UNIVERSITY OF WESTERN MACEDONIA

FACULTY OF EDUCATIION

PEDAGOGICAL DEPARTMENT OF ELEMENTARY EDUCATION

INTERDEPARTMENTAL – INTERUNIVERSITY POSTGRADUATE STUDIES PROGRAM

“DIDACTICS OF MATHEMATICS”

DIRECTION: A CYCLE

Master Dissertation

Delving into the obstacles impending Roma students' comprehension of school mathematics in the classroom: a survey of ethnographic characteristics in a school classroom

By

Kaplani Theodora, RN: 699

Supervisor: Professor Stathopoulou Charoula

Examiners: Assistant Professor Gana Eleni, Professor Sakonidis Charalampos, Professor Stathopoulou Charoula

Florina, November 2018

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ΠΑΝΕΠΙΣΤΗΜΙΟ ΔΥΤΙΚΗΣ ΜΑΚΕΔΟΝΙΑΣ

ΠΑΙΔΑΓΩΓΙΚΗ ΣΧΟΛΗ

ΠΑΙΔΑΓΩΓΙΚΟ ΤΜΗΜΑ ΔΗΜΟΤΙΚΗΣ ΕΚΠΑΙΔΕΥΣΗΣ

ΔΙΑΤΜΗΜΑΤΙΚΟ – ΔΙΑΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ

«ΔΙΔΑΚΤΙΚΗ ΤΩΝ ΜΑΘΗΜΑΤΙΚΩΝ»

ΚΑΤΕΥΘΥΝΣΗ: Α ΚΥΚΛΟΣ

Διπλωματική εργασία

Εμβαθύνοντας στα εμπόδια που παρεμποδίζουν τους Ρομά μαθητές να κατανοήσουν τα σχολικά μαθηματικά στην τάξη: μια έρευνα με εθνογραφικά χαρακτηριστικά σε μια σχολική τάξη

της

Καπλάνη Θεοδώρα, Α.Ε.Μ.: 699

Επιβλέπουσα: Καθηγήτρια Σταθοπούλου Χαρούλα

Εξεταστές: Επίκουρη Καθηγήτρια Γκανά Ελένη, Καθηγητής Σακονίδης Χαράλαμπος, Καθηγήτρια Σταθοπούλου Χαρούλα

Φλώρινα, Νοέμβριος 2018

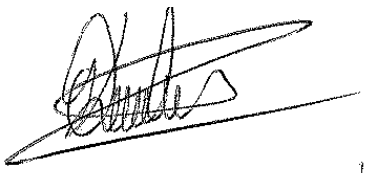
Statutory Declaration

We certify that I am the author of this Master Dissertation and that all the help offered for its compilation is acknowledged and is clearly indicated in the text. Furthermore, all primary as well as secondary resources used as well as the materials appearing in it have been properly quoted and attributed.

The author of the report

Kaplani Theodora

Signature



ABSTRACT

The current study investigated whether previous mathematical knowledge of Roma students was welcomed by the teachers as legitimized resource or not, in other words regarding the difficulties the pupils dealt with typical school mathematical acquisition, specifically in numeracy and problem solving activities, and what mathematics formal or informal the students did finally apply in the classroom milieu. The research had been conducted in a segregated school located in a quite deprived neighbourhood in a city, in Thessaly's periphery. In the classrooms where participant-observation had been conducted, 32 students from the 4th, 5th, and 6th grades respectively took part in, while 33 children and 3 teachers participated in interviews. The findings of the qualitative research showed that teachers ignored former cognition in problem solving and computations despite the fact that they were cognizant of Rom engagement in family business. As far as students' typical mathematical acquisition is concerned, some hindrances were spotted concerning matters such as discrimination phenomena, mathematical knowledge difficulties and language difficulties. Although the latter's preference wasn't quite clear, they tended to adopt informal strategies during mathematical problem solving.

Keywords: mathematical knowledge, Roma students, legitimized resource, difficulties, formal-informal

ΠΕΡΙΛΗΨΗ

Η παρούσα έρευνα αναζητά εάν η προηγούμενη μαθηματική γνώση των μαθητών Ρομά καλωσορίστηκε από τους δασκάλους ως αποδεκτός πόρος γνώσης ή όχι, ποιες ήταν οι δυσκολίες που αντιμετώπισαν οι μαθητές με την κατάκτηση των σχολικών μαθηματικών, ειδικότερα στις δραστηριότητες της αριθμητικής και της επίλυσης προβλήματος, και ποια μαθηματικά τυπικά ή άτυπα εφάρμοσαν τελικά οι μαθητές στο σχολικό περιβάλλον. Η έρευνα διεξήχθη σε ένα αμιγώς σχολείο Ρομά που βρίσκεται σε μια πολύ υποβαθμισμένη γειτονία της πόλης, στην περιφέρεια της Θεσσαλίας. Στις τάξεις στις οποίες πραγματοποιήθηκε συμμετοχική παρατήρηση συμμετείχαν 32 μαθητές από τις τάξεις της 4ης, 5ης, και 6ης, και στις συνεντεύξεις 33 παιδιά και 3 δάσκαλοι. Τα ευρήματα της ποιοτικής μεθόδου έδειξαν ότι οι δάσκαλοι αγνοούσαν την προηγούμενη γνώση στην επίλυση προβλήματος και στην εκτέλεση των πράξεων ακόμη κι αν γνώριζαν την ενασχόληση των Ρομ παιδιών στην οικογενειακή επιχείρηση και τη συνακόλουθη μαθηματική γνώση. Επίσης, τα εμπόδια ως προς την κατάκτηση της τυπικής μαθηματικής γνώσης που εντοπίστηκαν αφορούσαν σε ζητήματα διάκρισης από εκπαιδευτικούς και μαθητές, σε δυσκολίες μαθηματικής γνώσης και δυσκολίες γλωσσικές από την πλευρά των μαθητών. Παρότι η προτίμησή των τελευταίων δεν ήταν ξεκάθαρη, έτειναν να αξιοποιούν τις άτυπες στρατηγικές κατά την επίλυση μαθηματικών προβλημάτων.

Λέξεις κλειδιά: μαθηματική γνώση, μαθητές Ρομά, αποδεκτός πόρος, δυσκολίες, τυπικές-άτυπες (μέθοδοι)

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INTRODUCTION

The research negotiates the mathematical knowledge of students acquired within school boundaries, and besides, varied functional processes of mathematical meanings and their applications in versatile dimensions are demonstrated. It has been shown that multiple contributions of different cultures have formulated mathematical practice and have re-designed curricula within integration of indigenous mathematical background expertise and techniques, which gear towards a culturally responsive teaching and benefits of the non-mainstream students. However, sophisticated misplaced methods and content of mathematics teaching still are dominant; as long as an underlying objective of the non-development of minority students prevails into socio-economic area. But does that mean missing the opportunity for a better position in the field of economy or in society? For students who struggle between formal and informal mathematics in schools it is prominent for each and every one of them to achieve and maintain a more privileged status capacity since one crucial sector of the demanding job industry always leads to further advanced formalized mathematics (Rosenthal, 2017). Those were discussed to a greater or lesser extent in the first chapter.

In this respect, the strife in which they endeavor to succeed in one or both areas is also examined under a socio-cultural-political lens (Gutierrez, 2013; Lerman, 2001; Planas & Valero, 2016).In the second chapter, the political setting of mathematical education of Roma students has been examined through macro, meso (middle) and micro level analysis. Emphasis has been placed on the extensive educational policy of inequality where mathematical practices along with the curriculum, mathematical textbooks and other structures of school continue to be incompatible with their everyday lives perpetuating the continuous low achievement in numeracy and literacy. In addition to this, the discrepancy between the mental processes used by them and the formalities taught at school broadens. It has been underlined among others, the extreme marginalization within the isolated minority “ghetto” schools and racist attitudes of non-Roma towards them, as well as the dominance of the Greek language without any translation of basic word concepts into their own and discourse analysis in a context of social, political and cultural assets.

On the whole ,not only was the investigation focused on the field of students’ knowledge, its perception and utilization on the teachers’ part, but also on the difficulties gypsy pupils encountered with typical school mathematical acquisition, particularly in numeracy and problem solving activities, along with what mathematics formal or informal they did prefer to elaborate on in the classroom milieu.

One important message that comes out of this research is that other students beside the majority should be heard and ought to be respected. Their previous mathematical knowledge should be used as a resource rather than as a barrier. Their multifarious difficulties should be detected and weeded out by bridging the informal with formal mathematics and keeping their cultural characteristics.

Chapter 1. In and out of school mathematical knowledge

A lot of research has been conducted regarding mathematical learning and understanding in relation to in and out of school mathematics disciplines and cognitive development (Abreu, 2008; Abreu & Crafter, 2016). Several years before, studies were essentially focused on relationships between culture and mathematics cognition in addition to envisage the mathematical practices non-dominant culture groups applied in their life and working area. Another reason why investigations took place in foreign non-schooled grounds and civilizations was the intention of primarily Western countries to introduce their way of schooling (Abreu, 2008).

Next, the central point of research shifted to multicultural settings within culturally responsive teaching strategies where driving forces of this expansion of research were the increased levels of globalization and immigration in modern Western societies (Abreu, 2008; Abreu & Crafter, 2016; Gorgorió & Planas, 2005; Knijnik & Wanderer, 2015; Ukpokodu, 2011). In particular, Greece still displays an explicit increase of immigrants[1] (e.g. Albanians, Ukrainians, Georgians, Pakistani and Russians: the 5 most populous immigrant communities) repatriated Pontiacs and refugees (e.g. Kurds, Syrians[2]) (iefimerida, 2016; NTM, 2017; Stathopoulou & Kalabasis, 2007). Part of these members comes along with children, where the issue of school education is raised along with that of survival. According to UNHCR, UNICEF and IOM (2017) despite of not fully data assessment only 2 out of 10 children are in formal education in Greece, Serbia and Bulgaria .In our country 29% of the estimated 12,000 children (6-17 years old) visits formal education, 35% participate in non-formal education activities and 36% do not attend any type of education.

Overall, these constantly moving populations affected and reformed the composition of school systems (Abreu & Crafter, 2016; Civil, 2008; Gorgorió & Planas, 2005; Stathopoulou & Kalabasis, 2007) in a harsh but rather flourishing way since more than ever minority students exceed in number. Multiculturalism has manifested all their mathematical meaning thus providing a trustworthy evidence of diversity in mathematical procedures, algorithms and needs which every society had to create and pass on determining its evolution process. So, it would be prosperous both teachers and students should accept the fact that mathematical knowledge comes from different cultural backgrounds (D'Ambrosio, 1985). Despite the fact that mathematics may be regarded as a subject which is more or less the same worldwide, the ways people use to solve local challenges are different (Chirume, 2017).

[1]There are more than 577,000 legal immigrants from almost 150 different countries of origin living in Greece according to a record on 30 November 2016 occasioned by World Immigrant Day on 18 December (iefimerida, 2016)

[2]Since the entry into force of the EU-Turkey agreement in March 2016, thousands of refugees and immigrants are trapped in Greece. The latest UNHCR and Greek government data indicate that 33,745 people in mainland Greece and 13,214 in Greek islands live in formal and informal camps, other state structures or in NGO hosting centers (NTM, 2017)

According to this point of view, research in the domain of out of school mathematics knowledge examines locus practices and ideas that differ from the typical Western reasoning of proof and confirmation, thus establishing a characterization of another branch of mathematics. Dating back in ancient times, Greeks and Egyptians used to refer to specific branches of mathematics, called scholarly and practical mathematics. The first was incorporated in education while the second was implemented to refer to workers. Those categories prevailed over the Roman Empire by the names "trivium" and "quadrivium" (D' Ambrosio, 1985) until today where scholarly mathematics has been replaced with academic mathematics or school mathematics and practical mathematics has been replaced with a large number of notions (D' Ambrosio, 1985; Gerdes, xx). Some terms describing practical mathematics (cited in Gerdes, xx) constitute indigenous mathematics (Gay & Cole, 1967), socio mathematics (Zaslavsky, 1973), informal mathematics (Ginsburg, 1977; Posner, 1982), everyday mathematics (Lave, 1991), oral or street mathematics (Nunes, Carraher & Schliemann, 1982; 1985; 1987; 1993), ethnomathematics (D'Ambrosio, 1985), hidden or frozen mathematics (Gerdes, 1985; 1986; xx).

All these definitions arose from diverse researchers' work on various heterogeneous cultural groups from every part of the world, like Nunes, Carraher and Schliemann (1985; 1993) who experimented on Brazilian street vendors and carpenters .Besides, Zaslavsky (1970a; 1973) concentrated on African tribes and their numeration systems while Posner (1982) focused on west African societies and the perceptual strategies in numerosity. But all research workers (see references of additional work in book International Handbook of Mathematics Education Part two in Chapter 24: Ethno mathematics and Mathematics Education, Gerdes, 1996) in this field interfered with examining "*mathematics or (mathematical ideas) in its (their) relationship to the whole of cultural and social life",* leading also to an ethnomathematical movement (Gerdes, 1996), which proclaims that mathematics was developed under multidimensional conditions, concerning social, economic and cultural circumstances, and geared towards different directions through time era and region. Thus, it becomes obvious, that mathematics generated its own history, truths and techniques, while at the same time mathematics became coherent as a result of human construction, a cultural product and a universal pan-human activity (Frankenstein & Powell, 1994; Gerdes, 1996; xx; Gorgorió, Planas & Vilella, 2002; Zaslavsky, 1994).

Taking into account all the above studies along with a plethora of others on the scope of ethnomathematics constitute a wealth of answers to some people who until now maintain as Plato openly had stated: "*all these studies* (ciphering and arithmetic, mensuration and relations of planetary orbits, capabilities of classifying, ordering, inferring and modelling) *into their minute details are not for the masses but for a selected few"* (D' Ambrosio, 1985). Nevertheless, this discrimination shouldn't affect the well-organized body of mathematical meanings and principles of applied mathematics. Since practical mathematics uses central ideas of academic mathematics and the latter's abstract theorization wouldn't have occurred without the experimentation and testing of the first. It is more than just a mere distinction between practical and scholarly mathematics, between formal and informal mathematics or in and out of school mathematics.

It becomes obvious that we are working in fields with fuzzy boundaries between in and out of school mathematics (Nunes, Carraher & Schliemann, 1993), so it would be difficult to set the background of any research. However, an attempt will be made to highlight some aspects of the benefits of cultural funds of knowledge recognition and implementation in school frames with everyday mathematics based on historical and cultural knowledge, skills and practices initiated and elicited by minority students' homes and communities (Turner & Drake, 2016). From this standpoint, it is of prime importance to glance at a wide range of cultural population's paradigms of students' struggling to keep pace with dominant mathematics practices but also to view the curriculum reformulations that tend to eliminate this .It is of paramount importance that every child should be given the opportunity of equal and well-rounded education regardless of language, color and way of living. Finally, the group of study, in this assignment, the Romany students, the main socio-cultural and political liabilities are being investigated. Liabilities that prevent them from succeeding in the school environment with great emphasis on math.

1.1 Funds of Knowledge

In the late 1980s the concept of funds of knowledge (FoK) was developed and after that many researchers made a turn to it with numerous advancements and proposals seeking to overcome the deficits in curriculum settings, teaching and racist policies (Llopart & Esteban-Guitart, 2018). The FoK project was funded in 1990 by the W. K. Kellogg Foundation. It was a cross-discipline endeavor by González (anthropologist), Moll (educational researcher) and Amanti (teacher), steered by sociocultural theory, to grow the lens and research methodologies to divulge families' funds of knowledge (Williams, Tunks, Gonzalez-Carriedo, Faulkenberry & Middlemiss 2016).

Naturally in the field of mathematics education, it was accepted and still holds a prominent position. The FoK approach includes the principles of ethnographic literature, multidisciplinary methods and analysis since the studies take place in communities, households and schools. Its purpose is highlighted by the importance of uncovering and tapping into the diverse mathematical resources and experiences, as well as bringing those in the classroom and trying to bridge them with the dominant school practices while at the same time of establishing relations of trust between teachers and students or other members of community (Civil, 2007; Moll, 2014; Rios-Aguilar, Marquez Kiyama, Gravitt & Moll, 2011).

The necessity of breaking the dichotomy of formal and informal knowledge insofar as Fok literature supports goes on in reducing the probable disparities between school and home contexts in order to enable pupils to believe that their cultural pores are valued in math (Stathopoulou, Govaris, Applebaum & Gana, 2014). That is an additional aspect towards this culturally responsive route that we try to demonstrate below by means of arguments and paradigms since the broad statement claims that joint action research in multicultural settings as well as curriculum reconstructions could help students' learning.

(The need of) diverse mathematical contributions embraced and accepted through different indigenous practices

First of all, teachers, it would be advisable that researchers and every individual in the educational community inform students that *"people have been capable of and will be capable of developing mathematics"* (Gerdes, 1985) in every corner of the planet, in different styles and genres, in all milieus. It is quite encouraging to hear (especially minority) students uttering phrases such as "*until now I gave up on mathematics and didn't make an effort. If I had known that my mother knows so much math, I wouldn't have given up*", "*The only thing that makes me mad is that I didn't know that something like conversion is a subject they know at home*", "*It is fun to know that there is more than one method of solving the same question*" (Amit & Qouder, 2017). Taking into consideration that every student could be proud of their people's mathematical achievements, it would be nice to be offered the opportunity to become familiar with the evolution of mathematics and become confident with some indigenous practices in order to bridge informal with formal mathematical knowledge (Civil, 2002; Frankenstein & Powell, 1994; Knignik & Wanderer, 2015) and to make mathematics seem more comprehensible or manageable (Amit & Qouder, 2017).

As a consequence, students could acquire some kind of knowledge regarding historical aspects of their mathematical heritage (Frankenstein & Powell, 1994). To illustrate the point, modern Africans who came from the Yoruba tribe could become more acquainted with their incredible numeration system which had base 20 and reached up to 1,000,000 with subtraction rules mainly. Apart from numeration, their counting system and vocabulary included a wide range of other concepts, such as fractions, squares and square roots, as well as the idea of infinity to name but a few (Zaslavsky, 1970a; 1970b). In addition to this, another example that could be cited would be that of the contemporary Australian students, who may have roots in Papua New Guinea's mathematical culture, in order to compare the broad arithmetic system in use with the body counting system, which attributes a one-to-one correspondence between the counting numbers and particular points on the body (Saxe, 1981; Souviney, 1983).

Furthermore, the different needs should be highlighted. In this respect, extensive systems of numeration were results of animal herding (Gerdes, 1985; Zaslavsky, 1970a), land measuring and construction or art settings (Gerdes, 1985; Lumpkin, 1987; Zaslavsky, 1970a) and large-scale occupations, such as tailoring and merchandising (Lave, 1977; 1991; Nunes, Carraher & Schliemann, 1985; 1987; 1993; Posner, 1982; Saxe, 1981; 1988; Souviney, 1983; Zaslavsky, 1970a; 1970b). The last one especially led to the development of peculiar forms of currency in each commune. So, in market-places where applications of counting and operations on large numbers were frequently requested, people had to make transactions in different currency values by converting for example, cowrie shells to pennies. Nowadays, the introduction of a widespread money economy and decimal currency has encouraged a more stable current counting system but there are still figments of different money purchasing value (Souviney, 1983; Zaslavsky, 1970a).

This phenomenon extends through merchants, either on land or in the open sea. They have always been practicing in efficient problem solving practices, such as regrouping which involves breaking down large numbers and recombining them into more common unit sums (Posner, 1982). As far as occupations are concerned, money exchange practices are attached with pertinent ideas and methods. Teachers should empower all their students to accept and elaborate on their ancestors' mathematical legacy by utilizing closely associated thinking styles in an attempt to prod people of all races and ethnicities to do math and do it well. In addition, students who belong notably to marginalized groups such as Romany pupils should be enlightened to be able to solve problems such as those if they were in the 1st grade. For instance: "*How many five drachma* (the Greek currency before euro) *coins does a five hundred have?*" or "*Your father has given one thousand drachmas to your brother and to you five hundred drachmas, four hundred drachmas and two fifty drachmas coins. Has anyone of you got more money and who is he/she*" (Stathopoulou & Kalabasis, 2002). In this case, they could solve similar thematic problems at school employed in a wide range of contexts on a daily basis.

Culturally influenced curriculum reformulation and teachers' development

New situations derived from different contexts can "*challenge students to go beyond their everyday experience, to refine their intuitive understanding, and to express it in new ways*" contributing in meaningfulness instruction (Carraher & Schliemann, 2002). Therefore, the curriculum could include relevant principles of informal instruction, as Lipka and his team of researchers, teachers and Yup'ik elders established a supplementary culturally based math curriculum '*Math in a Cultural Context'* for elementary school students with ten mathematics modules and accompanying storybooks. It supports an adaptive implementation of both Western and Yup'ik oriented practices of learning/knowing within pedagogy of engagement that includes the dynamic of low-socioeconomic-status groups (e.g. Alaska Native and American Indian) (Kisker, et al., 2012; Lipka, et al., 2015; Lipka, et al., 2005; Lipka, et al., 2007).

More specifically, it encompasses a mixture of their natal and schooling community of culture to avoid the struggle between the systematic exclusion of indigenous people and the replacement of their language and identity (Kisker, et al., 2012; Lipka & Yanez, 1998). The merge is accomplished through expert–apprentice modeling (Kisker, et al., 2012; Lipka, 1994; Lipka & Yanez, 1998; Lipka, et al., 2007; Lipka, et al., 2015) where teachers or elder students use to teach novices until the entire class is involved within a task, while these roles are also being observed in Yup'ik communities in their everyday activities including star navigating, search and rescue on land and rivers, making parka patterns in clothing and baskets among other things. Other forms of practices are being attached to the mathematical content of spatial and algebraic reasoning implemented into the curriculum, which also asserts language transitions of few words or concepts with Yup'ik glossary as many communes of Alaska, like Manokotak are experiencing rapid language loss (Kisker, et al., 2012; Lipka, et al., 2007).

