International Handbook of Discrimination, Prejudice and Stereotyping*.

403. Poster, M., (1990). The mode of information: Poststructuralism and social context . Cambridge: Polity Press.

404. Povey, H., & Zevenbergen, R., (2008). Mathematics education and society. In M. Menghini, F. Furinghetti, L. Giacardi & F. Arzarello (Eds.), The first century of the International

405. Pramudita, K., & Rosnawati, R., (2019, March). Exploration of Javanese culture ethnomathematics based on geometry perspective. In *Journal of Physics: Conference Series* (Vol. 1200, No. 1, p. 012002). IOP Publishing.

406. Puigvert, L., Christou, M., & Holford, J., (2012). Critical Communicative Methodology: including vulnerable voices in research through dialogue. Cambridge Journal of Education, 42, 513–526.

407. Putri, H. E., Wahyudy, M. A., Yuliyanto, A., & Nuraeni, F., (2020). Development of Instruments to Measure Mathematical Anxiety of Elementary School Students. *International Journal of Learning, Teaching and Educational Research*, *19*(6), 282-302.

408. Quality_of_life_indicators_-_education (accessed on 8 June 2018).

409. Radford, L., & Empey, H., (2007). Culture, knowledge and the self: Mathematics and the formation of new social sensibilities in the Renaissance and Medieval Islam. Revista Brasileira de História de Matemática, Especial no. 1, 231-254.

410. Radford, L., (2008). Connecting theories in mathematics education: challenges and possibilities. ZDM – The International Journal on Mathematics Education, 40 (2), 317–327.

411. Radford, L., (2008). Culture and cognition: Towards and anthropology of mathematical thinking. In L. D. English & M. G. Bartolini Bussi (Eds.), Handbook of international research in

mathematics education (2nd ed., pp. 439-464). New York, NY: Routledge.

412. Radovic, D., Black, L., Williams, J., & Salas, C. E., (2018). Towards conceptual coherence in the research on mathematics learner identity: A systematic review of the literature. *Educational Studies in Mathematics*, *99*(1), 21-42.

413. Ragsdell, G., Stadler, R., & Fullagar, S., (2016). Appreciating formal and informal knowledge transfer practices within creative festival organizations. Journal of Knowledge Management.

414. Rajchman, J., (2001). The Deleuze Connections; MIT Press: Cambridge, UK, 2001.

415. Rakočević, N. & Miljević, A.,. (2003). Roma and Education. Beograd, Dečiji Romski Centar.

416. Rauh, C., (2018). DECOMPOSING GAPS BETWEEN ROMA AND NON-ROMA IN ROMANIA. Journal of Demographic Economics, 84(02), 209–229.

417. Ravitch, Diane., (2000). Left Back: A Century of Battles over School Reform . New York: Simon and Schuster.

418. Ray, S. M., (2019). Teaching Case—Applications of culturally relevant pedagogy in a community college classroom. New Horizons in Adult Education and Human Resource Development, 31(4), 65-69.

419. Register, J.; Stephan, M.; Pugalee, D. (2021) Ethical Reasoning in Mathematics: New Directions for Didactics in U.S. Mathematics Education. Mathematics 2021, 9, 799. https://doi.org/10.3390/math9080799

420. Republic, Hungary, Romania, and Slovakia. http://www.errc.org/cikk.php?cikk=1892 (accessed July 2, 2016).

421. Revenga, A.; Ringold, D.; Tracy, W.M., (2002). Poverty and Ethnicity: A Cross-Country Study of Roma Poverty in Central Europe;World Bank Publications: Washington, DC, USA, 2002; ISBN 0-8213-5339-X.

422. Rodriguez, S. L., & Blaney, J. M., (2020). “We’re the unicorns in STEM”: Understanding how academic and social experiences influence sense of belonging for Latina undergraduate students. *Journal of Diversity in Higher Education*.

423. Rodríguez, S., Regueiro, B., Piñeiro, I., Valle, A., Sánchez, B., Vieites, T., & Rodríguez-Llorente, C., (2020). Success in Mathematics

and Academic Wellbeing in Primary-School Students. *Sustainability*, *12*(9), 3796.