Kisker et al. (2012) introduced for example, a game called Guess My Number (see appendix Kisker, et al., 2012, p. 113) for second graders, which infused with Yup'ik counting system in base 20 and sub base 5. The base 20 is represented by a whole human body and the sub base 5 by a hand depicting five fingers. Another culturally novel mathematics tool is a Yup'ik abacus, "*a tool that is not found in Yup 'ik culture but follows Yup 'ik language and the way elders count using their bodies*". The newly developed abacus has been approved and enjoyed by elders' community and children at school alike. Furthermore, the constructed activities *Picking Berries* and *Going to Egg Island* showed promising results, since research exemplified that students taught with math culturally embedded modules outperformed students taught with only the existing curriculum. The gains in student's understanding of multiple mathematics concepts like measurement, grouping and place value increased and pupils retained knowledge after evaluation. In addition, the gains in test scores were higher in treatment than control groups both in rural (target area) and in urban locations by 10.77 and 9.80 percentage points respectively.

Besides, the improvement of students and teachers' self-development was witnessed as well. To illustrate the point, there are two cases: one of cultural "insider" and one of "outsider" novice sixth-grade teachers who used an area and perimeter module-*Building a Fish Rack*-is illustrated in Lipka, et al. (2005). They effectively taught culturally based curriculum activities transforming their teaching methods and classroom dynamics by allowing cultural connections and employing a more student-centered, open-ended, inquiry-based pedagogical style. Towards this direction the teachers used stories and real hand materials, like a string for the construction of a rectangle in the gym or in the classroom by provoking children to prove that the shape they had created was in fact a rectangle, moving further to the discussion of the properties of a rectangle. At that point, some responses were given denoting that a rectangle has: "*four lines*" or "*four sides*" and a rectangle is: "*a closed shape*"or "*longer than a square*" or "*one side is longer- has one longer leg*". All the above mentioned are some samples of this body of work (Kisker, et al., 2012; Lipka, 1994; Lipka & Yanez, 1998; Lipka, et al., 2005; Lipka, et al., 2007; Lipka, et al., 2015) that suggests school mathematics be ameliorated by implementing indigenous people's knowledge into the school curriculum but it may also deject a teacher-centered procedure, that is heavily reliant on textbooks and worksheets of pedagogy.

The latter one supports the idea that teachers are to be better prepared mathematics educators in a context of relentlessly professional development and learning to effectively teach the culturally, linguistically, and socioeconomically heterogeneous pupil population (Aguirre, Turner, Bartell, Kalinec-Craig, Foote, McDuffie & Drake, 2012; Sakonidis & Potari, 2014). By adopting this perspective, teaching could be seen as "*learning to develop learning*" where teachers are taking an insider position as researchers with regard to their constant training and its impact on their practice (Sakonidis & Potari, 2014).

As a result, culturally influenced pedagogy of teaching and professional development can be traced in individual case examples, in which teachers let mathematics come alive and become more personalised for the students themselves in the classroom by assigning tasks that refer to familiar elements and experiences in an attempt to do better in order to create better future instructions. For instance, Harding-De Kam (2014) observed and interviewed eight elementary and kindergarten teachers not from a common residency and schools from across the state of Colorado. Despite the different socioeconomic level, the area and the minority population in every school, she found that most of them focused on traditional food through recipes for fractions or measurements and geometrical shape cuts. On the other hand, others encouraged the money and foreign currency use for economic transactions and the farming constructions for area and perimeter and some permitted students to use their native language discourse to enhance mathematical meanings. In another study of Civil and Hunter (2015) Pāsifika students in New Zealand and immigrant Mexican Americans in US were encouraged to use except English and their first language in collaborative mathematical activities. Favorably this explicit language switching has been studied and encouraged in the mathematics literature since student's understanding and participation are enhanced (more in: Bose & Choudhury, 2010; McNeil, 2015).

Consequently, studies as the above (Harding-DeKam, 2014; Kisker, et al., 2012; Lipka & Yanez, 1998; Lipka, et al., 2007; Lipka, et al., 2015; Posner, 1982) have indicated that students who learn mathematics in cohesive ethnomathematical content attain better scores on standard mathematics tests, while at the same time, they ascribe higher self-perception and motivation, feeling that their community culture integrates mathematics and most importantly their own family applies it. The latter impact has been detected furthermore in Amit and Qouder (2017) howbeit with almost no effect on achievements of Bedouin 7th grade students in school length and weight measurement tests. Perhaps, it was due to a short intervention of a 30 hour teaching curriculum or to a large amount of measurement units[3]or due to strict legislations that reinforced the idea that previous pupils' scores or any other aspect of the research should not be displayed. Nevertheless, this program and many others may also be expanded as an old Bedouin proverb says: "*the march of a thousand miles begins with one small step*".

[3] More information about diverse units of measurement systems of variegated cultures you may find for example in Zaslavsky (1973), Nutti (2013); Lipka, et al. (2015), Amit and Qouder (2017), Septianawati, Turmudi and Puspita, (2017).

1.2 Decontextualized teaching and consequences

It is common that most school teaching methods are irrelevant and there are no applications for real-world problem solving tasks in the classroom (Mji and Makgato, 2006; Northcote & Marshall, 2016; Pattison, Rubin & Wright, 2016). Carraher and Schliemann (2002) and Civil (2002) argued that school is pushing students to adopt techniques and learn algorithms and properties without establishing any link between physical quantities of numbers embedded in a problem and symbolic manipulation of numerical values .For example, many children who knew how to solve creatively and effectively arithmetical problems encountered in everyday life, couldn't later at school solve the same problems by performing the methods taught in class (Nunes, Carraher & Schliemann, 1985; 1993; Saxe, 1988). Despite the fact that the African cultures acquire greater skills in multiplication applied in their everyday life problems, at school they are supposed to stick to memorizing the multiplication tables only (Posner, 1982; Zaslavsky, 1970b; 1973). This phenomenon is being witnessed worldwide from the most impoverished to the most economically developed countries.

As a result, school methods differ from pupils' home practice techniques lending weight to correctness of procedures, memorization of mathematical rules and generally handling the ongoing necessity of capitalist global market economy. The latter means mathematics education policy and mathematics basic ideas through centuries have been incessantly reformed in order to align with the logic of greater cost-profit technological advances and typical mathematical development (Rosenthal, 2017).Besides, the adoption of typical mathematics into the curriculum involved the training on part of the elite to maintain the socio-economic structure to be prepared for effective management of non-dominant students headed for productive sector (D' Ambrosio, 1985, Gerdes, 1985; Moses & Cobb, 2001).

This is the reason why the majority of non-dominant culture students at any country they live in, no matter what class they attend to, or any attempt of culturally responsive teaching they have, are excluded from the educational and personal success in mathematics literacy, along with science and technology (Feza, 2014; McNeil, 2015; Ukpokodu, 2011). It is common knowledge that literacy demands higher math skills which are substantial in the new technological era of the 21st century and subsequently for economic access (Moses & Cobb, 2001).

A typical example that portrays the difficulty of a second generation Jamaican immigrant student in England is described in Tomlin, Baker and Street (2002). He is attending 1st grade and already has trouble with numeracy lessons at school. His grandmother who was a teacher in her country-Jamaica assists him with his homework in a different and more formalistic approach as she herself received when she was educated. She clearly states that "*it is too much for him*". It is beyond his age, when comparing the learning and teaching level of mathematics between two different epochs, hers and her grandson's. The latter requires a large amount of mathematical knowledge from an early age when contrasting to her period of childhood, along with the fact that the comparison is being made between two different nations with disparate mathematical methods.

Under these circumstances, in view of the way that society is organized, it becomes obvious that knowledge is not neutral and objective as it presupposes how, why and in whose interest it is used (Frankenstein & Powell, 1994). A close look at how, why and in whose interest mathematical knowledge is used by can be the following example from Carraher and Schliemann (2002). Consider a case of an eighth-grade peasant child from a third-world country who learns algebra at school. You might wonder as her parents and teachers do, the reason why she studies algebra or how this knowledge would be helpful if she is supposed to run a farm and cultivate crops. These suppositions are based on one-sided belief that entails the fact that she will simply exercise her parents' job in which case algebra is irrespective to running a small farm and only knowledge which is directly applied is worthwhile. But what if the girl decides to follow a different job career? How is algebra irrelevant to this occupation if she is to approximately estimate the cost of seeds with labour time, the gallons of water or fertilizer per year, the daily liters of milk per money and that kind of stuff? Does knowledge which is immediately applied always yields the best results? All these questions need to be taken into serious consideration. However, the most important question raised is the following: should others decide which option is more preferable for her? That kind of question stands for every student, whatsoever.

Chapter 2. Politics and its role in Romany mathematics education: A macro-meso-micro level analysis

At first, we will set the historical background of Romany's people folklore drawn from historiographies and ethno-socio-cultural studies. Next, we will start investigating the political scenery above mathematical education by deconstructing initially the macro level, namely the role of society and government education policy which alienate this particular group of students from entering the market economy and prestige within mathematical advance. Furthermore, we will thoroughly analyze meso (middle) level concerning school tactics which involve matters such as reception in(ex)clusion classes, curriculum and textbooks stratification and disparities. Whereas, at micro level we will discuss within the classroom demonstrations the classroom's culture to wit student's and teacher's perception of who is "good" at mathematics, their position literally and metaphorically in the classroom, the teacher's practices and discourse along with the mental and typical mathematical knowledge from Rom pupils if mastered or not. Last but not least, we will summarize the main difficulties that prevent Romany students from acquiring the formalized mathematics- a topic that will set the methodological plan next.

2.1 Historical background

Any culture globally isn't static or stiff when time passes, but rather a dynamic, flexible enriching system which is continuously evolving and adjusting in time, region and tradition (Marushiakova & Popov, 2016). Thus, the Roma culture gradually has been developed due to movements and influences that exert various countries. In advance they had been distinguished by Liegeois (1994) as "*a rich mosaic of ethnic fragments*". At present there are approximately 150,000 to 200,000 in Greece (Vavougios, 2008) and 10 to 12 million Rom all over the world going under different names, such as Kalderas, Lovari, Sinti, Manus, Romanichals, Kale, and the like.

On the other hand, dominant cultures of host countries tend to use a wide but different terminology of names, like Roms, Roma, Romany, Travelers, Athiganos, Gypsies and Tsiganos for that particular minority ethnic group (Boot, 2013; Chronaki, 2005; Derrington, 2016; Lapat & Eret, 2013), where the two latter idioms carry negative connotations (not always) and usually are used as racist expressions by the majority (Foster & Norton, 2012). The latter name Tsiganos (or according to Chronaki (2005) Gitanos in Spanish or Tsiganes in French and Zingari in Italian), is a Greek pejoratively expression and the Gypsy locution, which is originated from the word Egyptians, is generally used by all Europeans denoting the country that facilitated their entrance into Europe rather than the place that they came from. Overall, the Roma are believed to be a caste of untouchables descended from Northwestern India that had fled to India wandering through Iran, Asia Minor and Balkans and spread all over Europe between 9th and 14th century (Csapo, 1982; Derrington, 2016; Liegeois, 1994).

A birth of hostility (annihilation, expulsion, slavery) in every part of Europe was salient and still remains quite the same, since continuous persecutions and attempts of rough assimilation (Claveria & Alonso, 2003; Csapo, 1982; Kostadinova, 2011) had created a stereotyped, exotisized Gypsy image across states (Daskalaki, 2003). They commonly imagined Roma as a homogenous group ignoring their national and linguistic approach that makes them heterogeneous multi-groups. For example, there are many Greek-Gypsies, as they prefer to be called, that separate themselves from Turkey-Gypsies or Albanian-Gypsies that live in Greece. Just like Greeks from Pontus differentiate between Greeks from Macedonia, Thrace, Crete or any other group with their specific customs, traditions and lingual idioms (Daskalaki, 2003; Gkofa, 2017; Kostadinova, 2011). However, the authoritative culture still doesn't recognize that most Roma in Greece are Greek citizens. For instance, they acquired their political rights in the 1970s despite the fact that the first gypsy-population had been established in Peloponnesus in 14th century (Skourtou, xx).

In addition, Roma's livelihood undergoes a process of modernization changing their way of live (Lapat & Eret, 2013). As many other tribes , like Bedouins of Negev, used to be nomads travelling all around in search of their goods (Amit & Qouder, 2017) or lived a semi-nomadic life (Marushiakova & Popov, 2016), now most of them have permanently settled in a certain terrain. It is a common sight that the way they live lacks any infrastructure (electricity, sewer, clean running water, garbage collection, roads, etc.) and it is noticeable in distant separate "Gypsy settlements", dwellings away from the center of cities and villages, often without planning permission and limited access to medical care (Daskalaki, 2003; Foundation Secretariado Gitano, 2009; Lapat & Eret, 2013). They are excluded and marginalised topologically and economically as their jobs can be a constraint to market sellers, individual businessmen, agricultural workers, music players or even beggars. They are also flexible in shifting their economic activities according to Daskalaki (2003) towards more "*labour intense and opportunistic working patterns*" due to the competitive industrialized environment. Consequently, a major question raised is how can they maintain their traditional culture and analogous equity in a rapid globalization? Or how can they "*become something socially better*" (Stathopoulou, 2017) through school mathematics achievement without being alienated from their cultural and ethical elements?

2.2 Macro level

The reconstruction of Europe after the plague of World War II led to the reformulation and development of education and also around 1960 to handling the North-South "problem" by addressing an educational plan movement for newly independent countries in Asia, Africa, and Latin America. The reason behind this was to create a modern education system supported by the modernization theory and the human resource theory in advance when compared to the technologically, industrially and economically lagged countries. Due to the fact that many industrial companies had moved their businesses into those countries seeking cheap hands in the form of development assistance, the basic education was disdained and ironically an imbalance between the rich and the poor was escalated. Regardless of protests made by some countries in the 1970s and the 1980s for endogenous alternative development, a short change didn't make a difference till 1990 when four international organizations- World Bank, UNDP, UNICEF, and UNESCO- declared Education for All (Baba, 2002).

As a result, "***Mathematics for All***" was in the limelight and acknowledged even if the research community in mathematics education had already deliberated on "Mathematics for All" (Baba, 2002). Since then, researchers have been discussing the problems many students face with mathematics more widely. A particular minority group, the Romany pupils, as well as their difficulties and their smooth entrance into the school mathematics education became the focal point of a team of researchers into the Greek community (Chronaki, 2005; Stathopoulou, 2003; Stathopoulou, Govaris, Applebaum & Gana, 2014; Stathopoulou & Kalabasis, 2002).

The extent of Roma's educational inequity

Until 1980's -and later on- Greece as many other European democratic countries but also further communist ones, seemed that regardless of the political aspiration differences, they had followed a similar responding education settlement to the needs of Romany children. Their goal was either to assimilate them into the dominant culture "*melting them into society* (Csapo, 1982)" through the use of standard curriculum, language, values, social and economic ambitions taught in schools or to exclude them from compulsory mainstream schools and send them to segregated schools, special needs schools (for the mentally disabled kids) or to segregated classrooms (see more at p. 23) into mainstream schools (Albert, Matache, Taba & Zimova, 2015; Csapo, 1982; Kostadinova, 2011). The formation of separate "*Roma-only schools*" in Greece has been espoused but with poorer resources (campus facilities, educational materials, teachers) since they were regarded as less valuable. Those schools are represented only by Gypsy children, treated as "ghetto schools" (Dragonas 2012).

The discrimination is so explicit once again since the majority shows no signs of permitting their children to socialize with Romany kids in public schools changing their school environment to a further degree (Albert, et al., 2015; Dragonas, 2012) - "*white flight*" (Albert, et al., 2015). This is also the case witnessed worldwide when many dominant culture parents are moving their children from public schools which have 'too many' minority children into other public schools or sometimes private schools if they could afford tuition fees (Albert, et al., 2015; Gorgorió, Planas & Vilella, 2002). The negative aspect is that the whole situation illustrates an explicit illusion that our society is seemingly tolerant but it does not appear to have changed a lot as the intention of taking privileges and opportunities with high expectations out of Roma is still voiced. It is distinguished that continuous persecutions on their rigid forms have switched over time into policy restrictions and suppression.

In the aftermath, Romany pupils are underperforming dramatically as they have the lowest achieving results in literacy and numeracy (see definition below at p. 29) than any other minority group considering the academic progress (Boot, 2013; Derrington, 2016; Gkofa, 2017a). They are at risk of being excluded from school because of the commonly misinterpretation, disapproval, racism and fear of volatile behavior (Benekos, 2007; Boot, 2013; Derrington, 2016; Foster & Norton, 2012; Ofsted, 2003). The misunderstanding and all traumatic educational experiences they receive according to some theoretical and ethnographical studies are the results of a conflict on the part of authority figures within schools (i.e. teachers and teaching assistants or non-Roma peers) mainly because the norms and values of the dominant society often oppose to those of their own culture (Wilding, 2008). For example, many of them spot the differences between the pursuit of high economic status the school offers and their family expectations of early financial independence, marriage and parenthood (Foster & Norton, 2012).Girls still are getting married in early adolescence, often in pre-arranged marriages and little boys apprentice to their fathers' occupation directly into the unskilled job market (Chronaki, 2005; Dragonas, 2012; Stathopoulou 2003).

Inevitably Roma students are in a constant discord between their family education and formal education (Daskalaki, 2003; Gkofa, 2017a; O'Hanlon & Holmes, 2004). The former one is present in everyday practice and narrative communicating knowledge without moving to abstract thinking while the latter one, concerning the particular case of mathematics, promotes rigorously advanced mathematical concepts and operations emphasized in symbolic representational systems (Chronaki, 2005; Stathopoulou, 2003). It becomes salient the principles of educational system are not based on equal opportunities (Foster & Norton, 2012; Wilding, 2008), since the mathematical practices and structures of school continue to be incompatible with their everyday lives perpetuating the discrimination and low achieving expectations of marginalized Roma pupil groups.

Another major issue and outcome of the above strictness and prejudice of the repressive system is the erratic attendance and withdrawal in connection with the high dropout rates from school (Boot, 2013; Claveria & Alonso, 2003; Derrington, 2016; Ofsted, 2003) especially as they move to secondary education (Daskalaki, 2003; Gkofa, 2017a; 2017b; Kiprianos, Daskalaki & Stamelos, 2012), where school education is mandatory until the third grade of secondary school. Most of them never graduate from high school and consequently, they are unable to meet the criteria offered for higher education while according to Foundation Secretariado Gitano (2009) 83% of Greek Roma receives no education at all. Contrary to this, the state provides financial aid (300€ for each child annually) to poorer Roma parents (those with an annual income lower than 3,000€) who send their children to school (Gkofa, 2017b; Kostadinova, 2011; Ministry of Economics, 2015), albeit with no remarkable results. Again the attendance is poor, just a few months with irregular appearance in class, and their education progress and performance are discouragingly low (Kiprianos, Daskalaki & Stamelos, 2012). However, those who achieve their entrance to universities, are granted extra points on the Greek nationwide exams and through their completion of studies by means of affirmative action measures, provided they belong to low-wage families (≥30,000€ per year), such as by providing financial support (1,000€ per year), medical care (to uninsured university students), free accommodation and restaurant facilities (Gkofa, 2017b; Ministry of Education, 2015). Yet, their awarded diplomas are occasionally not so competitive facing the danger of unemployment or low-paid jobs (Kiprianos, Daskalaki & Stamelos, 2012).

Nevertheless, these emblematic exceptional cases of students who completed Tertiary (or even Secondary) Education and some excelled in many epistemological fields could be demonstrated as role models to younger Rom students (Baris & Alexopoulos, 2002; Gkofa, 2017b), as catalysts for inspiration, motive and progression and admiral efforts for such chances. In this way, the involvement of exemplary students could act positively as one further direction upon "*Integration Program for Gypsy/Roma children at School*"4,whose materialization according to Skourtou (xx) is supported by many universities of every geographical department aiming at Roma pupils' integration into schools of mixed student populations. Over the years, this focal program has enrolled many specialists conducting seminars at every periphery/region (Makedonia, Attica, Thessaly, Thrace, etc.) of the country as teachers' reeducation map about teaching mathematics to Roma students (see Vavougios, 2008). Unless teachers (and generally society and members of authoritative legislation) recognize the potential of Roma pupils and support their ambitions for further education, pupils will remain at ostracism, at the margins of society (Claveria & Alonso, 2003).

2.3 Meso level

Moving on to the next level, we focus on language policy of segregated classrooms, curriculum and textbooks used when teaching mathematics. Again, the stiffening ring becomes tighter as political decisions determine what are the main mathematical ideas and sources available in all school teaching books and curriculum programs and what kind of training is suitable in segregated classes .According to Sakonidis (2015; 2017) political mathematics stance constitutes for the prevailing class a control practice of diverse non-dominant groups and a prevention from entering into the majority's reality, usually with the "*mechanism of filibuster* (kolysyergia)" of none actual educational change.

[4]Additional educational programs-***exclusive, direct and indirect programs***- are under operation by the Ministry of Education or Universities for the prevention of the Roma inequities.Epigrammatically we just mention a few: The *Programme for the Education of Muslim minority children inThrace; Education of Roma children in the regions ofCentral Macedonia and Western Macedonia*;*Education of Roma children in the regions of Epirus, Ionian Islands, Thessaly andWestern Greece*; *Education of Roma children in the regions of Sterea Ellada, Attica, etc.* However their inconsistency, inadequacy and the absence of combined interventions in many sectors eventuate in no long-lasting results (see Dragonas, 2012 p. 41-43).

Segregated classes

Firstly, by analyzing the former we may become cognizant of many Rom students who attend mainstream schools and spend most of their time in those classes; generally speaking, they are minority students, who speak their origin languages or have been characterized as low performers and therefore are separated from their regular classes during lessons at any school hour receiving further instructions and exercises in Greek and mathematics but with no use of their mother tongue. It is obvious that Romani and any other language of minority groups are often regarded as obstacles in promoting mathematics efficiency and are not recognized in the mainstream school system.

Analogous classes have also been endured in several countries, for example, in South Africa where children before attending 1st grade, they are placed to grade R, a reception class, where they have been taught numeracy (curriculum provision dictates pupils of 5-6 years old to count meaningfully to 10) in their home languages with no English transition expected as this would be the formal language afterwards (DBE, 2014; Feza, 2016). It reminds us a dreg of former racially education regime systems, such as Bantu Education (see Moore, 2015), which stated that “outsider’s” (African) education should be inferior opposite to other races (Feza, 2014; Moore, 2015; Wikipedia, 2017) with strong provocative statement for “good educated labourers” by the "Architect of Apartheid" Hendrik Verwoerd the Minister of Native Affairs at the time, saying: "*There is no place for [the Bantu] in the European community above the level of certain forms of labour... What is the use of teaching the Bantu child mathematics when it cannot be used in practice*?" (Wikipedia, 2017). In view of mathematics education, the development of any child is crucial, as both, Greece and South Africa (and others of course), reveal a tactic that still ensures non-dominant graduating youth will continue to staff the unskilled “slavery” jobs (Moore, 2015; Wikipedia, 2017) and be excluded from higher education careers in Science, Technology, Engineering and Mathematics (Feza, 2014).

Consequently, one of the contributing factors in low performance is the language of instruction which is dissimilar to their own (Cuevas, 1984; Feza, 2014; 2016; Seati, 2005; 2008) while there is no transition from one language to another. All courses are conducted in Greek without being allowed or accepted to use their home utterance, in spite of the fact that the international literature suggests its learning benefits and the great role in internalizing mathematical ideas (Bose & Choudhury, 2010; Cummins, 2008; Setati, 2005; 2008; Skourtou, xx). In advance, mathematics itself reveal an additional language difficulty that is traced in mathematics terminology, notations, conventions, models and expressions used for communication and interpretation (Setati, 2008). For instance, Roma students have to cope with the understanding of everyday concepts in verbal or word problems based on specialized vocabulary or have to switch between the verbal instruction (Greek to Romani or Romani to Greek) and arithmetic form of the numbers (Stylianidou & Biza, 2015). They even have to be confronted with fixed expressions used in conjectures, proofs and models and according to Cuevas (1984) they become cognizant with the multiplicity of meanings same words have. But further the linguistic form of Roma pupils is depressed, "*implicit, context-bound and particularistic*" molding into a "*restricted code*" rather than an "*elaborated code*" which is "*explicit, context-independent and universalistic*" (see Bernstein, 1960; 1973; Jones, 2013) leaving little space for semantic continuity and development in mathematics lexis and structure.

Their word repertoire for a lot of mathematical concepts about number, space and time is limited combined with the lack of a written Romany code since they use a combination of Greek and their own dialect phrases. A quite simple example exemplified is the number words used here: 1=ek, 2=dui, 3=trin, 4=star, 5=pants, 6=siov, 7=epta, 8=okto, 9=enea, 10=des, 11=desiek, 12=desidui, 13=desentrin, 14=desistar, 15=desipants, 16=desisiov, 17=desepta, 18=desokto, 19=desenia, 20=bis, 30=trianta, 100=sel, 200=dui sel, 1000=papin, etc. Here the numbers 1 to 6 and number 10 are in their dialect, while the numbers 7, 8 and 9, as well as 30, 40, and up to 90, are Greek words; as long as we may see numbers like 17, 18, 19 are composed of words from both languages (Stathopoulou, 2003). Moreover, we should mention that Romani language is not easy to be integrated into classrooms and more widely into mathematics curriculum due to the fact that the school space seems antagonistic towards the use of Romani. Two possible major variables are the strict official language policy of monolingualism and the linguistic devaluation of Romani (Kokkoni, 2017). However, it would be sufficient if teachers (who teach Roma kids) would learn a few words and phrases in Romani because as a student clearly recognized and answered to the researcher Stathopoulou (2017) that he believed that "*since the young Roma use to speak Romani most of the day, teachers should speak basic Romani too, not fluently, but just as a bridge to come closer to the child*".

Curriculum and Textbooks

In the case of mathematics curriculum and textbooks, notwithstanding, we know quite few mathematics' topics that people have learned in their school years, emanated from Asia and Africa before the Europeans were cognizant of the most foremost principles of mathematics (Zaslavsky, 1994) and much of the computational mathematics we use today originated from Islamic contribution (Leung, 2008). However, it is pinpointed that they do not include the cultural strengths of those. They do not contain the minority or low-socioeconomic-status groups' mathematics virtues or scientific way of thought (Francois & Stathopoulou, 2012; Kisker, et al., 2012; Zachos, 2017). On the contrary, if we examine the curriculum we may notice that it remains a "*canonical curriculum*" which was introduced in all parts of the world and was developed in the Industrial Western Europe with the distinctive characteristic of its Greek origin (Leung, 2008). Every ethnocentric element is dominant (Zachos, 2017) and Greek-European mathematical legacy is praised. It passes over the overall contribution of others (Chirume, 2017; Lumpkin, 1987; Orey & Rosa, 2007) and the techniques presented are oriented towards a sharp emphasis on rationalism and deductive reasoning (Leung, 2008).

Since 2003 (DEPPS-APS, 2003) it has been the same uniform curriculum (Francois & Stathopoulou, 2012) only with minor changes even when there were efforts of replacement at 2011 (NPS, 2011) which still bide untapped. But again, the content is mainly delimited in the majority's experiences (Francois & Stathopoulou, 2012) and it does not recommend an open agenda from which any teacher can choose and organize his/her mathematics lesson according to student's dynamic and diversity. It is more closed-strict to its educational and mathematical aims as long as Orey & Rosa (2007) had stated teachers are not liable or allowed to support any other material away from the authorized texts and curriculum that change significant the verity of content they must accomplish. In addition, a group of researchers and teachers created a series of books[5](Georgiadou-Kabouridi & Markopoulos, 2007; Klothou, et al., 2008a; Klothou, et al., 2008b; Klothou, et al., 2008c) especially for gypsy kids in elementary school but very few are cognizant of their existence and even fewer use them in class (they could be also used for non-Roma students).

Besides, teachers themselves believe they should prepare their students in the best possible way for further future educational studies in specialized areas and positions. In order to achieve this, they stick to their fixed national teaching agenda and materials-textbooks with the necessary mathematical concepts organized in that certain way which unfortunately benefits the prevailing class (Nutti, 2013; Pais, 2011). Otherwise equivalent culture-based teaching on an ethnomathematical perspective is at stake since dominant students will continue to indulge in formal academic mathematics which allows them to compete in high ranks of a more mathematized and thus privileged world, while host students "*will only learn a kind of local and rudimentary knowledge that scarcely contributes to their emancipation*" functioning instead as "*a factor of exclusion*" (Pais, 2011).

In line with this belief, we can say curriculum and textbooks legitimize educational system standards and teachers' choices for antagonistic attitudes in capitalistic/technocratic values. This ideological-political frame of school reality is offered for the pursuit or impregnation of students with ideas without substantive content that leads the future generation to uncritical mathematical acceptance of political and social establishment. In Greece as in many other countries, it is assumed how aggressive this control of curricula by the state is and how the school applies it through a series of books which have been designed by the Pedagogical Institute on behalf of the government (Flouris, 1997; Saliaris, 2009), while the political clientelism (see Marantzidis & Mavrommatis, 1999) determines who is in charge of reformulation and republication of those. Every time a government or political executors department is switched (and it happens quite often), then, as an ongoing tradition, textbooks are actually transformed again due to political aspirations per se.

Teachers are obliged to explicitly follow them and many willingly choose this "safety route". Except teachers who are attached to school textbooks, it is common that many

[5]You can visit the source of the program " *Integration of Gypsy kids in Education*" with the teaching materials in the link: http://roma.pre.uth.gr/main/didaktika-ylika

children use their mathematics books as the “Bible” consulting them, in order to know which subject the class is studying at the moment so that they can apply the right algorithms without basic comprehensive understanding. From that point of view, they insist on solving methods, which they have learned as appropriate for exact particular reasoning and problems, and transplant mechanically supportive strategies for a huge amount of different kind of problems.

The following ‘vignette’ from Gorgorió, Planas and Vilella (2002) shows an aspect of the above into a school of Barcelona:

(The teacher had given the students worksheets for the session)

N: *May I bring the books I had in Morocco?*

Teacher: *To show them to me?*

N: *No! To use them.*

Teacher: *What do you need them for?*

N: *To work with them, to know what the class is about!*

Her previous school habits in Morocco indicate the teacher was just an interpreter of mathematics textbook and the student herself always used it as a remarkable and infallible source to feel at ease when she asserted that she didn’t know what to implement. This was and still is quite popular in any traditional Greek classroom.

2.4 Micro level

The construct of dialogic instruction in classroom within teachers’ authentic and higher cognitive demand questions seems to be identified as a critical dimension in students engagement and improvement, because the attention is given to their own knowledge and thinking (Cazden & Beck, 2003). So, in the micro level we concentrated on incidents inside the classroom which revealed the different aspects of mathematical discourse, the intentions and the position of students and teachers, and the mental and typical mathematical knowledge of Rom kids.

Mathematical discourse within cultural and socio-political models

It is important to shed light onto discourse because it is a mildly explicit way of expressing, understanding and analyzing the idiosyncratic thoughts, changes and conflicts into a mathematical classroom. Beforehand, we should mention that there are many approaches underpinning the notion of discourse under diverse philosophical, psychological or sociological lenses. But as far as our aims are concerned, we chose to describe the mathematical discourse by taking into consideration on the one hand, the pure subject of mathematics and on the other, he interrelated connotations of cultural and socio-political reflections within it.

According to Lerman (2001), we need a bridge between micro and macro complexities that enables us to delve into an integrated account of how social, political and cultural forces affect the development of mathematical thinking. Thus, discursive practices go beyond conjectures, symbolically expressed language and terminology, supporting claims and explanations with evidence and representation of mathematical concepts that happen between interlocutors at a given moment in time (Moschkovich, 2002, as cited in Esmonde, 2009). More precisely, they involve a greater deal than a mere mathematical language by making the politics and ideologies encompassed through words and actions more visible and recognisable. Their salient nature includes a great variety of language manipulation in a socially, politically and culturally accepted association network among ways of using gestures, signs, mimicking and other expressions, and artifacts of thinking, feeling, believing, valuing, acting, interacting and sometimes writing and reading in a meaningful role (Gee, 2011; Lerman, 2001).

However, it is not an easy task to identify as well as giving meaning into discursive practices in mathematics domain, especially when demographic changes necessitate a vast understanding of what discourse might look like in the classroom (Walshaw & Anthony, 2008).

Position and reaction of students in mathematics classroom

Any form of practice is imbued with power relations. Students are arranged in mathematical practices as powerful or powerless according to their personal experiences and behavioral traits and the configuration of the discourse (Lerman, 2001). Therefore they seem to have a quite strong impression of who is popular among children, who is smart, who knows mathematics, what is the proper way of acting and responding in front of others and what to expect from teachers, their classmates and the subject regarding their mathematics learning. In short, they have clear ideas of what is everybody position in the classroom (Civil, 2002; Gorgorió & Planas, 2005).

As illustrations from Civil (2002) think about an individualist traditional fifth-grade class consisted of students with mixed cultures (Mexican, Hispanic, Anglo-American, African American and Native American origins) that had to work in groups with open-ended problem solving tasks. The tasks were new to them and required collaboration, proposing questions and conjectures and listening to mathematical arguments. In other words they could be characterized as problems that mathematicians grapple. Such problems were given as games to pupils to end up with a generalized solution. A problem named the Game of Nim and referred to probabilistic thought, involved a single pile of 12 pieces and it required two players. Each player in turn was taking 1, 2, or 3 pieces, and player who had taken the last one was the winner. They were supposed to discover the winning strategy, which was the rule to leave the opponent with 4 pieces by determining the winning number positions as a student suggested that were the multiplies of 4 (4, 8, 12 were the winning positions). However only a few students were involved in the discussion and even fewer, considered the top of the class, intrigued by why this pattern was emerging. Some of you might think students that didn't actively participate would have lacked mathematical abilities and knowledge but the main reason was not mathematical at all. Personal and social values are far more important. Students were concerned with their status in the classroom, which means they were extra cautious about issues of how the groups were formed and who gets to speak, what their peers would have thought about them if they were right or wrong and how to react in every situation or problem. Actually it is not easy for anyone to advance an idea and a second later see it shatters.

Besides this stressful feeling of shattering in front of others, which is attributed mostly in Western values and is quite obvious in Greek classrooms also, lay additional reasons for non-active participation in different culture ethics. For instance Pāsifika students due to respect of not causing any embarrassment to their peers stay quite without asking or contributing in any argumentation with them. Their manners rely on reticence and modesty (Civil & Hunter, 2015). Another strong evidence of shyness inside classrooms we may notice in Pakistani girls' behavior, since it is considered as the proper way of reaction for a female linked to virtues of humbleness and purity. This is common again to some gypsy girls and wider to religious Islamic cultures (Chronaki, Mountzouri, Zaharaki & Planas, 2016).

Furthermore the reduced social obligations and cognitive demands from their teachers lead to no involvement (of immigrant students) in (Spanish) classroom discussions and hence to constrains over their development within a thetic mathematical disposition (Planas & Gorgorió, 2004). So if teachers do not believe in the potential of their students and do not give them opportunities to participate in mathematical argumentation, they-the teachers exclude them from full engagement. But many of the pupils receive disappointment or renouncement of mathematics because they can't manage the mathematical meanings or procedures in new terms and contexts from those used to. They find it hard and quit pretty soon. According to Abreu, Crafter, Gorgorió & Prat (2013) a student from Chile, for example, that was characterized as a good math pupil and stated he liked the subject, when moved in Catalonia he started failing math. The ruptures he as an immigrant student experienced had put him in conflict between withdrawing of mathematics and committed to humanities and social sciences or letting off the old mathematics and improving his grades in an attempt of chasing mechanics career.

One last paradigm that strengthens this viewpoint is quoted in Gorgorió, Planas and Vilella (2002):

Teacher: *I want you to think, for tomorrow, of a mathematical problem or situation that can be linked with this photograph* (of a rural market with a woman selling)

M: (the next day) *This was a trick! There is no mathematics problem, the woman has never been to school, she does not know mathematics.*

Miguel, a 16 years old gypsy pupil student, who works with his family in street markets has a very low opinion of his Romany community mathematical knowledge and does not accept any need to know mathematics to sell products in agora. He believes mathematics only exists in the boundaries of school and if "*his people knew mathematics they would not be selling in street markets*".

In the aftermath we may notice the preponderance of those elements and the contradictions within them lead an individual to intra-disputes and doubts. Because children from any locus, traditions and beliefs put themselves into positions coherent to learner's mathematical ability, ethics or emotions and communication motives in relation to discourse outline. Their reactions further depend from previous experiences, personal goals of learning, attention and success (Lerman, 2001) and last but not least from teachers' preferability or prejudicial notions e.g. of color, of gender equality and capability, etc. (about gender issues see more in Walkerdine, 2005).

Romany's mental and typical mathematical knowledge or understanding/mastery

In this section we exemplify a) paradigms of numerical sense and computation and problem solving strategies that Romany students perform by trial and error method customarily, whereas b) we identify the core disadvantages in school standard algorithms and c) their non-typical strategical approach in arithmetic. Before we overindulge in those concepts and practices, it would be useful to give a short definition of numeracy.

Historically and geographically numeracy receives multiple fluid definitions and explanations from a lot of researchers of mathematics education (Brown, Askew, Baker, Denvir & Millett, 1998; Kaye, 2015; O'Donoghue, 2002; Sellars, 2017; Smith, 2015) but it is generally accepted as an important life skill and social practice for everyone because it is valued in society and in economic capital (Sellars, 2017). It defines something more than knowing about numbers and number operations (Brown, Johnson, Street, Askew & Wiliam, 2001) within the quantitative demands of modern world (Smith, 2015). Numeracy includes the assessment and interpretation of information using data analysis methods, charts and graphs, the identification and estimation of possibilities, ideas of chance, and the ability and inclination to problem solving that involves money, time, measurement, fractions and percentages (Brown et al., 2001; Scottish Curriculum, 2017). Therefore, numeracy as interdisciplinary to mathematics, not only is the math concept involved herein, but also the use of that concept in various situations (Smith, 2015). The discrepancy between the formal school numeracy and everyday practical numeracy perception and strategies is apparent (Brown et al., 1998; Lave, 1991; Nunes, Carraher & Schliemann, 1993; Saxe, 1988).

a) Mental computation and problem solving strategies

Findings show that people who have not attended school usually solve real life problems in different ways and use no standard algorithms from people who have (Carraher, & Schliemann, 2002; Nunes, Carraher & Schliemann, 1985; 1987; 1993; Saxe, 1988). In addition, children who attend school and at the same time are involved in economic activities tend to decode and resolve problems easily on oral mode with mental computations. When they become conversant with mental techniques and transactions, they fluently find the answer even with multi digit number operations (Bose & Subramaniam, 2011). Apart from their tremendous skill in performing mental calculations, they can recall the transaction numbers involved for quite some time, like African traders did years ago (Zaslavsky, 1994). This still amaze us but it may seems reasonable while nomads or several others tribes fully depended on oral tradition.

Therefore, like Brazilian street vendors (Civil, 2008; Nunes, Carraher & Schliemann, 1985; 1993; Saxe, 1988) or African traders and merchants (Posner, 1982; Zaslavsky, 1970a; 1970b; 1994) or India's market sellers (Bose &Subramaniam, 2011; Pilz, Uma & Venkatram, 2015) or many other children alike, the Roma pupils solve problems as if they were in their workplace relentlessly grounded in physical quantities generated throughout the solution processes within the certain situation (Carraher & Schliemann, 2002). They are able to calculate by doing mental computations without any need of paper and pencil and if they are obliged to use them, they merely write the final result (Lapat & Eret, 2013; Stathopoulou, 2003; Stathopoulou & Kalabasis, 2007). Below, we exemplify a range of certain paradigms of mental computations of Roma students to better understand the effective strategies used in sales or hypothetical situations of purchase.

Consider for example two children, one Brazilian street vendor and one Portuguese Romany pupil, who work in merchandising. Both of them do not use any form of writing. On the contrary, they express their thoughts verbally by means of either mental representation or of concrete objects. In the dialogues that follow, we can see that they carry out multiplications by repeated addition and transformation of initial quantity of money into more convenient numbers.

A Brazilian street vendor child:

Researcher: *I'll take 12 lemons* (one lemon is Cr$ 5.00).

Child: *10, 20, 30, 40, 50, 60* while separating out two lemons at a time (Nunes, Carraher & Schliemann, 1985).

Portuguese Romany child:

Researcher: *You sell the glasses to how much?*

Child: *They are about 15 euros, 10?*

Researcher: *If for example I asked you how much 5 glasses cost?*

Child: *How much?*

Researcher: *About 15 euros.*

Child: *A 15? I have to do 5 times 15, do not I?*

Yes it is… 15 and 15 makes 30, 30 and 30 ... 60

Researcher: *15 plus 15 ... 30 and 30*

Child: *60 ... 70 ... 75.*

Researcher: *75, yes sir, very well!* (Moreira & Pires, 2012; Pires, 2005; Pires & Moreira, 2005).

Another illustration which tries to depict the modus of a Romany student's thought on division but this time in the paper is presented in Figure 1. Here, we notice that in order to perform the calculation, the pupil began apportioning the unit digits by divisor 3, then moved to the tens and then to the hundreds (Moreira & Pires, 2012; Pires, 2005) and made the following entry in the notebook saying what is being transcribed below by Pires (2005):

Róg: *Put 3 for each side. Put 2 for each side. Put 1 on each side.*

Researcher: *What now?*

Róg: (After a pause answered) *Read «up».*

(And circled the result 123 in pencil)

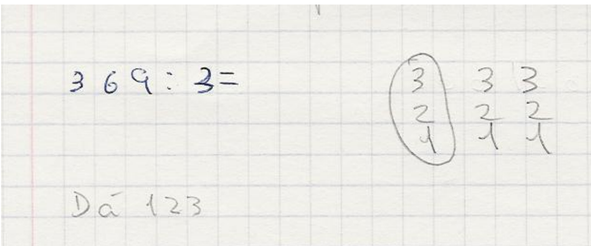

Figure 1

This resemblance may be distinct due to the exercise related to money exchange practices where they have been parallelisms with commercial activities taking an active part in the sale of the products, which gave them an immersion in contexts of mathematical activity and for that reason they are trusted with the family business (Moreira & Pires, 2012; Stathopoulou & Kalabasis, 2002; Stathopoulou & Moreira, 2013). Therefore, Roma children's predisposition to mathematics is detected through participating in those community practices and their parents' work (especially markets, fairs and street agoras), particularly resulting in a demonstration of agility towards mental calculus and memorization of a great amount of information from an early age (3-4 years old) (Moreira, 2007; Stathopoulou & Kalabasis, 2007).

b) Core disadvantages in school standard algorithms

In spite of their oral tradition and knowledge, they lack a written Romany language and arithmetic system as previously had been stated. This absence makes Roma students face **difficulties with symbolically expressed algorithms** usually displayed at classrooms (Lapat & Eret, 2013; Stathopoulou, 2003; Stathopoulou, 2004; Stathopoulou & Kalabasis, 2007) which solely derive from context free mathematical procedures such as computational tasks involving just operations with numbers. But when they are given the power and autonomy to perform their own strategies and algorithms mainly in conceptualized problems from everyday reality and in some cases to imaginary situations (word problems) like in textbooks included, they easily succeed in executing operations meaningfully (Bose & Subramaniam, 2011; Nunes, Carraher & Schliemann, 1985; 1993). Whenever a child mechanically completes an addition following the steps taught at school results in many errors and generally fails to perform any operation of addition, subtraction, multiplication or division properly. However, when embedded in a problem, they find a solution utilizing different strategies and more comprehensive ones. For instance, when a Romany pupil was asked to solve the following operation 25+25 vertically, he wrote 4010, even if he previously had answered correctly what the double of 25 was (Ferreira, 2003: cited in Moreira, 2007). Another instance refers to a time when a 1st year Greek classroom of Roma students were asked what the result of 5+3 was, they all paused without producing any answer, but right after the researcher's statement '*You have 5 hundred drachma* (the currency used before euro) *and your mother gives you 3 more.*' they replied "*8 Miss.*" (Stathopoulou & Kalabasis, 2002).

A further difficulty is traced in the writing deficiency of arithmetic number symbols where students habitually **are making place value errors in the written form but orally responding correctly** again (Bose & Subramaniam, 2011; Carraher & Schliemann, 2002; Jurdak & Shahin, 1999; Moreira, 2007; Nunes, Carraher & Schliemann, 1985; 1987; 1993). Researchers noticed several examples in which students take numbers as 'closed units' putting as many zeros as the value of ten, hundred and thousand demands. The above example from Ferreira (2003: cited in Moreira, 2007) depicts the child's thought of 4010 as '40' and '10' units. Likewise, another student who wrote 6005010 then read it 'six hundred fifty and ten more' and 'one hundred and seventy four' for the figure 10074 (Bose & Subramaniam, 2011).