424. Rodríguez-García, D., (2010). Beyond assimilation and multiculturalism: A critical review of the debate on managing diversity. Journal of International Migration and Integration, 11, 251-271. doi:10.1007/ s12134-010-0140-x

425. Rogoff, B., Goodman Turkanis, C., & Bartlett, L., (2001). Learning together: Children and adults in a school community.

426. Rosa, M., & Orey, D. C., (2010). Ethno Modelling: a pedagogical action for uncovering ethnomathematical practices. Journal of Mathematical Modelling and Application, 1(3), 58–67.

427. Rosa, M., & Orey, D. C., (2015b). A trivium curriculum for mathematics based on literacy, matheracy, and technocracy: an ethnomathematics perspective. ZDM, 47(4), 587-598.

428. Rosa, M., (2010). *A mixed-methods study to understand the perceptions of high school leaders about English language learners (ELL)*: the case of mathematics. (Doctorate dissertation). College of Education. California State University, Sacramento

429. Rosa, M., (2013). Accessing the perceptions of high school teachers about the influence of language and culture in the mathematics learning of English language learners (ELLs) students. Linguistics, Culture & Education, 2(1), 36-71.

430. Rosa, M., Orey, D. C., (2003). Vinho e queijo: Etnomatemática e modelagem! [Wine and cheese: ethnomathematics and modeling!]. *BOLEMA, 16*(20), 1-16.

431. Rose, N., (1999). Powers of freedom: Reframing political thought. Cambridge: Cambridge University Press

432. Rose, R., (1983). Sinti and Roma in Germany. Roma, 7, 21 –24. Sheldon, S. B., & Epstein, J. L. (2005). Involvement counts: Family and community partnerships and mathematics achievement. Journal of Educational Research, 98, 196–206.

433. Rosenthal, R.; Jacobson, L., (1968). Pygmalion in the classroom. Urban Rev. 1968, 3, 16–20. [CrossRef]

434. Rotaru, I., & Grebeldinger, (2020). D. CASE STUDY: FACES OF ROMA IN ROMANIAN EDUCATIONAL SYSTEM–FROM SCHOOL DROPOUT TO EDUCATIONAL SUCCESS1.

435. Roth, W. M., & Walshaw, M., (2020). Re/thinking mathematics for social justice: a transactional approach. *Pedagogies: An International Journal*, *15*(4), 279-295.

436. Roth, W. M., (2020). Interdisciplinary approaches in mathematics education. *Encyclopedia of mathematics education*, 415-419.

437. Rousseau, C., & Tate, W. F., (2008). Still separate, still unequal: Democratic access to mathematics in U.S. schools. In L. D. English & M. G. Bartolini Bussi (Eds.), Handbook of international research in mathematics education (2nd ed., pp. 299-319). New York, NY: Routledge.

438. Rubel, L. H., (2017). Equity-directed instructional practices: Beyond the dominant perspective. *Journal of Urban Mathematics Education*, *10*(2).

439. Ruitenberg, Claudia., (2010). "Conflict, affect and the political: On disagreement as democratic capacity." *Factis Pax* 4.1 (2010):, 40-55.

440. Russo, J., Bobis, J., Downton, A., Feng, M., Hughes, S., Livy, S., ... & Sullivan, P., (2021). Characteristics of high enjoyment teachers of mathematics in primary schools. *Mathematics Education Research Journal*, 1-21.

441. Ruthven, K., & Goodchild, S., (2008). Linking researching with teaching. Towards synergy of scholarly and craft knowledge. In L. D. English & M. G. Bartolini Bussi (Eds.), Handbook of international research in mathematics education (2nd ed., pp. 561-588). New York, NY: Routledge.