Another remark of dissonance in mathematical teaching stands in the different magnitude of numbers used in daily process and in school exposed problems. It surprisingly appears to be strange to them if they have to compute with prices of items that do not reflect actual costs (Moreira, 2007; Stathopoulou & Kalabasis, 2002). In order to define the word strange we cite two examples of two researchers quoting some parts of the dialogues which took place in their study.

Researcher: *Tell me how much someone should pay for three pieces, seven euros and seventy five cents, each?*

C: *It does not exist. What a strange price! Ok. How many pieces?...* (Cadeia, 2006: cited in Stathopoulou & Moreira, 2013).

Researcher: *You have a 20 drachma coin and you want to buy a pencil that costs 11 drachmas and an eraser which costs 8 drachmas. How much change do you get?*

During the break K produced an answer on his own:

K: *Miss, we don't get anything.*

Researcher: *Why? How much do the two things cost?*

K: *19*

Researcher: *And we give 20….*

K: *Yes, they cost 19; we give 20 we don't have any change.* (Stathopoulou, 2003; Stathopoulou & Kalabasis, 2002).

In the first case, the student expressed her faultiness of having such a price and in the second case the other student confidently said he would not get any change back. Those statements ascertain a strong contextualization of their common occupation with transactions. Thus, it is quite understandable that it is not wise to work with such prices or to accept that frugal amount of money change; sometimes, it may be considered offensive as well, based on entrepreneurial spirit.

c) Informal acceptable strategies in arithmetic

Despite the above obstacles, students' mathematics learning within outside school settings seems to bear some characteristics. Firstly, it is usually mastered by **apprenticeship**, where the goal is to transfer the complex interrelated knowledge from an experienced adult or teenager to other children as a process of socially shared cognition that results in entering community practices (Lave, 1977; 1991). Furthermore, knowledge involves **elaboration in contextualized problems** upon which the problem solver has a certain degree of control over tasks and strategies. If they find any difficulty at a particular strategy, they abandon it without hesitation and quite as easy they desert a technique, they invent a new one that fits their comprehension model in order to complete the task (Civil, 2002).

By these means algorithmic procedures are easily forgotten and left aside because there is no connection to their apprehension. Instead, the main computational strategies are identified as follows: (a) ***decomposition*** mostly used through addition; (b) ***counting-up***, which is applied in subtraction; and (c) ***repeated grouping***, employed for multiplication. The first approach alludes to logic of a composed number that can be separated into units and carried out without changing the value of the number until the final result of addition. Those individual sums are interrelated with a coherent network of relationships into a whole which is much better summoned than isolated bits of numbers through mental actions (Jurdak & Shahin, 1999; Nunes, Carraher & Schliemann, 1985; 1987; 1993). This description is clarified by the following example:

Researcher: *I would like to take 5.5 kilos (4,000 lira/kilo) how much do I owe you?*

Al: *10 kilo for 4,000 lira, then 4 and 4 is 8, another 4 and 4 give* (pause) *8 and 8 is 16, then 16 and 4* (pause, thinking) *and 0.5 kilo for 2,000, hence 22,000 will be the cost of 5.5 kilos of garlic.* (Jurdak & Shahin, 1999)

The second tactic is performed by starting with the smaller addend and counted up to the larger one (Jurdak & Shahin, 1999; Nunes, Carraher & Schliemann, 1985; 1987; 1993;). An example for this rapid way of subtraction is displayed below:

Researcher: *O.K., there remains 9 cages and you have bought 14 cages, then how many have you sold?*

W: *9, 10, 11, 12, 13, 14, . . . then I sold 5*. (Jurdak & Shahin, 1999)

The third strategy of successive additions includes working with amounts equal to or larger than those exhibited to problems and conceals the property of distributivity. It is supported by the first idea of decomposition where convenient multiplication of the rearranged parts takes place till the last adding of the multiplied numbers (Jurdak & Shahin, 1999; Nunes, Carraher & Schliemann, 1985; 1987; 1993;). An illustration of such computation is already been exemplified above and we cite one more:

Researcher: *What is the cost of 4 kilos of cucumbers, at 1,250 lira per kilo?*

Ah: *4 kilos, say in 4,000 lira and then 4 of 250 lira makes 1,000 lira hence the answer is 5000 lira*. (Jurdak & Shahin, 1999)

Yet, the most oxymoron is that in their strategies and problem solving situations students use mathematics but they obtain a narrow perspective on what is and what counts as mathematics. **Much numeracy untangled in the head, leaving no visible evidence of math rather than common sense**. Therefore, they cannot distinguish the hidden mathematical ideas existing in such activities by connecting the concepts and skills of everyday life to school (Civil, 2002; Pattison, Rubin & Wright, 2016; Tomlin, Baker & Street, 2002).

As a result, many students drop out of school from an early age. They staff temporary occupations or family business and thus, lose the opportunity to work in the remunerative formal sector on account of their meager skills and education. Their informal training though highlights the utmost importance of knowledge transferred to them through observation, practice (learning by doing) and imitation which is considered far more important than an education certificate, since students feel they have learned everything needed to succeed and have acquired entrepreneurs' master status (Lapat & Eret, 2013; Pilz, Uma & Venkatram, 2015).

Chapter 3. Methodological Framework

The **aim of this study** is to investigate a) if the teachers utilize or not their previous mathematical knowledge, b) the difficulties Romany students cope with typical school mathematical acquisition, specifically in numeracy and problem solving activities, and c) what mathematics typical or non-typical they do finally apply.

The categories below resulted from the theoretical framework study. The bibliography used allowed us to become informed about the difficulties Roma children ran into, in the math class. At the same time though, we remain open to new evidence and other analytical categories that might have been emerged. So, three factors which prevent the solid development within typical school mathematical knowledge are:

- Language difficulties
  - Too many Romani dialects (Zachos, 2017), devaluation of those and clear monolingualism school policy (Kokkoni, 2017)
  - Lack of written Romany language and number system (Stathopoulou, 2003; Stathopoulou, 2004; Stathopoulou & Kalabasis, 2007)
  - Meager vocabulary and minimum repertoire for a large number of mathematical concepts (Bernstein, 1973; Jones, 2013; Stathopoulou, 2003)
  - Conduct of mathematical courses not in their mother tongue-no translation either (Bose & Choudhury, 2010; Cummins, 2008; Dragonas, 2012; Setati, 2005; 2008; Skourtou, xx)
  - Not familiar with mathematics terminology and conventions (Cuevas, 1984; Setati, 2008; Stylianidou & Biza, 2015)
- Conceptual and Procedural mathematical operation difficulties
  - Irrelevance of mathematical school problems with their everyday activities (Bose & Subramaniam, 2011; Jurdak & Shahin, 1999; Moreira, 2007;Nunes, Carraher & Schliemann, 1985; 1987; 1993; Stathopoulou, 2003; Stathopoulou, 2004; Stathopoulou & Kalabasis, 2002; 2007)
  - Lack of management and comprehension of symbolic representations (Bose & Subramaniam, 2011; Jurdak & Shahin, 1999; Lapat & Eret, 2013; Nunes, Carraher & Schliemann, 1985; 1987; 1993; Stathopoulou, 2003; Stathopoulou, 2004; Stathopoulou & Kalabasis, 2007;)
  - Use of "strange-extraordinary" numbers in word arithmetical problems that do not make any sense to them (Moreira, 2007; Stathopoulou, 2003; Stathopoulou & Kalabasis, 2002)
- Racially phenomena
  - practices
  - discourse

As it can be seen, <u>these categories in the posterior analysis have changed</u>. Nonetheless, we ought to elucidate that the current study seeks a variety of barriers that have already been traced from other researchers or not and how the teachers and the students themselves deal with them. We hope to add to the present state of knowledge without replicating existing studies (Iphofen, 2013) additional hidden obstacles or interpret them from a sociopolitical angle. In this way, there would be a different perspective in the situational context, which may show any change or not, leading to comparative or longitudinal analysis of existing data (Iphofen, 2013).

3.1 Research Questions

Our Research Questions were formed as follows:

a) ***Has diverse mathematical understanding of different sociocultural influences been leveraged as funds of knowledge or treated as barrier by teachers?***

b) ***If encountered as drawback, which obstacles, linguistic, math procedural or conceptual, racial practices and discourse or other, appear into mathematical classroom environment?***

c) ***Which mathematics eventually, school or preexisting math, do students prefer to use in numeracy and problem solving tasks and why?***

An additional Research Question emerged as an aftermath of the second Research Question but not studied is the following:

What are the consequences from each demonstrated hurdle in students' school mathematical achievement and how ethnomathematics posture could help answering in those?

That is given for future research in this particular field of ethnomathematics with closely associated topics of Roma or other marginalized groups.

3.2 Methods and Tools

The qualitative method used was an ***ethnographic perspective*** within mathematical educational settings (Eisenhart, 1988) because it created an open-ended research design to survey student's disposition or difficulties and teachers' management of those (Cohen, Manion & Morrison, 2007). In addition to this, we used a quantitative method for a small part of data analysis. The ***descriptive survey research*** (subjects measured once) was employed by statistical measurement to find out the central tendency (Muijs, 2004) of students' erratic attendance to school, the future ambitions of pupils, their treatment-behavior, their opinion about mathematics, the algorithmic computations and their preference in strategies, as well as their previous mathematical knowledge, the cultural relevance of school problems and language difficulties and management.

Our purpose though does not include an instruction of treatment implementation for better results to be achieved. It remains descriptive, analytical and interpretative.

As for the tools used, observation in classroom, open-ended interviews with students, and teachers, field notes and recording were selected. **Unstructured observation** was focused on the funds of knowledge of students and how teachers recognized or not the students' mathematical background, on the difficulties (discrimination, mathematical, language) children coped with and on what mathematics, formal or informal, they eventually preferred and used inside the classroom. We put ourselves in the shoes of the **observer-as-participant** and tried to document and record from a scientific distance all the above (Cohen, Manion & Morrison, 2007).

The main purpose of the interview was to test and develop hypothesis about the obstacles in typical mathematics, numeracy and problem solving comprehension and on top of that, what the repercussions would be of those according to knowledge and beliefs of students and teachers. The interviews were basically **semi-structured** (Cohen, Manion & Morrison, 2007, Sharma, 2013) and we established the following set of **open-ended** questions to pose to every respondent, however, with the freedom of extra reflective, unforced, explanatory ones. Also, the question format was direct to students and indirect to teachers so that teachers would be more likely to produce frank and open replies.

As far as **field notes** are concerned, we should mention that they were kept everywhere, at school, in classrooms, during breaks, outside school, and at any time during classroom observation and interviews. The **recording** though was restricted only to interviews of students and teachers because in classroom observations teachers felt uncomfortable, thus making us respect their desire.

Our key subject questions were emphasized into socio cultural settings dealing with the following: Roma's mathematical legacy and their differences from school mathematics, the difficulties which had been raised in those, certain experiences and relationships with the dominant culture, language and people.

Questions for students (in a more simplistic verbal form):

<u>For the 1st Research Question:</u>

Previous mathematical knowledge

- Has any teacher, anyone you had, ever asked you if you knew something before? Do the teachers ask you about your way of thinking when solving a problem? Before coming to school, did you know how to count or to execute operations, for example?

Cultural relevance

- Do you think the problems studied in class have anything to do with your interests? Would you like some problems to have references on subjects, acts and beliefs relating to your everyday life and culture?

<u>For the 2nd Research Question:</u>

Introduction

- Have you been attending this school for a long time? Do you like it here?

Treatment - Behavior

- What do you think of the school and the teachers? How do they behave in front of you? Do you have friends here; how do they treat you?

Opinion

- Which is your most favorite and the least favorite subject at school, and why? What do you think of mathematics? Do you understand it or is it hard for you?

Algorithmic computations – difficulties and differences

- Do you know how to count and to execute operations? Did you learn how to carry out calculations at school or somewhere else? Is your way of applying algorithms similar to that of school? Is it easier done with paper and pencil or in your head? Which way do you prefer? What confuses you in the school way?

Language – difficulties and management

- Is the language difficult for you? For example, when you deal with a mathematical word problem, can you understand it? Do you solve it easily or do you ask for help-from your teacher or your classmates? What is the reason you ask help for? Is it the unknown words-terminology, a further explanation, algorithms to choose or a procedure to carry out?
- Would you prefer some clarifications to be given in your language as well and not only in Greek? Do you have a large number of words at Romani concerning plenty of mathematical terms?

<u>For the 3rd Research Question:</u>

Future ambitions

- What does the school offer you? Will you continue your studies at school or will you choose to leave when you reach the permitted grade limit? Do you want to study later at a university? What profession would you prefer to practice?

Preference

- Which ways in mathematics eventually, school or yours, do you prefer to use and why?

Questions for teachers:

<u>For the 1st Research Question:</u>

Working experience

- How long have you been practicing the teacher’s job? Have you been teaching in many schools? Were there any Rom kids in any of the schools you attended?

Teaching approach

- How did you treat them, e .g didactically (easier tasks, extra help from others or from you, etc.), in space management (where do they sit or communicate, with whom, etc.)?
- How do you react or deal with them now and how did you use to react in the past? Has anything changed? Have you adopted a differentiated approach when teaching mathematics?

Previous mathematical knowledge

- Do students seem to have, in your opinion, any mathematical background or former informal knowledge from their outside school experience? Have you tested them? In what way? Does that affect your teaching? How? How do you use their knowledge? Can you give an example?

For the 2[st] Research Question:

Student profile

- How many Roma children do you have in your classroom and how many of them are registered? Do they attend on a regular basis? What is their attainment at school (at mathematics) in comparison with a middle non-Roma student? If it is low, what do you consider the main reasons to be?

Language - difficulties and management

- Are there any difficulties in language generally? What about the language of mathematics-the terminology, the symbols, the representations, the Greek language, the deductive reasoning? Give examples you may have noticed. What is that they do not understand and how do you deal with this? What are the consequences? Can you suggest any solutions?

Reasoning

- Can they use logical arguments or deductive reasoning to support their answers in problems? Can you give an example? Can they conceive the data and the relationships of those in a problem? How they manage the math symbols and their representations (in arithmetic problems for example)?

Parents - school relationship

- What is your interaction with Roma parents? Do you follow the same approach in liaising with Roma parents about their child's education as other ethnic groups, or do you resort to a different one? If different, how would you describe it? (Fremlova & Ureche, 2011). What is parents' attitude towards school? Does the school create the conditions needed to provide collaboration with the parents? Do they feel comfortable in the school grounds?

For the 3[st] Research Question:

Preference

- As long as algorithmic executions are concerned, have you noticed if they prefer mental computations and perhaps non-typical strategies, or written typical algorithms or the usage of hands and tangible materials? What is it that you personally prefer and what suggestions would you make and why? Have you convinced them? In what arguments or activities do you push them to?

Educational impacts

- What kind of inspirations do you have for these children, high or low? Do you believe that mathematics has always been considered to be an important asset for economic, social, etc. inclusion? Do you think that they are promoted to the next educational levels, like junior high school? If not, what do you think it is needed to reformulate in order to acquire the school required mathematical knowledge for the next educational levels? If you had the authority and any state benefits, how would you act, what would you change? How many of these Roma children do you think will manage to enter the higher educational institutions/universities or technical faculties?

- If a student wants to become a mathematical literacy citizen what mathematics do you believe he/she ought to master?

3.3 Data Collection

The selectivity was based upon non-probability sample targeting at a particular group of Roma students, where no attempts of generalization were desired. The segregated school (only consisted of Roma pupils) was located in a very deprived neighborhood in a city, in Thessaly's periphery. The sample constituted 3 teachers and 33 Romany pupils. Specifically, there were 7 girls and 8 boys from the 4^{th}grade, 4 girls and 6 boys from the 5^{th}grade, 1 girl and 6 boys from the 6^{th} grade and 1 extra boy from 2^{nd} grade (who participated only in an interview, as that what he wished to do). Basically, the students registered in class D were 21, in class E 24 and in class F 10, but 23 of them didn't show up to school.

In order to proceed with the study, it goes without saying that we took permission from the person in charge of primary education. Afterwards, we were given the approval from the school principle, from the students themselves, from the students' parents and from the 3 teachers who were the only ones who accepted to take part in our research (all the others presented a rejection towards participation).

Firstly, the observation accompanied with field notes had been carried out into those 3 classes during the lesson of mathematics for a period of 3 months (24/1/2018-30/4/2018), 4 days per week (totally 37 days) and up to 2 or 3 hours a day (totally 62 hours). The teachers were not comfortable as far as the recording of lessons is concerned, so we respected their wish and used that tool only in 15 minute interviews of 33 pupils and 45 minute interviews of those 3 teachers. The interviews were taken separately during school breaks or in the free time of the participants. There were also some informal observations and interviews-conversations that took place with small groups of children and some teachers.

3.4 Validity-Reliability and Ethical Issues

In the broadest context of qualitative research results, reliability and validity are not usually viewed extremely-separately as terms (Golafshani, 2003). The method used to support those principles was **triangulation** as you may see in the analysis below. So, there had been an engagement of multiple methods. We combined the Content analysis with the Grounded theory method to come up with a stratification of categories which showed to an extensive degree the resources used by teachers in respect of pupils' previous mathematical knowledge, the difficulties the children dealt inside the math class and the preference of formal or informal mathematics. Also, the tools employed, such as the observation of three mathematical classrooms, the interviews and the teachers and their students’ recordings as well as the field notes, were all inquiring those 3 aspects to correlate the data gathered, to control our possible biases and construct a reality (one of the many) exhibited in Figure 2 (Bernard, 2006; Golafshani, 2003; Noble & Smith, 2015).

As long as ethical issues are concerned, protection of anonymity, autonomy, wellbeing, safety and dignity of all research participants were ensured. Our judgments were as transparent as possible and independent of personal opinions or professional biases (Iphofen, 2013). We gained informed/conscious consent (for students we also took permission from their parents and the headmaster), guaranteed confidentiality and notified about the aims and the consequences of the research. Moreover, permission applications were distributed for validation to Department of Primary Education in local government and to school (Cohen, Manion & Morrison, 2007).

3.5 Data Analysis

For the analysis of the data selected, a combination of techniques of the **Content Analysis** (Stemler, 2015) and the **Grounded Theory** (Wiling, 2013) was employed, whereas for the identification and arrangement of the structure and content of the data a schema analysis was implemented (**Figure 2**) serving each Research Question and thematology. In addition, we utilized two methods to present the evidence, by ***issue*** and by ***instrument*** (and only in section C. we used also a third method by ***research question***), divided by themes resulted from the data and by each tool separated (Cohen, Manion & Morrison, 2007).

In section **A.** we analyzed the students’ interviews (with field notes) by 8 themes and their erratic attendance. Specifically, there were posed future ambitions (Table 1a), treatment-behavior (Table 1b), opinion (Table 2), algorithmic computations and preference (Table 3), previous mathematical knowledge (Table 4a), cultural relevance (Table 4b) and language difficulties and management (Tables 5a & 5b) (see Appendix, p. 139-160) which were summarized all in **Table S**, **Table SA**$_{\textbf{lgorithm}}$ and **Table SL**$_{\textbf{anguange}}$ (p. 47, 49 and 50). Here, we recapitulated descriptively the characteristics resulted from students’ interviews with the ***mean*** average of the data set that was organized in those ***frequency distribution Tables*** implementing for the statistical measurement the **Univariate Analysis** (one variable measured alone each time) (Muijs, 2004).

In section **B.** we analyzed the teachers’ interviews by 6 themes, in the aid of the development of an ***emergent coding system*** (Stemler, 2015). The basic themes were: 1) Didactical approach, 2) Difficulties, 3) Educational impact, 4) Previous mathematical knowledge, 5) Reasoning, 6) Preference (see **Table ST**$_{\textbf{eacher coding}}$, p. 54).

In section **C.** we analyzed the classroom observations (with field notes) by 3 themes related to the research questions (that section was exhibited also by ***research questions***) that were the funds of knowledge, the difficulties (discrimination phenomena, mathematical knowledge difficulties, language difficulties) and the typical or non-typical mathematical methods. Those themes had been displayed in the ***conceptually ordered networks*** ahead (see Diagrams A, B, C, D, E) made up of nodes (Walliman, 2011).

So, the correlated <u>theory (model)</u> (**Figure 2**) of concept categories formed in accordance with the <u>empirical (model)</u> elements and relationships (Stemler, 2015) rose from the unique details captured during fieldwork. The details were organized in a sequential and continuous procedure where ***data reduction*** within categorization took place in order to concentrate on the important aspects of the study and not to be lost in the massive amount of information (Walliman, 2011).

Figure 2

From a thorough point of view:

A. We built summarizing Tables of students' interviews measuring the central tendency of Roma's disposition and reflection in school mathematics and their erratic attendance by statistical mean (Muijs, 2004) with a narrative description of results. We end up in Table $SE_{rratic\text{-}Atendance}$ which keeps track of pupils' absences and in Table S, Table $SA_{lgorithm}$ and Table $SL_{anguange}$ which synopsize their answers in the interview questions. For further analytical details with excerpts of Rom pupils' responses see **Tables 1a, 1b, 2, 3, 4a, 4b, 5a** and **5b** in Appendix (p. 139-160).

Table SE$_{\textbf{rratic-Atendance}}$

Students/Absence	**Class D** (19 hours)	**Class E** (22 hours)	**Class F** (21 hours)
Prsk (female)	4/19 (21%)	-	-
Pic (female)	5/19 (26%)	-	-
Xru (female)	4/19 (24%)	-	-
Xval (female)	9/19 (47%)	-	-
E (female)	6/19 (32%)	-	-
M (female)	14/19 (74%)	-	-
Txou (female)	10/19 (53%)	-	-
Tap	6/19 (32%)	-	-
Tche	7/19 (37%)	-	-
N	5/19 (26%)	-	-
Than	9/19 (47%)	-	-
S	9/19 (47%)	-	-
Spe	9/19 (47%)	-	-
Tft	10/19 (53%)	-	-
F	15/19 (79%)	-	-
Tbl (female)	-	16/22 (73%)	-
Par (female)	-	8/22 (36%)	-
X (female)	-	9/22 (41%)	-
Ch (female)	-	6/22 (27%)	-
Ag	-	4/22 (18%)	-
Pj	-	6/22 (27%)	-
An	-	6/22 (27%)	-
Chri	-	9/22 (41%)	-
Ptw	-	5/22 (23%)	-
Val	-	17/22 (77%)	-
Pg (female)	-	-	9/21 (43%)
J*	-	-	11/21 (52%)
O	-	-	5/21 (24%)
L	-	-	4/21 (19%)
V*	-	-	13/21 (62%)
G	-	-	5/21 (24%)
T	-	-	2/21 (6%)
Partial Total	**122 (43%)**	**86 (39%)**	**49 (33%)**
Total		**257 (39%)**	

*Two kids J and V were absent so many times because of health problems and moved to another city after a while, respectively.