442. Ryan, R. M., & Deci, E. L., (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55, 68-78.

443. Sánchez, M.; Yuste, M.; de Botton, L.; Kostic, R., (2013). Communicative Methodology of Research with Minority Groups. Int. Rev. Qual. Res. 2013, 6, 226–238. [CrossRef]

444. Santagati, M., (2021). Interculturalism, education and society: Education policies for immigrant students in Italy. *Australian and New Zealand Journal of European Studies*, *8*(2).

445. Sarama, J. & Clements, D., (2009). Early childhood mathematics education research. Learning trajectories for young children. New York: Routledge.

446. Schneuwly, B., (2021). 'Didactiques" is not (entirely)'Didaktik'The origine and atmosphere of a recent academic field. *Didactic and Curriculum in an Ongoing Dialogue*, 164-184.

447. Schwab, Joseph J., (1978). Science, Curriculum, and Liberal Education: Selected Essays.[Edited by Ian Westbury and Neil J. Wilkof.] Chicago: University of Chicago Press.

448. Sellers, M. (2015). … working with (a) rhizoanalysis… and… working (with) a rhizoanalysis…. *Complicity: An international journal of complexity and education*, *12*(1).

449. Selter, C., (2009). Stimulating reflection on word problems by means of students' own productions. In L. Verschaffel, B. Greer, W. van Dooren & S. Mukhopadhyay (Eds.), Words and worlds. Modelling verbal descriptions of situations (pp. 315–332). Rotterdam: Sense Publishers.

450. Serneels, P., & Dercon, S., (2021). Aspirations, Poverty, and Education. Evidence from India. *The Journal of Development Studies*, *57*(1), 163-183.

451. Seung-Hee, Claire Son & Jin Hee Hur, (2020). Parental Math Talk During Home Cooking and Math Skills in Head Start Children: The Role of Task Management Talk, Journal of Research in Childhood Education, DOI: 10.1080/02568543.2019.1704318

452. Sfard, A., (2005). What Could Be More Practical than Good Research? Educational Studies in Mathematics, 58(3), 393-413.

453. Sfard, A., (2009). Disabling Numbers: On the Secret Charm of Numberese and Why It Should Be Resisted. In L. Black, H. Mendick & Y. Solomon (Eds.), Mathematical Relationships in Education: Identities and participation (pp. 9-18). New York: Routledge, Taylor and Francis.

454. Shaeffer, S., (2019). Inclusive education: a prerequisite for equity and social justice. *Asia Pacific Education Review*, *20*(2), 181-192.

455. Sharma, T., Sharman, T., & Orey, D. C., (2020). Developing mathematical skills and moral behavior through cultural artifacts: a study of math trail activities at Patan Durbar Square in Nepal. Revemop, 2, 202013.

456. Shimizu Y., (2020) Lesson Study in Mathematics Education. In: Lerman S. (eds) Encyclopedia of Mathematics Education. Springer, Cham. https://doi.org/10.1007/978-3-030-15789-0_91

457. Shor, I.; Freire, (1987). P., A Pedagogy for Liberation: Dialogues on Transforming Education; Bergin & Garvey: Westport,

458. Sierpinska, A., & Kilpatrick, J., (1998). Mathematics education as a research domain: A search for identity. Dordrecht: Kluwer.

459. Silva-Laya, M., D'Angelo, N., García, E., Zúñiga, L., & Fernández, T., (2020). Urban poverty and education. A systematic literature review. *Educational Research Review*, *29*, 100280.

460. Silver, E. A., & Herbst, P., (2007). Theory in Mathematics Education Scholarship Second Handbook of Research on Mathematics Teaching and Learning (Second ed.). Charlotte, USA: NCTM – IAP.

461. Silver, E. A., & Kilpatrick, J., (1994). E Pluribus Unum: Challenges of Diversity in the Future of Mathematics Education Research. Journal for Research in Mathematics Education, 25(6), 734-754.

462. Silver, H.ilary, (2007). The Process of Social Exclusion: The Dynamics of an Evolving Concept (October 1, 2007). Chronic Poverty Research Centre Working Paper No. 95. Available at SSRN: https://ssrn.com/abstract=1629282 or http://dx.doi.org/10.2139/ssrn.1629282

463. Simpson, David., (2002). Situatedness, or, Why We Keep Saying Where We ' re Coming From. Durham, NC: Duke University Press.

464. Sitabkhan, Y., Davis, J., Earnest, D., Evans, N., Ketterlin-Geller, L., Lutfeali, S.,. & Ralaingita, W., (2019). Instructional Strategies for Mathematics in the Early Grades (p. 4). A Working Paper Developed by the Mathematics Working Group. This work is licensed under the Creative Commons Attribution 4.0 International License. To view a copy of this license, visit http://creativecommons. org/licenses/by/4.0/or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.

465. Skovsmose O. (2020) Critical Mathematics Education. In: Lerman S. (eds) Encyclopedia of Mathematics Education. Springer, Cham

466. Skovsmose O., (2020). Critical Mathematics Education. In: Lerman S. (eds) Encyclopedia of Mathematics Education. Springer, Cham. https://doi.org/10.1007/978-3-030-15789-0_34

467. Skovsmose, O. & Borba, M., (2004). Research methodology and critical mathematics education. In: P. Valero & R. Zevenbergen, eds. Researching the socio-political dimensions of mathematics education. Dordrecht: Kluwer, pp. 207-226.

468. Skovsmose, O., & Valero, P., (2008). Democratic access to powerful mathematical ideas. In L. D. English (Ed.), Handbook of international research in mathematics education. Directions for the 21st Century. (2nd ed., pp. 415-438). Mahwah, NJ: Erlbaum.

469. Skovsmose, O., (1994). Towards a critical mathematics education. Educational Studies in Mathematics, 27(1), 35-57. Skovsmose, O. (2005). Meaning in mathematics education. In J. Kilpatrick, C. Hoyles & O. Skovsmose (Eds.), Meaning in mathematics education (pp. 83-100). New York: Springer.

470. Skovsmose, Ole., (2014). Critique as Uncertainty. Edited by Bharath Sriraman. Charlotte, NC: Information Age Publishing.

471. Slapac, A. (2021). Advancing Students' Global Competency through English Language Learning in Romania: An Exploratory Qualitative Case Study of Four English Language Teachers. *Journal of Research in Childhood Education*, *35*(2), 231-247.

472. Šlaus, I. (2011);. Jacobs, G. Human capital and sustainability. Sustainability 2011, 3, 97–154. [CrossRef]

473. Šlaus, I.; Jacobs, G., (2011). Human capital and sustainability. Sustainability 2011, 3, 97–154. [CrossRef]

474. Smith, L. T., (2005). Building a research agenda for indigenous epistemologies and education. Anthropology & education quarterly, 36(1), 93-95.

475. Snir, I. (2018). Making sense in education: Deleuze on thinking against common sense. Educ. Philos. Theory (2018), 50, 299–311. [CrossRef]

476. Sordé, T.; Serradell, O.; Puigvert, L.; Munté, (2014). A. Solidarity networks that challenge racialized discourses: The case of Romani immigrant women in Spain. Eur. J. Women's Stud. 2014, 21, 87–102. [CrossRef]

477. Sordé, T.; Serradell, O.; Puigvert, L.; Munté, A., (2014). Solidarity networks that challenge racialized discourses: The case of Romani immigrant women in Spain. Eur. J. Women's Stud. ies 2014, 21, 87–102. [CrossRef]

478. St Pierre, E., (2011), "Post qualitative research: the critique and the coming after", The Sage Handbook of Qualitative Research, Sage, Thousand Oaks, CA.

479. St. Pierre, (2018). Elizabeth Adams. "Writing post qualitative inquiry." *Qualitative inquiry* 24.9 (2018): 603-608.

480. St. Pierre, E. A., (2011). Post qualitative research: The critique and the coming after. In N. K. Denzin & Y. S. Lincoln (Eds.), The SAGE handbook of qualitative research. Los Angeles: Sage.

481. St. Pierre, E. A., (2019). Post qualitative inquiry in an ontology of immanence. *Qualitative Inquiry*, *25*(1), 3-16.