The **Table SE$_{\textbf{rratic-Atendance}}$** exhibits within the time period of 3 months, a relatively high erratic attendance of 32 Rom children of the 3 latest classes of primary school. As the classes grew bigger, the absence was lower but still perceptible and the number of students was also reduced. So, in 19 hours of observation of Class D, 43% of students were not present, in 22 hours of observation of Class E, 39% were not attending and in 21 hours of observation of Class F, 33% were not present. Altogether, the erratic attendance was up to 39%. At the same time from 15 students that were attending in Class D, the Class E was left with 10 and the Class F with 7 and the number of students officially registered in those classes was 5 to 10 greater (who never came apropos to school). The presence of girls had fallen dramatically since in Class F the analogy was 1 girl to 6 boys whereas in Class D was 7 girls to 8 boys.

For the **Table S**, initially we should clarify the beneath:

- Tables 1a and 1b satisfy the categories of 3rdand 2nd Research Question respectively referring to the perception that Rom students have in terms of school and its benefits and to how the others behave towards them.
  - The questions grouped and asked were the following:
    Qa= What do you think about school?
    Qb= What can school offer you?
    Qc= Do you want to study? (Table 1a)
    Qd= How do teachers treat you?
    Qe= How do students treat you? (Table 1b)
- Tables 2 and 3 refer to the category of 2nd Research Question which are about Mathematical Knowledge Difficulties and also refer to the 3rd Research Question about what mathematical practices they do prefer in and out of school.
  - The questions grouped and asked were the following:
    Qf= Which is your most favorite and the least favorite subject?
    Qg= What do you think of mathematics (easy-difficult)?
    Qh= What do you consider to be difficult for you (some examples)? (Table 2)
    Qi= What do you use more in operations, the paper or the mind, in and out of school?
    Qj= How do you apply the praxis in your mind-procedure (some examples)?
    Qk= What confuses you in the school way, in paper (an example)? (Table 3)
- Tables 4a and 4b serve the 1st Research Question about the possible or not possible usage of Rom’s Funds of Knowledge in the classroom by pushing teachers to become cognizant about their pupils’ previous experiences and integrate those into the mathematical problems.
  - The questions grouped and asked were the following:
    Ql= Have you known/learned something else before school (some examples)?
    Qm= Have the teachers ever asked you if you have already known anything (some examples)?

Qn= Do teachers ask you how you go about solving a problem (some examples)? (Table 4a)

Qo= Are the problems in class related to your interests and culture (some examples)?

Qp= Would you like to have some relation to those? Would it help you understand better? (Table 4b)

- Tables 5a and 5b respond to the category of 2nd Research Question about Language Difficulties within the formal written Greek in word problems, the transition and flexibility between their mother tongue and instruction language.
  - The questions grouped and asked were the following:

Qq= Is the Greek language easy or difficult and why?

Qr= Would you like to have a translator?

Qs= Are there many words in Romany (terminology) related to mathematics? (Table 5a)

Qt= When you do not understand words (mathematical/everyday) or the whole problem or what operation to choose in a problem do you ask for clarifications?

Qu= From whom (teacher or students) and in what language is more useful (Greek or Romani) to hear the explanations? (Table 5b)

Now, the Tables S, $SL_{anguage}$ and $SA_{lgorithm}$ are presented with the analysis attached.

Table S

Questions/Answers	Positive	Negative	Other*	No Response
Qa	33/33 (100%)	0	0	0
Qb	32/33 (97%)	0	0	1/33 (3%)
Qc	31/33 (94%)	1/33 (3%)	1/33 (3%)	0
Qd	26/33 (79%)	7/33 (21%)	0	0
Qe	24/33 (73%)	1/33 (3%)	7/33 (21%)	1/33 (3%)
Qf	20/33 (61%)	7/33 (21%)	6/33 (18%)	0
Qg	13/33 (40%)	14/33 (42%)	6/33 (18%)	0
Ql	27/33 (82%)	6/33 (18%)	0	0
Qm	6/33 (18%)	24/33 (73%)	1/33 (3%)	2/33 (6%)
Qn	8/33 (24%)	20/33 (61%)	3/33 (9%)	2/33 (6%)
Qo	7/33 (21%)	25/33 (76%)	0	1/33 (3%)
Qp	24/33 (73%)	2/33 (6%)	0	7/33 (21%)
Qq	23/33 (70%)	6/33 (18%)	4/33 (12%)	0
Qr	27/33 (82%)	5/33 (15%)	0	1/33 (3%)
Qs	0	33/33 (100%)	0	0
Total	61%	30%	6%	3%

*Other means: for Qc and Qe "*both good and bad*", for Qf "*other subjects besides math*", for Qg and Qq "*both easy and difficult*", for Qm and Qn "*don't know*".

By looking the Table S vertically, it is distinguishable that more than half (61%) have a positive stance towards school and mathematics. Almost 1/3 (30%) of pupils have negative thoughts, whereas a small number (6%) are not sure or do not know and only a 3% did not respond or the question did not address to each one of them.

Now, in a more thorough analysis, by looking every Question on the Table S horizontally, it is firstly discernible that all students like school (Qa-100%) and believe there is so much to gain from this (Qb-97%). The majority (Qc-94%) wants to study besides the 1 who does not know yet and another one who clearly said that wanted to stay home after finishing high school. The professions they formulate are accountants (8), police officers (7), hairdressers (6), athletes (3), lawyers (2), doctors (1), mechanics (1), teachers (1) or whatever their family decides (2).

The teachers (Qd-79%) and their classmates or other students (Qe-73%) treat them well with a small percentage (Qd-Qe-21%) of teachers treating them badly whereas students treat them in a neutral way.

As far as mathematics is concerned, a satisfying number of children (Qf-61%) find it favorable, with 18% keeping a neutral stance and 21% having negative disposition to it. However, almost half of them (Qg-42%) finds it difficult to handle a subject while another 40% find it easy, where 18% find it both, easy and hard.

Many students (Ql-82%) even before entering school maintained that they had learnt from their fathers, mothers, older siblings and by observing. In addition, they learnt on their own how to count (others until 10 and 20, others until 30 and 50 and some others until 100), to execute operations and manipulate money exchanges at their family work. Only 18% said that they hadn't known anything before attending 1stgrade. Nevertheless, a disappointing 73% (Qm) and 61% (Qn) of teachers did not pose any questions to their Rom students that were relevant to the fact that they had already known something or on how they went about solving a problem, respectively. Just 18% (Qm) and 24% (Qn) could recall related questions and even fewer announced some examples which concentrated mostly on procedural knowledge. Some of the questions they could recall are: Did you know that?, Do you know division, subtraction, addition?, Do you know mathematics? (Qm) – Do you know this? How did you find it (algorithm)?, How do you do this subtraction?, How do you solve the problem (what operation is applied)? (Qn).

Students (Qo-76%) also expressed that the math problems presented to them in the class were not related to their interests and culture and they (Qp-73%) would like to have some relation to their hobbies, work, customs and everyday reality. Only 7 (Qo-21%) stated that school math problems were referred to some of those but with almost no example framed.

Although many pupils (Qq-70%) think Greek language is easy to speak, communicate and read, 82% (Qr) they would like to have a translator in order to understand more explicitly the meaning of the math problems .Few of them (Qr-15%) said there is no need for such person because on the one hand, if he/she is not Roma then he/she could not help them as none non-Roma knows Romani and on the other hand, they could ask their Rom classmates to explain the problems in their lingua. It is also noticeable that all of them (Qs-100%) with no exception, could not recall any mathematical term in their language besides the names of the numbers and some of them declare that Roma people do not know or apply any form of mathematics. Their language is not static since they adapt words and phrases they need from foreign locutions and as a result, their dialect evolves into a mixture of different origins of words. So many words and mathematical terms, like numeracy, fractions, addition, subtraction, multiplication, division, decimal numbers, geometry, etc. come from Greek as long as their homeland is Greece.

For analytical details of the above see **Tables 1a, 1b, 2, 4a, 4b** and **5a** in Appendix p. 139-157.

Table SLanguage

Answers/Questions	Qt	Qu
No understanding of mathematical or general words	30/33 (91%)	-
No understanding of the whole problem	26/33 (79%)	-
Do not know what operation to apply	29/33 (88%)	-
Ask clarifications from teachers	-	20/33 (61%)
Ask clarifications from children	-	7/33 (21%)
Prefer explanations in Romani	-	25/33 (76%)
Prefer explanations in Greek	-	2/33 (6%)
Total	86%	-

The majority of children (86%) presented language difficulties in every problem with sapient words and syntax (see further analysis in Language Difficulties, p. 97). Actually 30 pupils affirmed that have trouble with understanding the meaning of words in a problem. Basically, 9 pupils do not understand mathematical related words, another 9 the general/everyday words and 12 both of them (see analytically in Table 5b, Appendix p. 157). Furthermore, 79% do not understand the whole problem while reading it and 88% said that could not figure out what operation to apply to solve it.

So, it is obvious that 82% ask for clarifications, 61% from teachers and 21% from their classmates, because they think teachers as prototypes are more trustful in explaining any questions adequately, correctly and more sophisticated than students who might not know either. Nonetheless, 76% prefer to hear the exegesis in Romani where no non-Roma knows their unwritten dialect (see analytically in Table 5b, Appendix p. 157).

Table SA$_{\textbf{lgorithm}}$

Answers/Questions	Qi	Qj	Qk	Qh
Paper	1/33 (3%)	-	-	-
Mind	9/33 (27%)	-	-	-
Paper and mind	10/33 (30%)	-	-	-
Fingers	8/33 (24%)	-	-	-
Mind and fingers	5/33 (15%)	-	-	-
Apply typical algorithms on paper	-	2/33 (6%)	-	-
Apply counting with finger	-	10/33 (30%)	-	-
Apply mind procedures	-	19/33 (58%)	-	-
Difficulties in typical algorithms	-	-	27/33 (82%)	-
No difficulties in typical algorithms	-	-	3/33 (9%)	-
Difficulties in mathematics	-	-	-	30/33 (91%)
Total	-	-	-	-

Only 1 to 2 students chose to apply written algorithms whereas more than half (58%) chose mind procedures. Particularly, it has been recorded that their main strategies are regrouping for addition, repeated addition for multiplication, counting downwards or upwards for subtraction, memorizing standard sums and quick estimations (see analytically in Table 3, Appendix p. 146). Some use mental strategies in combination with paper (30%) or with their fingers (15%) in order to keep track of the procedure.

The use of hands and tangible materials are popular to pupils from the smallest grades, in our case 8 students from Class D. It was also noticed that 6 out of 12 girls (50%) utilized exclusively their hands in comparison with 2 out of 21 boys (9,5%).Or 3 out of 12 girls (25%) employed both their fingers and mind (in bigger classes) in contrast of 2 out of 21 boys (9,5%).

The majority of the students (91%) exhibited difficulties in mathematics. Some of them stated that they were feeling discomfort standing on the whiteboard or feeling bored and confused copying from the whiteboard and others did not understand words and representations (see analytically in Table 2, Appendix p. 143). But most of them, (82%) declared that they were having trouble with typical algorithms. Specifically, they announced that they mixed the symbols, forgot or did not understand the steps/sequence of the algorithm, made place value errors and coped uncritically from the whiteboard (see analytically in Table 3, Appendix p. 146).

B. We also built a summarizing coding Table of teachers' interviews (**Table ST$_{\textbf{eacher coding}}$**) with the main elements resulting from their answers to the interviewer questions (p. 38). Further analytical details of whole excerpts of the interviews, you could find in **Table ST$_{\textbf{eacher}}$** in Appendix (p. 161). The 6 categories presented were created from the answers given on the teachers' part.

As the teachers stated in interviews, we conclude the following:

1) Didactical Approach

a. The ***Mathematical teaching design*** towards Rom students was characterized by:

- Lower grade level mathematical concepts and materials, e g math books of 2nd grade for 4th graders, of 3rd grade for 6th graders and of other materials
- Simpler, easier and lesser math exercises (also in the form of game) – no exercises at home
- Many examples, repetitions and explanations of problems and words
- Main focus in students' linguistic performance (explaining their reasoning at Greek using sufficient vocabulary and grammatically correct sentences)
- First let them work mentally and then in written form (teachers stated that but the observation showed the opposite)

2) Difficulties

b. Their ***Level of attainment*** in mathematics was low regarding their supposed grade level or middle regarding the grade level being taught in accordance with a middle non-Roma student. The reasons for this particularly poor attainment were attributed to the following:

- Never do their homework
- Have erratic attendance
- Deal more with parents' neglect rather than their illiteracy
- Live in poverty "*first comes the survival and then the education*"
- Get tired easily
- Have the Greek language as second language

- And the school is also to blame

d. In the official ***Language and terminology*** of mathematics there were difficulties, for example, a lot of unknown words and no comprehension of the meaning of the math problems due to the use of Romani language at home and to the difficult vocabulary and syntax of the problems in books.

j. The Roma pupils are definitely not ***promoted prepared*** to the next educational levels. This fact is undeniable. Again the teachers in higher classes until high school treat them differently by assigning easier exercises and providing them with manageable kind of materials. Additionally, the examining system is easier and the criteria for entering universities or other technical faculties are lower.

m. The ***Interaction with parents*** was not satisfactory. Generally speaking, the Roma parents did not feel comfortable in school boundaries, did not seem willing to cooperate and did not display any kind of interest to be informed about their children's progress. Furthermore, they were unaware of who was the educator of their kinds, being totally indifferent towards it, and apparently they had a negative attitude towards school, with the exception of some individual instances. Over the years, however, there has been a tendency towards adopting new stances and some tend to have set high standards and take great pride in their offsprings' education. Yet, there is a long way to go, since they are deprived of maturity and experience to evaluate school's educational targets.

o. The two female teachers have manifested a ***Gender bias*** against girls' mathematical ability due to a natural inferiority or to their unfamiliarity of their parents' occupation which triggers the mathematical learning.

3) Educational impact

c. Their ***Ambitions/Inspirations*** for Rom kids were almost fruitless, having Roma pupils simply moving on to the junior high school or even get a high school diploma and later find a job as junk dealers and street sellers away from the prototypes used and finally, ending up not getting married so early.

i. Educators believe that ***Mathematics is a great asset*** in every sector as it is common knowledge that it is considered to be a value of being smart/having a mathematical mind along with the fact that it is the prerequisite for economic and social inclusion,

k. The teachers associated with the ***Reformulation need*** would apply the law of compulsory education and their penalties in case any Roma parent did not confront with it in order to eradicate the erratic attendance and get all children learn the simple mathematical concepts from kindergarten in a smooth way (that stands as a contradiction though, because earlier above they stated that Rom kids had already known more synthesized mathematical elements in informal framework). Moreover, they would make school books for gypsies (as there have already been written but perhaps many teachers are being uninformed) filled with the style and culture of

Roma and would educate the Roma parents by means of different programs (as this had also happened before).

l. No one could E***nter universities or technical faculties*** according to the official, typical standards or the Greek national system of exams. Approximately, 7 out of 32 could make it, aided with the specialized exams.

n. For a Rom student to become a ***Mathematical literate citizen***, they should conquer the mathematics taught in school, everything from the start till the end of school years or at least the mathematical knowledge of primary school or mere the 4 praxes and the understanding of the problems of the 4 praxes.

4) Previous mathematical knowledge

e) According to ***Mathematical background***, they are cognizant to the fact that Rom children from an early age are occupied in their parents' jobs mainly in merchandising. By observation and their experience, they believe that these children acquire a kind of informal mathematical knowledge. Before their entrance to school, they know to count till 100, to do mental computations up to 2 digits numbers and to solve problems empirically.

5) Reasoning

f. The majority of students can use ***Logical arguments*** to support their answers and solutions to problems with empirically examples of everyday reality.

g. They grasp the ***data*** presented in a problem and their ***relationships***, but most of them need help by explanation and reformulation of it into simpler forms.

6) Preference

h. The students' preference of ***Algorithmic computations*** is clearly the mental way, as it is else being called the Chinese (grocer-bacalica) mathematics and also their hands. The teachers are suggesting and are promoting the typical written algorithms but by the means of mental thought and hand tangibles.

Table STeacher coding

Main Elements/Code Answers	Teacher G	Teacher A	Teacher E	Teachers' main elements of thought
a. Mathematical teaching design	16t, 18t, 24t, 60t, 86t, 102t	151t, 153t, 159t, 183t, 185t, 197t, 227t, 229t	286t, 292t, 294t, 320t, 3246t, 359t, 361t	Lower grade level, easier exercises, many examples, repetitions and explanations, concentrated on Greek language, first work mentally then written
b. Level of attainment	40t, 42t, 46t, 48t, 96t	171t, 173t, 175t, 177t, 179t, 181t	304t, 306t, 308t, 310t, 312t	Low because of: no homework, erratic attendance, parents' neglect rather than illiteracy, poverty, get tired easily, Greek language as second, the school
c. Ambitions/ Inspirations	34t, 36t	165t	298t	Reach until high or junior high school diploma
d. Language and terminology	52t, 56t, 58t	187t, 191t, 193t, 207t	322t, 324t, 328t	Obstacles: unknown words, difficult vocabulary and syntax
e. Mathematical background	98t, 100t	223t, 225t	351t, 355t	Occupied in parents' jobs-merchandising, able to count, to do mental computations and to solve problems empirically.
f. Logical argumentation	66t, 70t, 72t, 76t	169t, 203t	330t, 332t	Use of logical arguments to support their answers empirically with examples
g. Relationships/ data understanding	78t, 80t	205t	334t	Grasp the relationships of the data, but need explanation
h. Algorithmic computations	44t, 88t, 92t, 94t	209t, 211t, 213t, 219t	338t, 340t, 342t, 344t, 346t, 349t	Students prefer mental computations/teachers suggest typical written algorithms
i. Mathematics as important asset	106t	231t	365t, 367t	Important for every sector, offers economic and social inclusion
j. Promoted prepared	108t	235t, 237t	369t	They are not promoted prepared to the next educational levels
k. Reformulation need	110t, 112t, 114t, 116t	239t, 241t, 243t, 245t, 247t, 249t	371t, 373t	Teachers would apply the law of compulsory education, make school books for gypsies and educate the Roma parents
l. Entrance in universities/techn ical faculties	122t	225t, 263t, 265t	375t	No one with standardized exams, only few with specialized exams
m. Interaction with parents	126t, 128t, 130t, 132t, 136t	257t, 529t, 261t, 267t	377t, 379t, 381t, 387t, 389t, 391t	The Rom parents didn't feel comfortable in school, didn't cooperate, but over the years, they have changed their attitude
n. Mathematic literacy citizen	140t	271t	393t	Should conquer the mathematics taught in school
o. Gender bias		163t, 185t, 195t, 217t	308t	Teachers manifested a racist bias against girls' mathematical ability

C. We are moving onto the process of students' and teachers' observation material from the math classes D, E and F accompanied by field notes (only in a few cases we used students' statements and explanations from their interviews as paradigms). In every Research Question there would be a diagrammatic representation showing the dimensions of each theme and later the documentation organized under those pillars.

Before exhibiting the interpretation of the data we should mention that the procedure was continued until the devised subgroups could not add further details in the understanding of the category of the 1^{st}dimension and could not risk leading into collateral synthesized units. It reached till 5^{th}dimension and in few cases till 6^{th}dimension, where theoretical saturation (Wiling, 2013) in our opinion had been achieved.

Specifically, we did not count on a particular theory in the first place, but all the way through we used the data under investigation in cohesion with relative researches and theories in order to develop a suitable scheme analysis which tends to look at multiple variables. The method of content analysis guided us to the categorization of the 1^{st} dimension whilst later, on the other dimension, the formation was not predetermined so the method of grounded theory took place.

- The **1^{st}dimension**-Content Analysis

At this point the categories: previous informal mathematical knowledge (1^{st} Research Question), discrimination phenomena, mathematical knowledge difficulties and language difficulties (2^{nd} Research Question) and Formal-Informal mathematics (3^{rd} Research Question), were assembled. When the data from interviews and observation field notes were detected through depth readings, they were placed in those groups.

- The **2^{nd}**, **3^{rd}**, **4^{th}** and so on **dimensions**-Grounded Theory

After the 1^{st}dimension had set the outline of analysis, all the subcategories were emerged from the data which constantly evolved throughout the research process. At this point, the coding of wording started, acting and writing from which numerous examples had been arisen.

Below, in the categories required, we mentioned the classes **[D, E, F]** in which the examples presented thoroughly in the extensive analysis later were distinguished. We elucidate that even if there hadn't been given examples from all classes in every subgroup that doesn't mean though that there weren't manifested mostly to all 3 of them. Also, it would be necessary to clarify that the examples were given only to the last dimension of each branch. For example, if teacher' actions (2^{nd} dimension) steered to focusing actions (3^{rd} dimension) and then to perception of diverse strategies (4^{th} dimension) in order to end up in confirmation (5^{th} dimension) or rejection (5^{th} dimension), then the paradigms would be present into the 5^{th} dimension since they already belong to the previous categories. It would be the same if the analysis had been reached until the 3^{rd} dimension-the last, so the paradigm would have only appeared in this 3^{rd} dimension analysis.

The **Diagram A** (p. 64) has been constructed for the 1st Research Question, the **Diagrams B** (p. 77), **C** (p. 87) and **D** (p. 97) for the 2nd Research Question and the **Diagram E** (p. 109) for the 3rd Research Question.

Briefly, we are now presenting all dimensions acknowledged in the study under each Research Question towards process and different aspects.

1st Research Question:

- Firstly, in P***revious informal mathematical knowledge*** (1st dimension) we distinguished the ***Teachers' actions*** (2nd dimension) by their process of didactical approaches and within the aspect of how they acted or talked towards their students' previous mastery of informal mathematics.
- It was noticed that the teachers were using:

  Redirecting actions (3rd dimension) e.g. steering students into typical ways
  Progressing actions (3rd dimension) e.g. the need of teachers to complete a task and move quickly forward
  Focusing actions (3rd dimension) e.g. looking into details or maybe reasons behind an answer or idea of a student
- In greater depth the Redirecting actions were divided in:

  Compulsive adaptation of typical ways (4th dimension) e.g. advising their pupils to deal with the typical agenda of school centered approaches
  Giving hints (4th dimension) e.g. revealing the actions necessary to proceed in a problem [D, E, F]
  Tabula rasa (4th dimension) e.g. treating their students as an "unwritten board", with no previous knowledge or experiences [F]

  Also the Progressing actions were divided in:

  Demonstrating strategies/solutions (4th dimension) e.g. without giving children the space or time to unfold their own strategies or solutions [D, F]
  Example-repetition-explanation (4th dimension) e.g. giving examples by explaining the problem and by repeating the data of the problem many times.
  Simpler exercises (4th dimension) e.g. assigning to pupils the simplest exercises.

  And the Focusing actions were divided in:

  Perception of diverse strategies (4th dimension) e.g. were cognizant of their students' versatile mathematical knowledge.
- Later the Compulsive adaptation of typical ways was split in:

  Order of abandoning previous strategies (5th dimension) e.g. impelling students to make use of written algorithmic operations vertically [E, F]

Mololateral guidance (5th dimension) e.g. were not trying to give different solutions, answers and tactics [D, E]

Also the Simpler exercises were split in:

Apply similar easy tasks (5th dimension) e.g. assigning similar tasks with different data [D, E]
Apply lower grade level tasks (5th dimension) e.g. assigning tasks of 2nd grade to 4th graders [D, E, F]

And the Perception of diverse strategies was split in:

Enlighten details/Confirmation (5th dimension) e.g. exploring the details of pupils' answers
Rejection (5th dimension) e.g. rejecting students' strategies [D, F]

- Finally, the Enlighten details/Confirmation was split in:

  Utilization (6th dimension) e.g. letting them work first mentally and then passing on other new forms of solutions [D, F]
  Reward (6th dimension) e.g. appreciating students' solutions with compliment [D]

(see **Diagram A**, p. 64)

  All the above generally were observed in all 3 classes but not to the same degree.

<u>2ndResearch Question:</u>

- At first, the **Difficulties** (0 dimension) were categorized in **Phenomena of discrimination** (1st dimension), **Mathematical knowledge difficulties** (1st dimension) and **Language difficulties** (1st dimension).

- In order to render the Phenomena of discrimination more obvious, we searched into **Practices and discourse** (1st dimension) of teachers and students inside the mathematical classroom which allowed us to distinguish 3 <u>interlocking positions</u>:

  The **Race** (2nd dimension) referring to unfair treatment towards Rom students because of constructed phenotypical traits
  The **Gender** (2nd dimension) referring to characteristics depending on the context of sex-based social structures
  The **Social class** (2nd dimension) referring to subjective models of social stratification in which people position other people into a chain of hierarchy within the aspect of <u>social constructions-interrelated axes among diverse group experiences</u>.

- In each three constructions a predisposition was noticed of:

  Comments (3rddimension) towards race, e.g. teachers generally felt comfortable reprimanding the Roma children

Inequality bias (3rd dimension) towards gender, e.g. teachers believed that girls lagged behind boys in mathematics
Lower aspirations (3rd dimension) towards social class, e.g. teachers would be pleased if Roma kids would reach junior high school [D, E, F]

- Further the assault was split in:

  Physical (4th dimension) e.g. specific kids had been thrown out of class [D]
  Verbal (4th dimension) e.g. teachers threatened some kids that they would call their parents because of disobedience [D, E]

  And the inequality bias was detected by:

  Negligence (4th dimension) e.g. girls had not acquired the same attention span as boys
  Resistance (4th dimension) e.g. some girls resisted towards teachers' attitude either by complaining or by not cooperating [D, E]
  Perception of weakness (4th dimension) e g. teachers were fallen into the myth of male superiority in mathematics

- Next the neglect of girls was divided in:

  Disapproval of involvement (5th dimension) e.g. teachers were not asking girls to participate in mathematics discussion as much as boys [D]
  No help (5th dimension) e.g. girls always were not taking the help of teachers when requested [D]
  No equally challenging tasks (5th dimension) e.g. teachers were assigning exercises into simpler forms for girls [D, E, F]

  And the perception of weakness was exhibited from:

  Teachers (5th dimension) e.g. "*the Roma boys are one level above-higher than the Roma girls and besides, that is also the case with the Greek students, always the boys get ahead in mathematics*"[E]
  Boys (5th dimension) e.g. "*You have a teacher next to you and still you know nothing*", "*Sir let me do it, she doesn't know!*", "*I will tell her, Mrs.*" [D, E]

  (see **Diagram B**, p. 77)

  In all classes, there was a gender bias against girls' mathematical ability as well as lower aspirations from teachers due to the social class of Roma. Only in D class, a pretty strong racist behavior/activity was displayed.

- In order to make clear the **Mathematical knowledge difficulties** (1st dimension) of Rom kids, we tried to make the process of **<u>Conceptual</u> difficulties** explicit (2nd dimension) and **<u>Procedural</u> difficulties** (2nd dimension) within the aspect of <u>mistakes evaluation and miscomprehension of knowledge principles and strategies</u>.
- It was discerned in conceptual difficulties that kids were dealing with:

No clear comprehension of mathematical ideas (3^{rd} dimension) e.g. no understanding of numeracy and fractions
Relations (3^{rd} dimension) e.g. no comprehension of the data of problems
Operations (3^{rd} dimension) e.g. had false assumptions about place value

And in procedural difficulties they were dealing with:

Mistakes in typical algorithms (3^{rd} dimension) e.g. did not know at all the series of steps needed in 4 major operations
Not adequate interiorized actions in solving a problem (3^{rd} dimension) e.g. using unmethodical attempts when solving problems

- More thoroughly, the Relations were separated into:

Incoherence in word problems (4^{th} dimension) e.g. did not pay attention to the relevance of the context and the numerical data
Decimal representation of fractions and vice versa (4^{th} dimension) e.g. difficulty in transferring 3/10 to 0.3 [F]
Comparisons (4^{th} dimension) e.g. had trouble with comparing numbers on the number line

Also the operations were separated into:

Place value (4^{th} dimension) e.g. had difficulties in the realization of groups of tens, hundreds, etc. [E, D, F]
Order/Cardinality (4^{th} dimension) e.g. they wrote twenty five as "*52*" [D]

Further mistakes in typical algorithms were due to:

Not familiar with the procedures (4^{th} dimension) e.g. did not know or did not remember how to begin to execute an operation [D, E, F]
4 praxes (4^{th} dimension) e.g. students' solutions in typical written algorithms were inaccurate-false

The inadequate interiorized actions in solving a problem were being tackled:

By chance (4^{th} dimension) e.g. they were choosing a method haphazardly [E, D, F]
Waiting for teachers' guidelines (4^{th} dimension) e.g. the answers were directly told by the teacher [E]

- More closely, the incoherence in word problems was discerned in:

Irrelevance of numerical data (5^{th} dimension) e.g. "*No…, to tell the truth, I would have thought if the numbers were too big I would do subtraction while if they were small I would add them*" [E]

Extraordinary numbers (5^{th} dimension) e.g. "*But Mrs. is the price of the coat always that much?* [E]
Disconnection of concepts (5^{th} dimension) e.g.

T: "One, two, three … nine (enumeration).*Nine and nine eighteen and nine 21… no, 27.*

R: *That's right. In other words, you can say three times nine… 3 times 9 is the same as 9 and 9 and 9 as you did.* [D, F]

Also in comparisons difficulties were spotted in:

Number lines (5th dimension) e .g. could not set the numbers in the right order from the smallest to the biggest numbers [F]
Quantities (5th dimension) e.g. in a picture of two 20cents and one of 2cents, a pupil read the coin of 2cents as 20cents and found 60 cents instead of 42cents [F]

And in the 4 praxes, mistakes were seen:

With natural numbers (5th dimension) e.g. they were used in the carrying-lending digits method in addition, subtraction and multiplication but systematically had forgotten or mixed the digits [D, E, F]
With decimal numbers (5th dimension) e.g. they systematically had forgotten or mixed the digits before and after the decimal point [E]

(see **Diagram C**, p. 87)

In all classes, it was observed that the pupils could not fully understand the mathematical ideas that they were working on and the relations in word problems. They solved them by chance or waiting for the teachers' solutions. All of them, made place value mistakes or mistakes in typical algorithms. Further difficulties were presented in order/cardinality but only in the smallest grade D and in representation of fractions in class F as they had only been taught that idea in the last grade.

- In the **Language difficulties** (1st dimension) we spotted that children had linguistic problems in second language proficiency acquisition which were obvious from 3 aspects:

  Linguistic structure in word problems (2nd dimension) e.g. features that may have significant impact on language translation and code switching
  Mathematical symbolization (2nd dimension) e.g. they confused or completely forgot the symbols
  Discursive form (2nd dimension) e.g. the interpretation of mathematical objects within dialogues and body moves were obvious

- Obstacles were noticed in linguistic structure dealing with word problems where the kids exactly had trouble specifically with:

  Lexical comprehension (3rd dimension) e.g. referring to difficulties in understanding lexical items in Greek
  Syntactic (3rd dimension) e.g. passive voice, superfluous phrases
  Semantic (3rd dimension) e.g. the meaning that students had been ascribing to the whole word problem or to isolated words

Cultural (3^{rd} dimension) e.g. teachers followed the book structure which had not particular references to their culture

Also in mathematical symbolization students couldn't handle:

Representation (3^{rd} dimension) e.g. a pupil wrote 6=6 instead of 6+6
Transformation (3^{rd} dimension) e.g.in the question "*how do we call this operation (-)?*" some students timidly answered: "*it is the and-plus (+) and the equal (=)*".

And in discursive form pupils interchanged between the two languages:

Romani (3^{rd} dimension) e.g. all students used their first language many times inside the mathematics classroom
Official-Greek language (3^{rd} dimension) e.g. dominance of monolingualism

- To a great extend the lexical comprehension was distinguished into:

Mishearing a lexical element (4^{th} dimension) e.g. students perceived one or more phonetic/phonemic feature differently [E, F]
Morphosyntaxic complexity (4^{th} dimension) e.g. complex utterances like the ending of a verb

Also in syntactic we noticed:

Comparative construction (4^{th} dimension) e.g. expressions or words with the meaning of comparative assumptions indicating minimum, maximum or in between [D, E, F]
Complex negatives (4^{th} dimension) e.g. phrases with connotations regarding double negations or negatives combined with comparatives-no more than
Specialized vocabulary in mathematics (4^{th} dimension) e.g. any word or phrase that has a particular meaning in mathematics is usually unknown to them [D, E, F]

Furthermore, in semantic structure we pinpointed some misunderstandings in:

Homophonic words with other meaning (4^{th} dimension) e.g. the word peasant (=yeoryos) it doesn't mean the name George (=Yioryos) as they had thought [E]
Unfamiliar contextual references (4^{th} dimension) e.g. words that are not used on a daily basis but they are rather technical or scientific and as a result unfamiliar to them [D, E, F]

In addition, in cultural features we noticed:

Local colloquial usages (4^{th} dimension) e.g. the problems were stretched with formal morphology usages, in which children were not used to such conventionalized terms
Reference to specific culture (4^{th} dimension) e.g. the context of the problems was out of their habits and interests

In Romani, we discerned pupils utilized:

Inner speech (4h dimension) e.g. they were trying to translate Greek to Romani in order to grasp as many details as possible
Offer explanation (4th dimension) e.g.to each other or to teachers every time they were asked

In official-Greek language they had:

Minimum proficiency in both languages (4th dimension) e.g. in mathematical terms Romani tend to be forgotten and replaced by other languages
No translation to their language (4th dimension) e.g. no transition classes

- More specifically children offer explanations:

  In Greek or Romani (5th dimension) e.g. they preferred to give an explanation to their classmates in Romani
  With gestures and deictic moves (5th dimension) e.g. "*That with one line!*" (subtraction) [E. F]

  Also there is no translation to their language because of:

  Teachers not familiar with Romani (5th dimension)
  No written code (5th dimension)

- In Greek or Romani explanations were:

  Acceptable or not by teachers-when (6th dimension) e.g. they enforced pupils to practice the official language inside classroom [D, F]

(see **Diagram D**, p. 97)

Generally, children from all classes exhibited difficulties in linguistic structure of word problems due to lexical, syntactic, semantic and cultural features, as well as in symbolic representation or transformation and in mathematical discourse expressed in Greek.

3rd Research Question:

- In the **Formal-Informal mathematics** (0 dimension) we searched 1 aspect, the **Preference** (1st dimension) of students in what to use in class.
- Their preference was divided in:

  Typical (2nd dimension) e.g. referring to the school oriented and well accepted methods
  Non-typical (2nd dimension) e.g. referring to methods which learned outside school

- In typical and non-typical, we also searched for the process used in:

Algorithms and methods (3rd dimension) e.g. In 3x7 a pupil explained "*7 and 7, 14 and 7, 21*", in 6x7 he used the previous result 21 as a double and said "*since it is 6 times it is half of 3, so 21 and 21, 42*". [E, D, F]

(see **Diagram E**, p. 109)

In all classes there were students who used typical and non-typical methods.

Next you can discern the extensive analysis organized as follows:

Funds of Knowledge

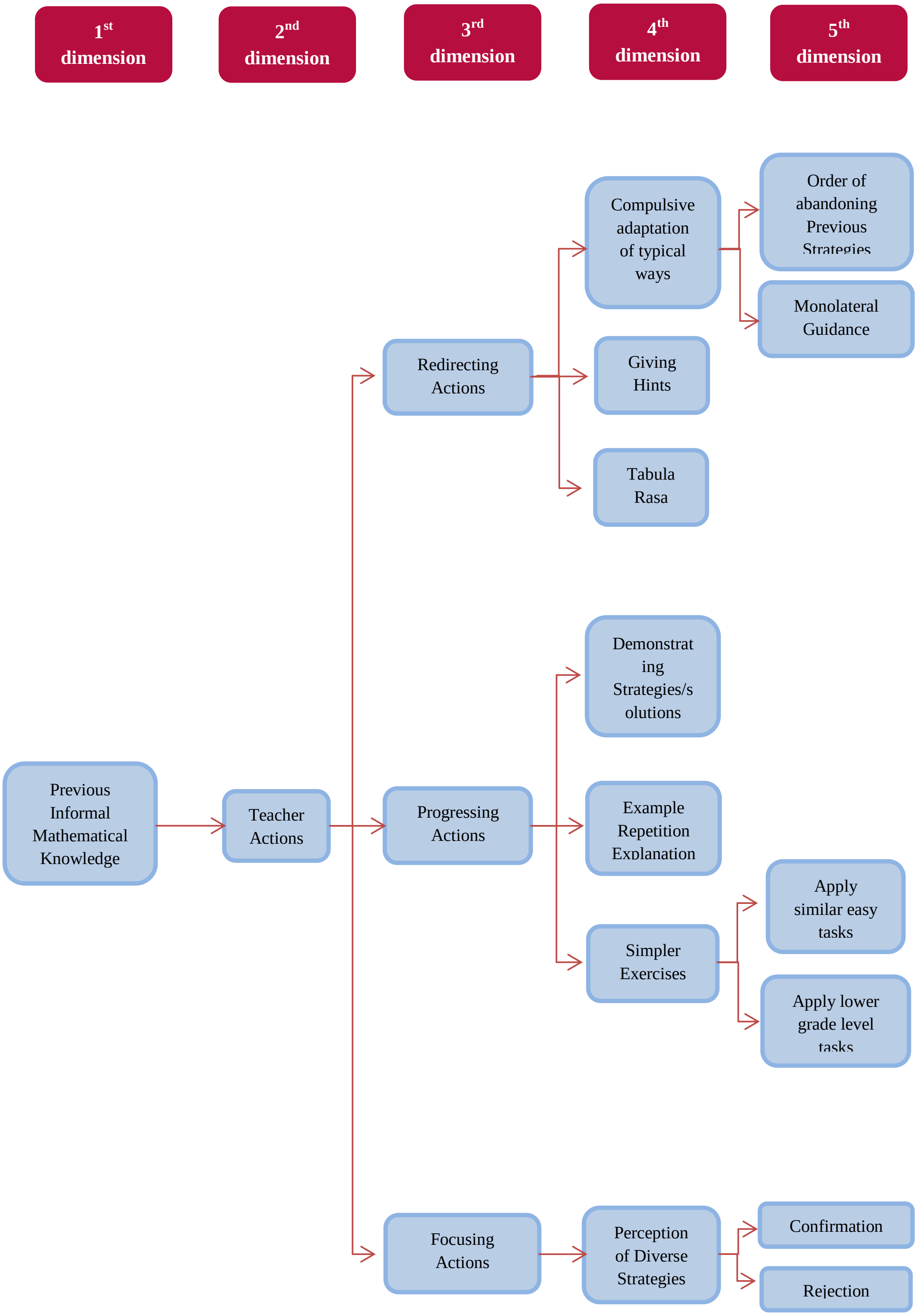

Diagram A

Through funds of knowledge there has been an attempt of describing the classroom mathematical discourse and classroom culture as teachers had established. A framework of Drageset (2014; 2015) has been utilized for 2nd and 3rd dimensions to make a more detailed categorization and to capture the communicative features of teacher-student interaction. At the same time, the other emerging subcategories have been developed from the observation of teacher practice inside the math class. In those subcategories, which extend from 4th until 6th dimension, there were paradigms of excerpts of all 3 classes studied, accompanied with a description and interpretation. The above diagram A depicts the categorization model up to 5th dimension, whereas a more thorough examination is detailed next.

Data Interpretation

We organized the data related to funds of knowledge (0 dimension) of students' outside experience under the pillars of the treatment of teachers as shown in Diagram A with paradigms in many subcategories.

1st dimension *Previous Informal Mathematical Knowledge*

It was observed in the math lessons of all classes and from the early grades that Rom pupils obtain previous informal mathematical knowledge, mainly due to their occupation with their family jobs and businesses.

2nd dimension *Teacher Actions*

Here, we were concentrated on how teachers act towards their students' previous mastery of informal mathematics, since the classroom discourse was dominated by the teacher talk, where regularly the teacher initiated the questions. That particular approach could be seen as directive, focused or progressive.

3rd dimension *Redirecting Actions*

Redirecting actions were being employed to alter student approaches. At this point we often noticed a rather compulsive attitude of educationalists to steer students into typical ways and give them hints without comprehension or treat them as tabula rasa, forgetting their preexisting mathematical knowledge.

4th dimension *Compulsive Adaptation of Typical Ways*

The teachers were insistently advising their pupils to deal with the typical agenda of school centered approaches. In this way, they required students to abandon their strategies, with no dialogic interaction, or followed a monolateral direction where they were guiding them to particular strategies or they offered arguments to support this formal mathematics.

5th dimension *Order of Abandoning Previous Strategies*

The teachers usually ordered students to use formal ways of solving problems and the most salient pressure was noted in arithmetical operations. The teachers constantly impelled students to make use of written algorithmic operations vertically eliminating any chance of mental computations not even for verification or estimation of the results.

Observation Class E

For instance, when a student was asked to subtract 2.400 from 2.564, he replied without delay 164 but the teacher avoided to inform him and the others if it was the right or the wrong answer and firmly said "*No, you will do the operation* (on the whiteboard), *not with the mind*".

Observation Class F

A student (J) executing the operation 4.32 + 3.25 vertically started to add from the front instead of the back as the typical algorithm demanded. The teacher could let him use and improve his procedure of convenience but she said "*we never start from the front…*" even if it was plausible and acceptable.

5th dimension *Monolateral Guidance*

They were employing a unilateral perspective towards students, since they were exhibiting strategies and solutions in specific ways. Rarely, they were trying to give different solutions, answers and tactics. They were not trying to give different solutions, answers and tactics. They guided students through a series of predictable steps.

Observation Class D

In an exercise asking how many glassy there are in 4 cases, he was giving orders without comprehension of multiplication of 7 as the sum of multiplications of 2 and 5.

Teacher: *How many are red glassy?*

Students: *8* (by counting them one by one).

Teacher: *How many are the blue?*

Students: *20* (by counting them one by one).

Teacher: *Altogether?*

Students: *28.*

The children had to fill columns with different colors to display a form of multiplication as two others. Their engagement in that particular type of exercise was steered by the teacher in all multiplication tables from 3 to 9 and they were just painting the boxes as shown on the board. The following dialogue is from the multiplication of 6.

Teacher: *Look what we do here. How much is 3x7?*

Tap: *21!*

Teacher: *Nice, 21. Now paint 21 boxes like this* (He pointed them on the whiteboard) *into 7 columns and 3 rows…*

Students: *…I did it… We did it, now what should we do?*

Teacher: *What is the double of 21?*

Tap: *42!*

Teacher: *Yes. Now we are painting the other below 6x7 by the same way* (He again pointed on the whiteboard).

(…)

Teacher: *Ok. Did you all finish? Let's move to the next, 5x7. How much is it, Prsk? ... 7 times 5, count 5, 10…*

Prsk: *…5, 10, 15, 20, 25, 30, 35.*

Teacher: *Paint them like this… and 7x1…*

Prsk: *I don't understand them sir!*

(…)

Teacher: *So, if we add those two, 5x7 and 1x7 we can find 6x7=42…*

(…)

Teacher: *On the next one 5x6 we can do it again with two ways… you can see here by using 5x(3+3) or 5x(5+1) we can make 5x6* (He marked them on the whiteboard). *How much is 5x6?*

Students: *30!*

In a problem where each box could fit 6 colorful markers, students had to figure out how many there were in 9 boxes. A pupil (Tche) stood up on the whiteboard and the teacher explained the problem to him while he demanded to count by six and write the results in the columns below.

Teacher: *We have a box with 6* markers (he drew a rectangle with 6 lines inside). *If we have 9 of those boxes…? Let' make 9 boxes. Write 6 in every one of them… now count one by one.*

Tche: *6 and 6, 12…*

Teacher: *Write it down, here.*

Tche: *13, 14, 15, 16, 17, 18.*

Teacher: *3x6=18, so 18 write it.*

Tche: *19, 20, 21, 22, 23, 24.*

(…)

Tche: *49, 50, 51, 52, 53, 54*

Teacher: *Ok. So how many did we find?*

Students: *54!*

Teacher: *Write down 9x6=54.*

A question in the math school book was asking "*how many triangles can I make with exactly 24 sticks*". The teacher picked a child to elaborate it on the board but hadn't given her any time to read it and express some thoughts. He drew 24 lines presenting the sticks and told her every time she marked 3 of them (multiplication of 3), she would make a triangle. At last, when he asked how many triangles were created, he rushed into instructing her to count them. The same happened with another student with the discrepancy of marking 6 lines in order to build a house (multiplication of 6).