482. St. Pierre, E. A., (2021). Post qualitative inquiry, the refusal of method, and the risk of the new. *Qualitative Inquiry*, *27*(1), 3-9.

483. Stancliffe, R. J., Wehmeyer, M. L., Shogren, K. A., & Abery, B. H. (Eds.). (2020). Choice, Preference, and Disability: Promoting Self-Determination Across the Lifespan.

484. Stathopoulou, C.; Kalabasis, (2017). F. Language and culture in Mathematics Education: Reflections on Observing a Romany Class in a Greek School. Educ. Stud. Math. 2007, 64, 231–238. [CrossRef]

485. Stathopoulou, C.; Kalabasis, F., (2007). Language and culture in Mathematics Education: Reflections on Observing a Romany Class in a Greek School. Educ. Stud. Math. 2007, 64, 231–238. [CrossRef]

486. Steinig, R. M., (2016). Stop ruining math! Reasons and remedies for the maladies of mathematics education. *Journal of Humanistic Mathematics*, *6*(2), 128-147.

487. Stemhagen, K., & Henney, C., (2021). *Democracy and Mathematics Education: Rethinking School Math for Our Troubled Times*. Routledge.

488. Stentoft, D., (2009). Challenging research conceptions in (mathematics) education: Telling stories of multiplicity and complexity. Aalborg University, Aalborg. Stentoft, D. & Valero, P. (In press). Identities-in-action: Exploring the fragility of discourse and identity in learning mathematics. Nordic Studies in Mathematics Education, 14(2).

489. Stephan M., (2014) Teacher-Centered Teaching in Mathematics Education. In: Lerman S. (eds) Encyclopedia of Mathematics Education. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-4978-8_150

490. Strom, K.J., (2018). “That’s not very Deleuzian”: Thoughts on interrupting the exclusionary nature of “High Theory”. Educ. Philos. Theory 2018, 50, 10413.

491. Subero, D.; Vila, I.; Esteban-Guitart, M., (2015). Some contemporary forms of the Funds of Knowledge approach. Developing culturally responsive pedagogy for social justice. Int. J. Educ. Psychol. 2015, 4, 33–53. [CrossRef]

492. Suffari, N. F., Zain, M., Majid, M., & Tazilah, M. D. A. K., (2019). A Conceptual Study of Social Responsibility Awareness and Practices among School Children. *International Journal of Business and Technology Management*, *1*(1), 1-17.

493. sustainable development. Revista Española de Pedagog*í*a 2013, 71, 71–86.

494. Sweet, J. D., Nurminen, E., & Koro-Ljungberg, M., (2020). Becoming research with shadow work: Combining artful inquiry with research-creation. *Qualitative Inquiry*, *26*(3-4), 388-399.

495. Tanase, M., & Lucey, T. A., (2015). Interdisciplinary connections: teaching mathematics for social justice and financial literacy. Journal of Mathematics and Culture, 9(1), 81-118.

496. Tate,W., (1997). Race-ethnicity, SES, gender and language proficiency trends in mathematics achievement:An update. J. Res. Math. Educ. 1997, 286, 652–679. [CrossRef]

497. Taylor, C. A., (2016). “Close Encounters of a Critical Kind: A Diffractive Musing in/between Material Feminism and Object Oriented Ontology.” Cultural Studies <=> Critical Methodologies 16 (2): 201–212.

498. Taylor, C. A., (2016): Rethinking the empirical in higher education: post qualitative inquiry as a less comfortable social science, International Journal of Research & Method in Education, DOI: 10.1080/1743727X.2016.1256984

499. Tekkumru-Kisa, M., Stein, M. K., & Doyle, W., (2020). Theory and Research on Tasks Revisited: Task as a Context for Students’ Thinking in the Era of Ambitious Reforms in Mathematics and Science. *Educational Researcher*, *49*(8), 606-617.

500. Tellado, I., & Sava, S., (2010). The role of non-expert adult guidance in the dialogic construction of knowledge. Journal of Psycho Didactics, 15, 163–176.