Teacher: *Let's make 24 lines. For every 3 lines you will erase them and build a triangle, ok?*

E: *Ok. 1, 2, 3* (she crossed the lines off and made below a triangle) ... *1, 2, 3* (she continued till end).

Teacher: *Ok, now how many triangles have you made?*

E: *1, 2, 3, 4, 5, 6, 7, 8.*

Teacher: *Good. So 3 houses* (triangles) *times 3, how many?*

Students: … *24.*

(…)

Teacher: *You will do the same as her but with 6 lines and you will make houses instead of triangles.*

Xval: *Yes. 1, 2, 3, 4, 5,* 6 (she was crossing the lines off and made 4 houses).

Teacher: *How many houses are there?*

Xval: 4.

Teacher: *So… 4x6…*

Students: *... 24.*

4th dimension ***Giving Hints***

During the problem solving procedure, educationalists were always giving hints or even revealing the actions necessary to proceed with it.

Observation Class D

Although the students hadn't read the word problem, the educationalist started to pose questions to the pupil (Tap) on whiteboard and guided him through hints.

Teacher: *There are 7 kids, boys. Ok?*

Tap: *Yes.*

Teacher: *They paint 1 tree, 3 houses and 2 little kids, each of them. So, how many altogether?*

Tap: *6.*

Teacher: *Good. Now you have 7 kids and each of them is painting 6 pictures. How many are all the pictures? What will we do?*

Tap: *And (+)…*

Teacher: <u>*How did we learn to…*</u>

Tap: *Times, 6x7. It's uhm…* (He murmured and tried to find the result)

Teacher: *Kids look the result and tell him.*

Students: *42!*

Teacher: *Ok. Write it.* <u>*Now, it is the same*</u> *for girls, there are 5 girls and made 6 pictures each. So, what do we do?*

Tap: *A, 5x6… equals 30.*

Teacher: *Good. Altogether how many are the paintings?*

Tap: *72*.

<u>Observation Class E</u>

A student stood up and solved the problem (*Chris's mother bought one mobile phone 175 € and one telephone 129 €. How much did she pay?*) on the whiteboard step by step with the strict direction of the teacher in what procedure to execute and the help of her and of the other students.

Teacher: (First she repeated one by one the data problem) *what did she buy?*

Ag: *A mobile phone and.*

Teacher: *Write down 175 €. What else?*

Ag: *A telephone.*

Teacher: *How much did it cost? Write it down too. Now kids what are we going to do* (referring to what operation to apply)?

Students: *Addition! Addition!*

Teacher: *Ok Ag do it vertically*. <u>*So remember when we want to gather/sum things up what do we do-addition*</u>*!*

In a second problem (Christine had 300 €. She bought one jacket 35 € and a pair of trousers 24 €. How much money has she now?). The teacher again gave a hint.

Teacher: (First she repeated one by one the problem data) *How much money did she have?*

An: *300 €.*

Teacher: *What did she buy?*

An: *A jacket and a pair of trousers.*

Teacher: *What* (operation) *will you apply here? Careful, we have 2 operations now!* (and repeats again the data) *Don't we have to figure out how much money did she paid for both the jacket and the trouser?*

Observation Class F

The teacher gave some hints to the students regarding the subject they would work on, without letting them to discover it or suggesting some thoughts of their own. Following her statement, they were certain what actions to make.

Teacher: *Let's see the technique we apply here… to understand the secrets of mathematics. Here are some problems, so we can grasp better the tricks we learned with two digits multiplication.*

4th dimension *Tabula Rasa*

There were many times that teachers treated their students as tabula rasa (=unwritten board), denoting that students did not have any previous knowledge or experiences within the mathematical settings.

Observation Class F

At that point, where a lot of students were making mistakes and had difficulties in naming the operations, the teacher said all of a sudden: "*this is the problem we deal with; at most they can't separate the operations*". However, the teacher contradicted her thought in an earlier statement in which she had argued: "*Wait to see how they can sell the carpets at the bazaar*". Even though she hadn't previously checked if they could comprehend the operations in any other way, she thought that they could mentally produce the right results on the markets and job businesses but at school they could not adjust with calculations or follow the typical functions. The teacher had not taken advantage of their knowledge in order to connect or compare justifications and outcomes stemming from their way of thinking and the typical way of mathematical functioning.

3rd dimension *Progressing Actions*

Progressive actions were used when the teachers wanted to complete a task and wanted to move forward. Again, here we noticed an authoritative style of teachers, as they were demonstrating the strategies or the solutions to problems by themselves. They also used some examples and many times explanations and repetitions so that children could memorize them by always assigning them the easiest exercises.

4th dimension *Demonstrating Strategies/Solutions*

They were displaying strategies or solutions to problems without giving children the space or time to unfold on their own and work on them concomitantly.

Observation Class D

In an exercise as the above, the teacher urged the students on the whiteboard to find and write the results of time tables of 2 and 5 and then add them (so that multiplication products of 7 could be raised) and the others to copy the results.

Teacher: *What multiplication chart do we need here?*

Pic: *... of 2.*

Teacher: *Ok. Count by two.*

Pic: *2, 4, … 22.*

Teacher: *Now the next…from which chart is it?*

E: *Of 5.*

Teacher: *Ok. Count by 5.*

E: *5, 12, 15, … 60.*

Teacher: *At last look what we do. We have e.g. 2 and 5 which make 7 or 4 and 10 give us 14… So, with the multiplication tables of 2 and 5 we make 7*.

Observation Class F

Two students were using the method she, the teacher, had taught them in multiplication with ending zero. One of them displayed it correctly but more analytically and asked her if it was ok. In response, she authoritatively told all students to stop writing and pay attention to what she said.

V: *Here's what I did* (in 27x100). *I said 1 time 7 equals 7, I write it in the back and 1 time 2 equals 2, I write it in the front and then I putted the zeros behind*.

Teacher: *But you can do it straight. I don't have to say it again. Put all of you the pencils down so I can see your eyes on the whiteboard. I write the whole number, I multiple and then I put the zeros behind* (depicting on the whiteboard).

In addition and subtraction of natural numbers she explanatory showed to them the widespread written algorithm.

Teacher: *Look, I'll show you an example so you do the next ones. In 2,500+500 we start from the back and say zero plus zero equals zero. We write it on last position. Again in tens we have zero and zero equals zero, next five and five makes ten so we write zero and one the carrying digit, so 2 in front and one from earlier we have 3. So, the number formed is 3,000* (she drew attention to the algorithms being applied in that particular way).

The same happened in addition and subtraction of decimal numbers.

Teacher: *Pay attention! If we want to add those numbers e.g. 9.25 + 8.27* (vertically) *we set comma under comma. That is the secret of not making mistakes in addition, the decimal point under the decimal point… Let's see another example but with subtraction now, e.g. 27.6 – 3.04* (vertically), *again comma under comma. But what do we set here-27.6* (in the position of centimeters) *that we have nothing?*

O: *The zero.*

Teacher: *Yes, the zero and then we follow the steps as we learned in the regular-integer numbers.*

4th dimesnion ***Example, Repetition, Explanation***

The teachers used some examples of their everyday reality to give meaning to the problems and often repeated and explained the main points students were obliged to learn.

4th dimesnion ***Simpler Exercises***

They were always assigning simpler exercises to students. They were dealing with similar exercises and lower grade level tasks.

5th dimension ***Apply similar easy tasks***

Every time kids finished an exercise, they had to work on a similar one with different data.

Observation Class D

In a specific exercise exhibited in every unit, children had to write the multiplication products on a chart and on a picture of two palms. They followed teacher's orders and counted one by one aloud or with the help of lines the teacher drew if the number was larger than 5. As an example – dialogue, we refer to the multiplication tables of 3 and 6.

Teacher: *Come on N. Come here, you will do the next*.

N: *Yes.*

Teacher: *Here we have 3 and other 3, make 6 and other 3, make 9. Continue one by one and write the results when you are reaching every time at 3 fingers*.

Students: *Sir, I want to do it… 12 sir…*

Teacher: *Stop, stop let him find it…*

N: *9… 10, 11, 12* (aloud with the help of fingers*)… 13, 14, 15… … 28, 29, 30.*

Teacher: *Ok, well done. Sit down. M. come here. You will do the same as N. but you will write them* (results) *below in the boxes* (chart).

M: *9… 10, 11*

Tap: *12 sir, 12.*

Teacher: *Stop it children. Don't interrupt her… continue.*

M: *12… 13, 14, 15* (aloud with the help of fingers)… … *28, 29, 30.*

(…)

Teacher: *Now, we'll do the same but with 6. Come here Tche.*

Tche: *I came.*

Teacher: *Count by six in those lines here* (he drew 6 lines).

Tche: *12… 13, 14, 15, 16, 17, 18* (he wrote 18 and continued until 60).

Teacher: *Ok. Prsk you, the same here.*

Prsk: *13, 14, 15, 16, 17, 18 … … 54, 55, 56, 57, 58, 59, 60.*

Observation Class E

In a problem (*Outside from a basketball court there were gathered 1,356 men and 1,208 women for a basketball game. The seats were 2,400. How many funs could not get into the basketball court?*) the teacher pointed out the following:

Look, this problem is just like the one we did yesterday.

5th dimension *Apply lower grade tasks*

It was also identified from the observation in all classes, that lower grade level mathematical concepts and materials, e.g. math books of 2nd grade for 4th graders, of 3rd grade for 6th graders were used.

3rd dimension *Focusing Actions*

Focusing actions had been utilized by teachers in order to look into details or maybe reasons behind an answer or idea of student diverse knowledge.

4th dimension *Perception of Diverse Strategies*

The teachers were cognizant of their students' versatile mathematical knowledge and sometimes they confirmed it but others they rejected it.

5th dimension *Enlighten Details/Confirmation*

In the confirmation of diverse strategies, teachers explored the details of students' answers by utilization or they just gave them a reward and later moved on.

6th dimension *Utilization*

They used their previous knowledge and let them work mentally and then passed on other new forms of solutions.

When they were making known nuggets of their previous cognizance, they utilized the frame of familiar activities, like money exchange in shops, agoras and newsstand, measurement in clothes, etc. For example:

Observation Class E

The problem was the following: The neighborhood's bakery baked on Saturday 685 loaves of bread. On Saturday morning 496 loaves were sold and in the afternoon another 158 were also sold. How many were left unsold?

Teacher: (First she repeats one by one the problem data) *How many loaves did the bakery have?*

Pj: *469 Mrs.*

Teacher: *What are we looking for? How many had been left unsold. So what operation do we need?*

Students: *Subtraction… Aaa addition*.

(….)

Teacher: *And now? How many loaves were left? How many were in total? What will we do?*

Chri: *Subtraction.*

Observation Class F

Teacher: *Think about you are going to the grocery store and buy fruits for 7.50 euro and give 10 euro. How much will the employee return to you?*

G: *2.50 euro Mrs*.

In another problem, she asked pupils to find out if 1.8 and 1.5 kilos of fruit outreached 3 kilos and continued with other similar questions from textbooks. In her initial question a student tried to figure it out although unsuccessfully. She suggested using his mind, since he got tangled.

Teacher: *Are the fruits 3 kilos with the eye-by estimation?*

L: *Yes…*

Teacher: *Come to the whiteboard and add them to see how many kilos are exactly?*

L: *Hm…*

Teacher: *Ok, do it with the mind.*

L: *3.3 Mrs. with the mind.*

She rephrased a problem many times and asked students what acts were required to solve it.

Teacher: *The problem says a greengrocer bought 985 kilos of apples, 237 kilos of grapes, 598 kilos of bananas, 468 kilos of pears and cherries* (repeated it two times). *Firstly, it asks how many kilos he barged into if he loaded to his truck apples and bananas… What did he buy?*

V: *Apples.*

Teacher: *How many kilos?*

V: *985 Mrs.*

Teacher: *What else?*

L: *Bananas, 598 kilos.*

(…)

Teacher: *So what do we apply to find the kilos together?*

Students: *Ehm, multiplication… subtraction… addition.*

Teacher: *Hey, think about it children. He bought 985 kilos of apples and 237 kilos of grapes and 598 kilos of bananas, 468 kilos of pears. How do we place them together?*

L: *Subtraction.*

Teacher: *No!*

Students: *Addition.*

T: *Of course!*

6th dimension ***Reward***

They appreciated their students' solutions by complementing comments.

Observation Class D

A student (Prsk) in an exercise where they had to paint each result of addition and subtraction with a particular color she as many other kids used her fingers. In the subtraction 9-7 she used her fingers but after a while in 8-6 she yielded "*aaa it's also two, sir, this I did it with my mind because we raised one and go down another one*". However, the pedagogue didn't tap into her logic. He just noticed "*well done, do the others too*" and skipped it.

5th dimension ***Rejection***

They rejected students' strategies in comparison with the reliability of their own.

Observation Class D

In a problem from the school book students had to find out how many boxes of books children had already made if the goal was to reach 100 boxes and knew they should pack another 19. Rapidly a student answered "*81 Mr.*" whereas the teacher started a short dialogue asking for his method:

Teacher: *How did you find it?*

Tap: *With my mind!*

Teacher: *Everything with the mind?. .. With your mind, how? Tell us.*

Tap: *I said from 100 I take out 19, I went back 19 with my fingers.*

Teacher: *Are you sure or maybe did you have another way?*

Tap: *No, sir I did it this way.*

Teacher: *Ok, ok never mind… let's leave it and move on.*

The teacher at last, hadn't paid attention to the pupil's method and somehow rejected it since he moved on guiding students to typical algorithms and not presenting the chance to others to utilize and evaluate their classmate's method in order to figure out if it was convenient for them too. Apart from that, the teacher hadn't entirely understood the student's method since there were not any attempts made so as a further analytical explanation could be elicited. Nevertheless, it can be characterized as an endeavor of unraveling student's previous knowledge.

Observation Class F

In a problem from the school book, a student who had answered all sub questions performing mental calculations and merely wrote down the results, although some of them were wrong, she did not accept them and send him back to his desk to execute them applying the typical form.

Teacher: *Let me see this.*

T: *Yes* (he showed the exercise to the teacher).

Teacher: *How did you find them?*

T: *By myself.*

Teacher: *With the head you didn't go very well. Do them as operations* (written).

Phenomena of Discrimination

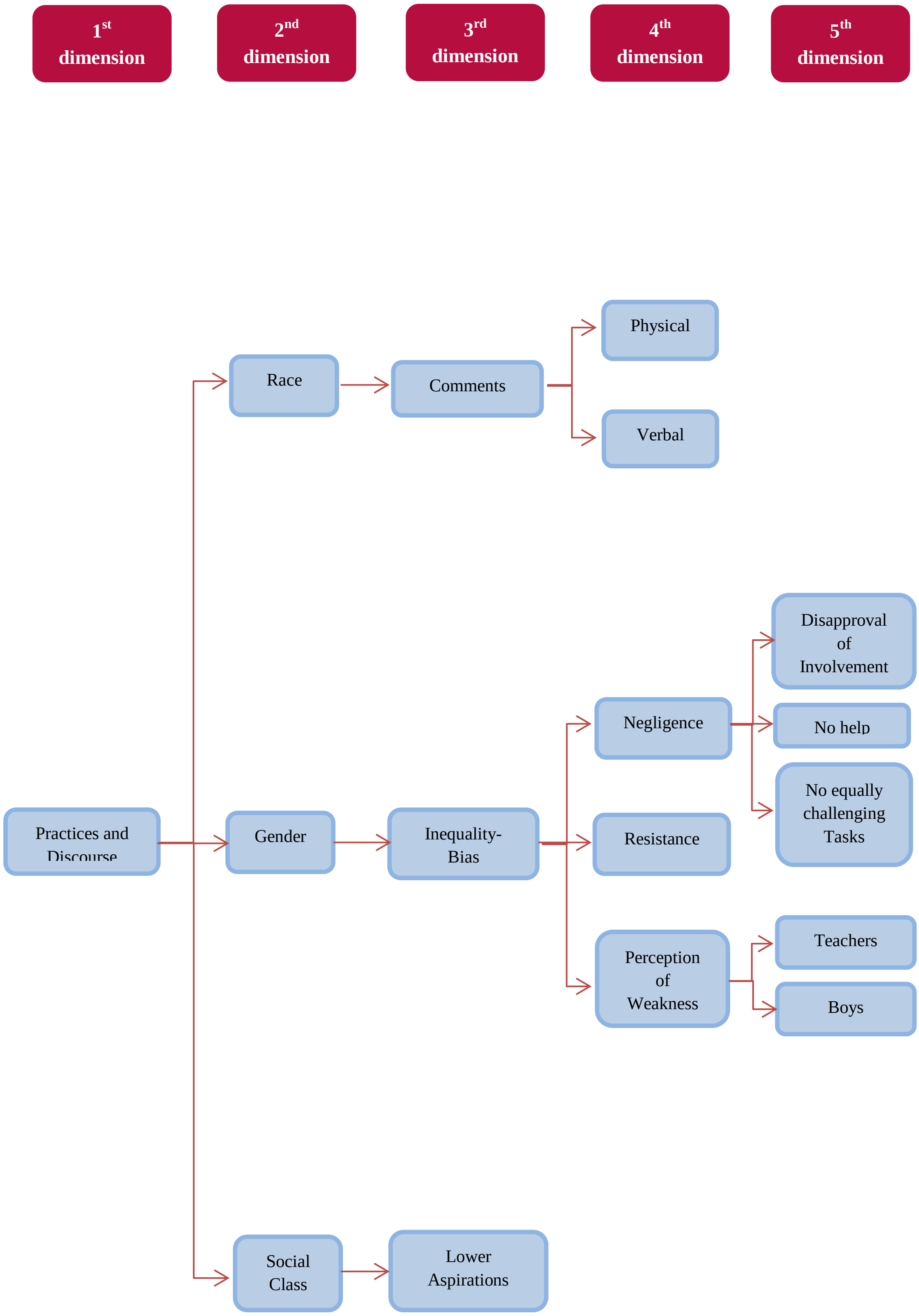

Diagram B

The 1st dimension of discourse and practices of teachers and students was divided into a multilevel system based on three main forms of discrimination influence, race, gender and social class (2nd dimensions). These essential types involve cultural beliefs and patterns of behavior and actions corresponding to an interactional level (Ridgeway & Correll, 2004), which explores the mathematics task performance processes (e.g. reasoning, problem solving), the psychosocial factors (e.g. mathematical attitudes, teacher expectations), and the contextual influences (e.g. cultural norms, instruction) (Leyva, 2017).

These elements stemming from the studies combined with the further dimensions, 3rd, 4th and 5th, which have been created from the observation, were combined to end up in this schema analysis. The above diagram B depicts the categorization model up to 5th dimension, whereas a more thorough examination is detailed next with a wide range of paradigms.

Data Interpretation

We highlighted the grouped data related to phenomena of discrimination (0 dimension) which hold back the Roma students from success in school mathematics as shown in Diagram B with paradigms in some subcategories.

1st dimension *Practices and Discourse*

There were some practices and discourses mainly from teachers to students that could be described as racist behaviors and actions. These would be filtered through the dimensions of race, gender, and social class.

2nd dimension *Race*

By race, we refer to unfair treatment towards Rom students because of constructed phenotypical traits, like culture with a symbolic identity and physical similarities.

3rd dimension *Comments*

It was observed in the math class and in school breaks outside, that teachers generally felt comfortable reprimanding the Roma children and even sometimes exceeding the limits.

4th dimension *Physical*

Specific kids were slightly attacked-slapped or threw out of class.

Observation Class D

Minor physically attacks inside classroom were not absent, generally slaps, towards boys and girls with an entourage of common phrases again, like "*What are you doing there moron*?".

Every time the teacher tried to prevail over that fuss, he violently threw a particular group of 5 (4 boys and 1 girl) kids out of the classroom by grabbing them tight and yelling at them. During the first lesson, we observed that he threw 3 boys out whilst to one of them he harshly said: "*You, do not ever come to school again!*". During the next three hours of math, the teacher got rid of their bags and jackets by tossing them on the schoolyard and said: "*Stay outside if you want to play but don't ever come to class. Take your bags and out, go to your parents…*". That peculiar reaction of throwing out students happened another 10 times during the three months of observation in the subject of mathematics (we only observed math lesson-we don't know his actions to other subjects).

Observation Class E

A particular student did not comply with the teacher's instructions to stay calm and quiet so he could work on the arithmetical word problem and she (the teacher) irritated gave him a soft hit on the head by saying authoritatively "*Chri stop now, start working on your sheet and pay attention*".

4th dimension ***Verbal***

Also mere verbally attacks towards them were exhibited using expressions like:

Observation Class D

"*What are you doing? Stop! Go outside if you want to play football*", "*Jog on! Sit down now*", "*You will not sit together again. That's enough, do not speak*", "*Go out, out! I've seen and the hours inside* (classroom) *what have you done… Why did you come back inside?*", "*Are you ok? Are you ok? No, you are not. You are sick* (sarcastically)."…

Sometimes, the teacher threatened a lot of boys that he would call their fathers if they could not be obedient. He literally made one phone call during that period demanding the father come to school and reprimand his child, e.g. "*Hey Nikos, where are you... Come here please to tell a few words to your son…".* For five consecutive times, he actually did not even allow a few male students to enter the class and urged them to play football outside, instead.

2nd dimension ***Gender***

By gender, we refer to characteristics depending on the context of sex-based social structures, which pertain to and differentiate between masculinity and femininity.

3rd dimension ***Inequality-Bias***

Girls and boys are not considered equal and the first are presented to lag behind the second in mathematics education due to socially constructed perceptions and cultural stereotypes of teachers. That was manifested through neglect and preconception of weakness from teachers and boys, but also through resistance to those.

4th dimension ***Negligence***

It was observed in the math class that girls hadn't acquired the same attention span as boys. The teachers disapproved of the involvement of girls in mathematical discourse, did not offer them help as much as it was needed and assigned them simpler tasks.

5th dimension ***Disapproval of Involvement***

The educationalists had not asked girls to participate in mathematics discussion as much as boys.