501. Tellado, I., (2017). Bridges between individuals and communities: Dialogic participation fueling meaningful social engagement. Res. Ageing Soc. Policy 2017, 5, 8–31. [CrossRef]

502. Thomas,W.I.; Znaniecki, F., (1927). The Polish Peasant in Europe and America; Alfred, A., Ed.; Knopf: New York, NY, USA, 1927; ISBN 0-252-06484-4.

503. Thompson, D. R., & Senk, S. L., (2020). Elementary school mathematics curriculum reform. In *Standards-Based School Mathematics Curricula* (pp. 31-44). Routledge.

504. Tillmanns, T., Holland, C., Lorenzi, F., & McDonagh, P., (2014). Interplay of rhizome and education for sustainable development. *Journal of Teacher Education for Sustainability*, *16*(2), 5-17.

505. Tillmanns, T.; Holland, C.; Lorenzi, F.; McDough, P., (2014). Interplay of rhizome and education for sustainable development. J. Teach. Educ. Sust. 2014, 16, 5–17.

506. Timothy J. Hatton, Immigration, public opinion and the recession in Europe, Economic Policy, Volume 31, Issue 86, April 2016, Pages 205–246, https://doi.org/10.1093/epolic/eiw004

507. Torras-Gómez, E., Ruiz-Eugenio, L., Sordé-Martí, T., & Duque, E., (2021). Challenging Bourdieu's Theory: Dialogic Interaction as a Means to Provide Access to Highbrow Culture for All. *SAGE Open*, *11*(2), 21582440211010739.

508. Torres-Velásquez, D., & Lobo, G., (2004). Culturally responsive mathematics teaching and English language learners. Teaching Children Mathematics, 11, 249-255.

509. Tout, D., (2020). Critical connections between numeracy and mathematics.

510. Tremblay A., (2019) The Multiculturalism Research Programme: Established and Emerging Concerns. In: Diversity in Decline?. Palgrave Politics of Identity and Citizenship Series. Palgrave Macmillan, Cham

511. Trinick, T., McMurchy-Pilkington, C., & Taplin, B., (2015). Reintroducing ethnomathematical practices into the classroom: linguistic issues. Journal of Mathematics and Culture, 8(1), 64-66.

512. Trumbull, E., Greenfield, P. M., Rothstein-Fisch, C., Maynard, A. E., Quiroz, B., & Yuan, Q., (2020). From Altered Perceptions to Altered Practice: Teachers Bridge Cultures in the Classroom. *School Community Journal*, *30*(1), 243-266.

513. Turner, R. N., & Brown, R., (2008). Improving Children's Attitudes Toward Refugees: An Evaluation of a School-Based Multicultural Curriculum and an Anti-Racist Intervention 1. *Journal of Applied Social Psychology*, *38*(5), 1295-1328.

514. Tus, JhoselleJ., (2020). An Assessment of the School Culture and Its Impact on the Academic Performance of the Students (May 2020). IJARW | ISSN (O) - 2582-1008 May 2020 | Vol. 1 Issue. 11, Available at SSRN: https://ssrn.com/abstract=3717285

515. UN. Goal 4: Ensure Inclusive and Quality Education for All and Promote Lifelong Learning. Available online:

516. UN. Resolution Adopted by the General Assembly on 25 September 2015. 70/1. Transforming Our World: The 2030 Agenda for Sustainable Development. UN. A/RES/70/1. Available online: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E (accessed on 15 May 2018).

517. UNESCO. Education for Sustainable Development Goals. Learning Objectives; UNESCO: Paris, France, (2017).; Available online: http://unesdoc.unesco.org/imag es/0024/002474/247444e.pdf (accessed on 15 May 2018).

518. UNESCO, (2018). Handbook on Measuring Equity in Education; UNESCO Institute for Statistics: Montreal, QC, Canada; ISBN 978-9-29-189227-3.

519. UNESCO. Roadmap for Implementing the Global Action Programme on Education for Sustainable Development;UNESCO: Paris, France, 2014; Available online: http://unesdoc.unesco.org/images/0023/002305/230514e. pdf (accessed on 15 May 2018).

520. Uta Papen P., & Karin Tusting T., (2019): Using ethnography and 'real literacies' to develop a curriculum for English literacy teaching for young deaf adults in India, Compare: A Journal of Comparative and International Education, DOI: 10.1080/03057925.2019.1585756

521. Valadez, J. M., (2018). *Deliberative democracy, political legitimacy, and self-determination in multicultural societies*. Routledge.

522. Valdez, A.driana, (2019). "Benefits of Culturally Relevant Literature on Latino Students" (2019). Capstone Projects and Master's Theses. 536. https://digitalcommons.csumb.edu/caps_thes_all/536

523. Valero, P., (1999). Deliberative mathematics education for social democratization in Latin America. Zentralblatt für Didaktik der Mathematik, 99(1), 20-26.

524. Valero, P., (2002). Reform, democracy and mathematics education. Towards a socio-political frame for understanding change in the organization of secondary school mathematics. Unpublished PhD Thesis, Danish University of Education, Copenhagen.

525. Valero, P., (2004a). Postmodernism as an attitude of critique to dominant mathematics education research. In M. Walshaw (Ed.), Mathematics education within the postmodern (pp. 35-54). Greenwich (USA): Information Age.

526. Valls, R., & Padrós, M., (2011). Using dialogic research to overcome poverty: From principles to action. European Journal of Education, 46, 173–183. Wells, G. (1999). Dialogic Inquiry. New York: Cambridge University Press.

527. Valls, R.; Kyriakides, L. (2013) The power of Interactive Groups: How diversity of adults volunteering in classroom groups can promote inclusion and success for children of vulnerable minority ethnic populations. Camb. J. Educ. 2013, 43, 17–33. [CrossRef]

528. Van Baar, H., (2018). Contained mobility and the racialization of poverty in Europe: The Roma at the development–security nexus. *Social identities*, *24*(4), 442-458.

529. Vandekinderen, C., Roets, G., Van Keer, H., & Roose, R., (2018). Tackling social inequality and exclusion in education: from human capital to capabilities. International Journal of Inclusive Education, 22(1), 1-20.

530. Vandekinderen, C., Roets, G., Van Keer, H., & Roose, R., (2018). Tackling social inequality and exclusion in education: from human capital to capabilities. *International Journal of Inclusive Education*, *22*(1), 1-20.

531. Vanegas, Y., D'Ambrosio, U., and Giménez Rodríguez, J., (2019). Discurso y prácticas democráticas en la clase de matemáticas. REDIMAT – Journal of Research in Mathematics Education, 8(2), 139-165. doi: 10.4471/redimat.2019.3112

532. Vargas, J.; Gómez, J. (2003) Why Roma do not like mainstream schools: Voices of a people without territory. Harv. Educ. Rev. 2003, 73, 559–590. [CrossRef]

533. Verkuyten, M., (2009). Support for multiculturalism and minority rights: The role of national identification and out-group threat. Social Justice Research, 22, 31-52. doi:10.1007/s11211-008-0087-7

534. Verkuyten, M., (2011). Assimilation ideology and situational well-being among ethnic minority members. Journal of Experimental Social Psychology, 46, 269-275. doi:10.1177/1368430211398506

535. Vincze, E., (2014). The racialization of Roma in the 'new' Europe and the political potential of Romani women. *European Journal of Women's Studies*, *21*(4), 435-442.

536. Vos, P., (2018). "How Real People Really Need Mathematics in the Real World"—Authenticity in Mathematics Education. *Education Sciences*, *8*(4), 195.

537. Wachira, P., & Mburu, J., (2019). Culturally responsive mathematics teaching and constructivism: Preparing teachers for diverse classrooms. *Multicultural Learning and Teaching*, *14*(1).

538. Wahid, S. N. S., Yusof, Y., & Nor, A. H. M., (2018). Effect of mathematics anxiety on students' performance in higher education level: A comparative study on gender. In *AIP Conference Proceedings* (Vol. 1974, No. 1, p. 050010). AIP Publishing LLC.

539. Walker, P., & Lovat, T., (2017). The Foundations and Benefits of Dialogic Consensus. In Life and Death Decisions in the Clinical Setting (pp. 37-50). Springer, Singapore.

540. Walsh, Z., Böhme, J., & Wamsler, C., (2020). Towards a relational paradigm in sustainability research, practice, and education. *Ambio*, 1-11.

541. Walshaw, M., (2013). Poststructuralism and ethical practical action: Issues of identity and power. Journal for Research in Mathematics Education, 44 (1), 100–118.

542. Walshaw, M., (Ed.). (2010). Unpacking pedagogy: New perspectives for mathematics classrooms . Charlotte, NC: Information Age.

543. Weinstein, Y., Madan, C. R., & Sumeracki, M. A., (2018). Teaching the science of learning. *Cognitive research: principles and implications*, *3*(1), 1-17.

544. Willis, P.E. (1977) Learning to Labor: How Working Class Kids Get Working Class Jobs; Columbia University Press: New York, NY, USA, 1977; ISBN 978-1-13-842184-4.

545. Wilson, A., & Urick, A., (2021). Cultural reproduction theory and schooling: The relationship between student capital and opportunity to learn. *American Journal of Education*, *127*(2), 000-000.

546. Wilson, W., (2003). Race, class and urban poverty: A rejoinder. Ethnic and Racial Studies, 26, 1096–1114.

547. Wright, P., (2012). The Math Wars: Tensions in the development of school mathematics curricula. For the Learning of Mathematics, 32(2), pp. 7-13.

548. Wright, P., (2013). School mathematics and discourses of inequity. University of Wales Journal of Education, Volume 16, pp. 85-99.

549. Wright, P., (2014). Teaching mathematics for social justice: Translating theory into classroom practice. Nottingham, British Congress of Mathematics Education.

550. Wulf, C. (2013)/ Human development in a globalized world. Education towards peace, cultural diversity and sustainable development. Revista Española de Pedagogía 2013, 71, 71–86.

551. Wulf, C. Human development in a globalized world. Education towards peace, cultural diversity and

552. Yeh, C., & Otis, B. M. (2019). Mathematics for whom: Reframing and humanizing mathematics. Occasional Paper Series, 2019(41), 8.

553. Yeh, C., & Otis, B. M., (2019). Mathematics for whom: Reframing and humanizing mathematics. Occasional Paper Series, 2019(41), 8.

554. Young-Loveridge, J. M., (1989). The relationship between children's home experiences and their mathematical skills on entry to school. Early Child Development and Care, 43(1), 43-59.

555. Zacharos, K., (2006). Prevailing educational practices for area measurement and students' failure in measuring areas. *The Journal of Mathematical Behavior*, *25*(3), 224-239.

556. Zhao, A., Brown, G. T., & Meissel, K., (2021). Manipulating the consequences of tests: how Shanghai teens react to different consequences. Educational Research and Evaluation.

557. Zhu Y., (2018) Equity in Mathematics Education: What Did TIMSS and PISA Tell Us in the Last Two Decades?. In: Kaiser G., Forgasz H., Graven M., Kuzniak A., Simmt E., Xu B. (eds) Invited Lectures from the 13th International Congress on Mathematical Education. ICME-13 Monographs. Springer, Cham

558. Zhu, Y., (2019). Can Participatory Action Research “Empower” Participants in Adult Educational Studies?. Canadian Journal for the Study of Adult Education, 31(01).

559. Zidny, R., Sjöström, J. & Eilks, I. , (2020), A Multi-Perspective Reflection on How Indigenous Knowledge and Related Ideas Can Improve Science Education for Sustainability. Sci & Educ 29, 145–185 (2020). https://doi.org/10.1007/s11191-019-00100-x

560. Zipin, L., (2020). Building curriculum knowledge work around community-based “problems that matter”: Let’s dare to imagine. Curriculum Perspectives, 40(1), 111-115.