Observation Class D

For example, in the concept of double numbers only the boys were activated and interacted with the teacher:

Teacher: *Now I want the turtle to go from 40 to 80. What are 80 for 40?*

Boy1: *…other 40!*

Teacher: *Yes, so what are 80? It is called the double, the double of 40.*

(…)

Teacher: *How many steps more does the turtle need to do?*

Boy2: *8…8!*

Boy3: *The double!*

Teacher: *So which number is the double of 8?*

Boy3: *The 16, I said it before sir*.

(…)

Teacher: *What are 88 in relation to 44?*

Boy1: *44.*

Teacher: *Yes, another 44 but how is it called? … Double, double!*

Again in the same unit lesson, the teacher collaborated only with boys to solve a similar exercise without the girls' participation.

5th dimension ***No help***

For quite some time the girls had not received the help they were seeking from teachers.

Observation Class D

When one girl (Xval) asked the teacher for help, he ignored her as he was trying to explain something to the boys and to end the buzzing. The girl after some attempts stood up and approached the teacher in the whiteboard and finally asked him: "*What do we place in here, I didn't understand… Is it 4… 8? Why?…".* Then, he began to explain but not conceptually.

Some other time, a girl (E) asked for his help by saying: "*Sir I was confused! Come here, for a while…*" and he stormy responded, "*What if you were confused, what can I do?*"

5th dimesnion *No equally challenging Tasks*

Almost always teachers were assigning exercises into simpler forms for girls.

<u>Observation Class D</u>

In mental computations with addition and subtraction up to 100 the teacher asked 4 boys to answer questions of this type:

Teacher: *62, 100 how many more?*

Boy: *32, sir.*

Teacher: *32, to which number is closer, 40 or 30?*

Boys: *40!*

But as it was the girl's turn, he asked the simplest question in a soft tender voice:

Teacher: *Look, we have 19; which number is near, 10 or 20?*

E: *20.*

When finding the multiplication products of 5 and 10 exploiting the relationship of half and double ratio, the teacher posed the easiest questions with small numbers to girls and the most difficult to boys:

Teacher: *Tell me how much are these 3 fives* (showing at the whiteboard 5+5+5).

Girl: *20.*

Boys: *Ha ha ha ha… 15*

(…)

Teacher: *Ok, you will tell me a difficult one. All these tens* (10 fives), *how many are they?*

Boy: *50… 10 times 5.*

The same happened in the multiplication products of 10, where the boys had answered questions, like: "*How are 2 tens called in multiplication form?... 2x10=20*" while girls were only requested to produce the addition form, e.g. 10+10 for 2 tens.

<u>Observation Class E</u>

One typical example was when the educator stated that *"boys know the operation of multiplication but we are solving simple problems because there are also the girls who are low* (ability)". Following that premise, she regularly called girls on the board for mere calculations of addition, subtraction, and multiplication later on. The times a girl was called for problem solving were limited and the girls themselves hesitated to approach the whiteboard. They were often saying: "*Mrs. I don't want to come to the* *whiteboard, I don't know these*", "*What? Me… no, no*" "*Aaa, no I'm not coming I'm scared*", "*I don't like it, I'll stay here at the desk, its better*", "*Why me? Pick up someone else*".

Observation Class F

The teacher discerned the only girl from the rest since she customarily assigned her easier tasks. She used to say: "*Come, I'll give you a simple multiplication* or…".

The teacher further discouraged her using a number of methods in different styles except the typical ones by saying: "*those* (praxis of addition) *are not easy, but it's better to do it vertically in your notebook; Pg I don't know if you can deal with them, so big numbers here*". The teacher had only mechanically taught her the operation algorithms and problem solving tasks.

4th dimension *Resistance*

Some girls though resisted towards teachers' attitude either by complaining and standing up for this unfairness or by not cooperating until they were treated the same way as boys.

Observation Class D

In view of the above mentioned reactions, girls sometimes stood up to the teacher and his discouraging comments. A student (Pic) shouted in front of her teacher's mocking reflection "*You are the teacher. Who will teach us?*"

In one particular case, we encountered a girl (Prsk) who actually avoided talking to the teacher for a few days after she said to him "*I will never talk again… we* (girls) *are not here, we are home because you don't give us answers… I will interrupt the others* (boys) *as they do*".

The same girl (Prsk) voiced she hadn't understood the task and asked to stand up and perform another one. The teacher explained the method he had shown by picking up a boy instead of her to find how many more they needed from 32 to reach 63 on the number line. Afterwards, he asked that girl to solve a similar problem but again the boys kept calling out the answers without letting her think or act. Notably, the teacher didn't stop the boys. He suggested repeating the task because the girl had heard the answers from them and didn't understand them. Even when the girl asked for another engagement on the number line, he refused and told her to sit down. The sequence of events took place as follows:

Girl: *Sir, I didn't understand it!*

Teacher: *Ah, again…*

Girl: *Can I do it? I want to stand up.*

Teacher: *Let's see. Let's get him* (Tax) *up. You* (the girl), *watch so you can understand it… You have 32 and you need to reach 63… At first count how many do you need to reach to the first next ten?*

(…)

Teacher: *Another example. Who wants to do it? Let's choose a girl since none of them had done an example.*

Girl: *What do I do sir?*

Teacher: *A, ok* (with a dismissive wave of his hand).

Boy1: *Sir let me do it, she doesn't know!...*

Teacher: *No, she will do it. We'll pick an easy one. Well, you are at 38 and you have to reach 100. Go to 38 on the number line… How many do you want till 40?*

Boys: *2…2…2!*

Girl: *2.*

Teacher: *Now count how many tens you need until 100.*

Boys: *6…6…6!*

Girl: *6.*

Teacher: *Keep going, which number is 6 tens?*

Boys: *60.*

Teacher: *How many you had in your head?*

Boys: *2…2!*

Teacher: *Together?*

Boys: *62!*

Girl: *Sir, I didn't understand it* (with disappointment).

Teacher: *I know, because everyone else is telling you* (the answers). *I'll ask you another; let's say 68 and you have to reach 100. Ok?...*

(Again, she couldn't figure out the method used and blamed a male student because he always interrupted her and called out the answers)

Girl: *Can I do one more? I didn't understand it.*

Teacher: *No, no, sit down.*

Observation Class E

Sometimes girls complained about boys always getting up. Again though, they weren't comfortable to work on the whiteboard. A common dialogue below describes such a situation.

Teacher: *Who wants to stand up?*

Boys: *I want… me Mrs… pick me…*

Teacher: *Come* (a boy) *on the whiteboard for one more…*

Girl: *A boy again? Mrs. you don't pick any of the girls! Always the boys…*

Teacher: *Ok, Ch* (girl) *if you want, come. I'll ask you an easy one.*

Girl: *Ah, Mrs. not me, I don't know it…*

4th dimension ***Preconception of Weakness***

Teachers appear to perpetuate the myth of male superiority in mathematics and in working areas related to mathematics. In that way, through their actions, they nourished that false idea. The boys and the girls seemed to further absorb that.

5th dimension ***Teachers***

Teachers were noticed to be biased in the observations.

Observation Class E

Teacher's prejudice about male and female mathematics ability was quite strong even if she had been at that school for 10 years by her own choice, *"to get to know the gypsy culture better*" as she clarified. For example, she rigorously argued that "*the Roma boys are one level above-higher than the Roma girls besides, that is also the case with the Greek students, always the boys get ahead in mathematics*"

Furthermore, she praised one girl for being an exemplary student saying "*she is an exemplary student even for a gypsy kid, she comes to school every day, never misses a class and has a lot of pieces of general knowledge*". The teacher though, didn't mention any positive elements associated with mathematics learning.

She thought boys could handle it better and encouraged them more to learn for example the operation of multiplication with decimal numbers and division with natural numbers. She said: "*Ok, you boys understand it. Let's pick a girl now… Come on stand up, come to the whiteboard and I'll help you…*"

5th dimension ***Boys***

The same actions and phrases had been disclosed from boys towards girls.

Observation Class D

Feedback and criticism from almost all boys of the class were captured below: "*You have a teacher next to you and still you know nothing*", "*Sir let me do it, she doesn't know!*", "*I will tell her, Mr.*".

On the one hand, boys allowed the girls to copy the answers with no explanation, and on the other hand, when they heard wrong responses from girls, they laughed at them (girls). Habitually, they didn't even let them (girls) reply on time by calling out the answers. For instance:

Girl: *5, 10, 15, 20, 25, ehm 40*

Boy: *40 she says, haha… what 40?... 30!*

(…)

Teacher: *How much is 10 and 10?* (Asked a girl)

Boy: *20!*

(…)

Teacher: *How much is 2 times 5?* (Asked a girl)

Boys: *10! 10!*

(…)

Teacher: *Which is the half of 100?* (Asked 2 girls)

Boys: *50, sir!*

(…)

Girl: *2, 4…* (she wrote on the whiteboard the results of multiplication of 2 by adding each time two)

Boy: *6! 6!*

Girl: *6, 8, 10, 12, 14, 16, 18…*

Boy1: *20, 22, 24, 26…*

(…)

Teacher: *M* (girl) *how much is 40 and 16?*

Boys: *56!*

(…)

Teacher: *3x8, Pic* (girl)*?*

Boy: *24!*

Observation Class E

When the teacher stated that boys are one level above girls, one boy (Chri) promptly added *"what? Only one Mrs? And two and three* (levels) *above*".

The boys were making fun of the girls when they made mistakes on the whiteboard and called out the answers promptly. Some examples are demonstrated below:

Teacher: *Come, go to the whiteboard. Don't be nervous I'll give you an easy one.*

Boy: *You stupid, hah stupid!*

Girl: *I don't want to Mrs. I don't know it…*

Teacher: *Write 32x2…*

Girl: *3 times 5…*

Boy1: *15, 15!*

Teacher: *Stop it! Don't say it to her; let her find it by herself.*

Girl: *5, 10, 15… 5 and 1 the carrying digit… 3 times 3*

Boy2: *9 and one the carrying digit from before 10… come on write 10 this is it!*

(...)

Girl: *2 times 2 equals 4* (In the multiplication 42x12 on the whiteboard)

Boy: *Hahaha, where did you put 4?* (She wrote it too far below)

(…)

Boy 1: *Come on, it's 504. Write it, write it I found it!*

(…)

Girl: *4 and 2, 42* (in a method of verification)

Boys: *Hahaha…*

(…)

Teacher: *Come on…*

Girl: *No Mrs. I don't know it… if I do it wrong…*

Boy: *I'll still laugh haha!*

(…)

Teacher: *Let's pick a girl too.*

Girls: *No, Mrs. No, I can't, don't know these…*

Boy: *Then, why do you come to school?*

2nd dimension ***Social Class***

By social class, we refer to subjective models of social stratification in which people put other people into a chain of hierarchy and supposedly believe their future is somehow predicted in math education and later in the labor market.

3rd dimension ***Lower Aspirations***

Teachers from all classes had low expectations from Rom kids. They said they would be pleased if Rom kids would reach junior high school and even high school and later find a better job, different to jobs that stereotypically Rom youth does.

Mathematical Knowledge Difficulties

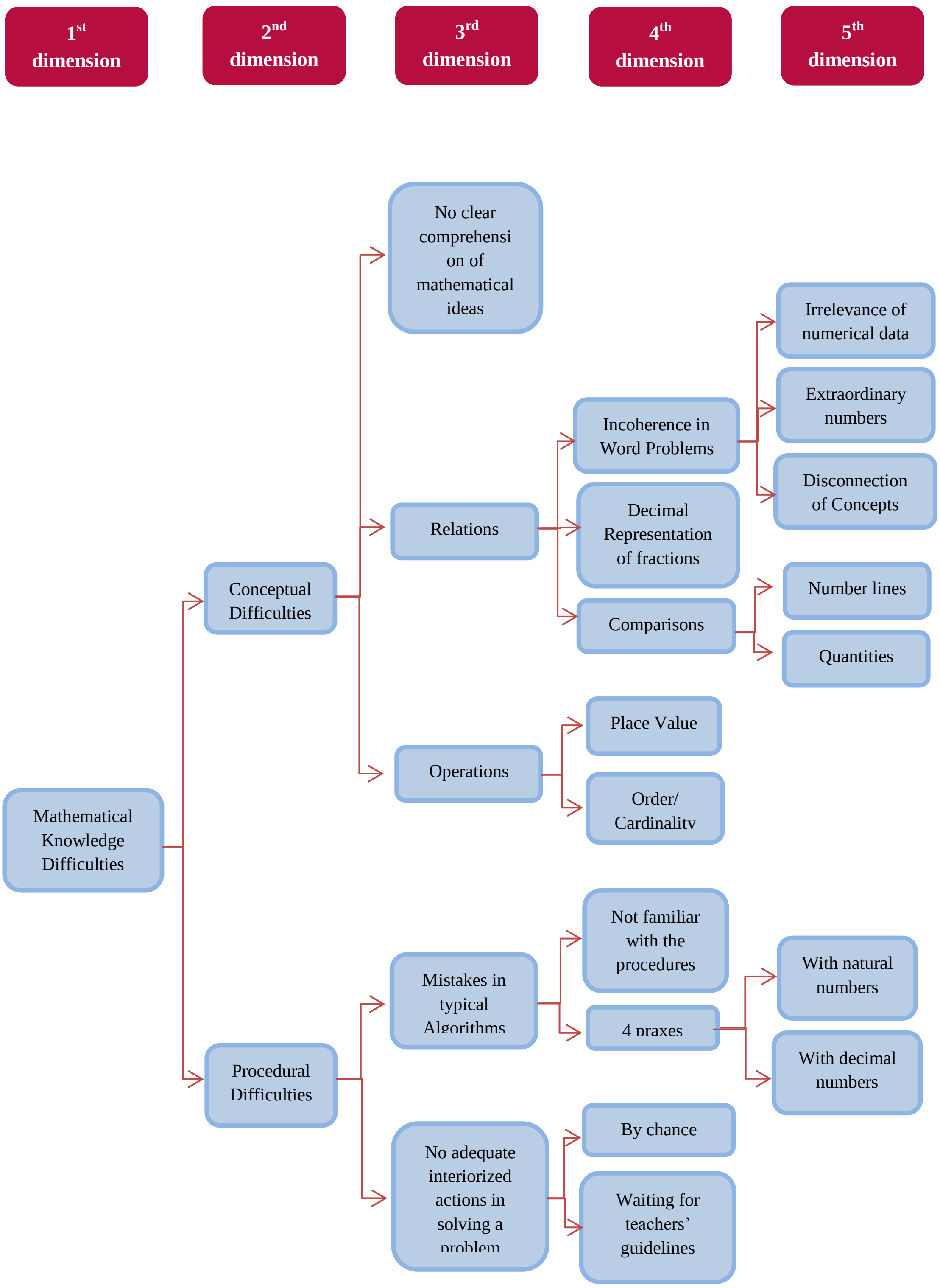

Diagram C

The 1st dimension of mathematical knowledge difficulties mirrors the elements of 2nd dimension, conceptual and procedural knowledge, which according to Rittle-Johnson and Schneider (2015) are seen as two interwoven and bi-directional relations with increases in one area leading to subsequent increases in the other and vice versa. Each one of them is divided into extra classifications of 3rd dimension. Particularly conceptual knowledge is defined as network knowledge of concepts -comprehension of mathematical ideas, operations, and relations- full of rich connections. Procedural knowledge is considered to be a procedure of a predetermined sequence of steps which lead to correctly executed algorithms or interiorized actions that must be coordinated approximately to solve a problem. So, this theory is utilized in order to model the first 3 dimensions of analysis. Further dimensions, 4th, and 5th, have been created from the data which was gathered from observation.

The elements of conceptual and procedural mathematical knowledge were organized in discrete groups and subgroups in order to elucidate the obstacles observed in classrooms. Sometimes though, they were overlapping between each other because these two main categories of difficulties are interlinked. The above diagram C depicts the categorization model up to 5th dimension, whereas a more thorough examination is detailed with a wide range of paradigms. In every category or subcategory, there is a description and interpretation of highlights of dialogs/conversations and acts concerning the difficulties detected in students' mathematical knowledge.

Data Interpretation

We constructed and followed the particular analysis as shown in Diagram C for a better organization and possible exegesis of the data correlated with students' mathematical knowledge difficulties (1st dimension).

2nd dimension *Conceptual difficulties*

In the conceptual difficulties, we spotted that students didn't have neat understandings of numeracy and fractions, as those were the two major sections they were occupied with in class. The relationships in the mathematical ideas were fragile and incoherent within problems, representations, and comparisons. Moreover, in operations they were making a lot of place value and order mistakes.

3rd dimension *No clear comprehension of mathematical ideas*

Students didn't have a clear understanding of the mathematical ideas correlated with numeracy and fractions or of their decimal representations.

3rd dimension *Relations*

It was detected that there wasn't a profound comprehension in problems, representations, and comparisons.

4th dimension *Incoherence in Word Problems*

Certain children presented some difficulties in how to act on solving word problems. They didn't pay attention to the relevance of the context and the numerical data. They were guided either by other clues (e.g. keywords, big-small numbers, etc.) they had marked, or by teachers' hints. They also seemed unconvinced about the authenticity of a problem when the prices of objects involved were incompatible with the prices in the real market. Falsely solving approaches were caused by the disconnection of concepts implied in them.

5th dimension **Irr*elevance of numerical data***

The majority of students didn't normally form logical connections and justifications between the numbers presented in the problems and the context relationships bounded in them.

Students' Interviews

Some students (Ch) actually stated in interviews: "*No…, to tell the truth, I would have thought if the numbers were too big I would do subtraction while if they were small I would add them*".

"I will see the big number. If it doesn't say the number, e.g. there are 10 kilos of bananas and there is no number… we'll take out from the other we'll do plus (+) *and we'll put then the others".*

5th dimension ***Extraordinary numbers***

A few pupils disclosed directly their query about the numbers used in arithmetical word problems as unconventional with daily circumstances.

Observation Class E

Issues were raised in the use of "strange-extraordinary" numbers. For example, one student (Ch) maintained her hesitation in a word problem about the price of the suit and coat by saying with surprise "*But Mrs. is the price of the coat always that much?*". Also, a pupil (Chri) expressed, in a different word problem, his doubt about the cost of a pencil case, saying "*What, 11 euros?*", while another one (Tbl) agreed with him.

5th dimension ***Disconnection of concepts***

The students sometimes found the result mentally, using repeated addition or regrouping for multiplication and addition and counting upwards or downwards for subtraction, but couldn't discern their actions into operations.

Observation Class D

In the dialogues below, we concentrated on pupils' responses. It seems, by their first reactions, that they understood the problem, but couldn't grasp the idea of multiplication. This idea emerged from the combination of the same number sums, or from the opposite function of the breakdown of the initial number into equivalent terms.

Teacher: *How many vegetables have we?*

Students: *24… 24.*

Teacher: *In what ways can we distribute them* (equally)*?*

Students: *2 by 2…4 by 4…3 by 3…12 by 12…6 by 6…*

(…)

Teacher: *If we put 2 vegetables in every row, how many rows will be formed?*

Students: (They were saying random, incoherent numbers).

(…)

Teacher: *Now if we put 3 rows, how many vegetables will be in every row?*

Txou: *We could have 9 and 9 and 6, Mr.*

Teacher: *No, they should be the same as we said. Count them; Pic drew them in the whiteboard… We have 8 in the first line, 8 in the second and 8 in the third, altogether 24.*

(…)

<u>Observation Class F</u>

A student (T) couldn't associate repeated addition with multiplication. In a word problem, he correctly chose to add 27 (boxes) times the number 6 (color tubes in each box) and then 24 (boxes) times the number 8 (color bottles in the box) even if we previously suggested implicitly the multiplication method.

R: *Ok. How many boxes do we have here?*

T: *One, two, three ... nine* (enumeration). *Nine and nine eighteen and nine 21… no, 27* (counted with fingers for being sure).

R: *That's right. In other words, you can say three times nine… 3 times 9 is the same as 9 and 9 and 9 as you did.*

T: *Aha, yes.*

R: *Alright. In the first picture we have 27 boxes as you said and 6 colors in each of them. So how are you going to find how many colors are there?*

T: *I will add 6 and 6, 12… and 6, 18… and 6, 24 and …*

R: *Yes, that is correct! Can I ask you; is there any other way less consuming?*

T: *I don't know any other way!*

R: *May I show you? It's the same method actually. You said you will add 6 and 6 and 6 and 6 and 6… so it's that times 6, as many times as the boxes are.*

T: *Ok.* (He used repeated addition and transformations to solve it)

R: *You did it that way, ok. Try to solve the other sub question too.*

(He again used his method)

4th dimension *Decimal Representation of fractions and vice versa*

Almost none of the students of the 6th grade could convert fractions to their decimal representations and the opposite comprehensively. They mechanically transformed those with the trick (of adding or erasing zeros and add the decimal point where is needed) they had learned in class.

Observation Class F

The student (L) had a particular difficulty in transferring these representations of numbers from one form to another. He used to forget the procedure or mix up the representations. For instance, in the equivalence of 3/100 or 35/1000, he wrote 0.3 and 0.0035 respectively. On the opposite procedure, he wrote 8.506 as 506/1000 and 5.006 as 5/1000. He didn't quite connect these representations.

4th dimension *Comparisons*

The students had trouble with comparing numbers on the number line or numbers representing a specific quantity.

5th dimension *Number lines*

In the number line, they couldn't set the numbers in the right order from the smallest to the biggest numbers or the opposite. In decimal numbers for example:

Observation Class F

The student (O) in an exercise where he had to put the numbers 1.5, 1.8, 0.3, 2.4, 6.7, 8.1 and 9.9 on the number line, divided from 0 to 10, with extra line spaces between two sequential numbers, he mixed them up and put almost half of them in wrong positions.

5th dimension *Quantities*

In some problems, where the quantities of the numbers were depicted in pictures, it was again not easy for the pupils to connect. Even in familiar contexts such as money manipulations, a few made mistakes. For example:

Observation Class F

The student (Pg) in an exercise with some amounts of coins couldn't figure out the final results of the sums of the money. For instance, in a picture of two 20cents and one 2cent, she read the coin of 2cent as 20cents and found 60 cents instead of 42cents.

3rd dimension *Operations*

Basically, all students of all classes had false assumptions about place value and made mistakes in typical operations. In 4th class also a few children had wrongly identified the numbers by order, name or symbols.

4th dimension *Place value*

- Many students had difficulties in the realization of groups of tens, hundreds, etc. They set the digits in different place value position in operations.

Observation Class D

A student (Prsk)working on mental computations of addition and subtraction with the help of a number line, had to figure out how many more she needed from 68 to 100. After she had found that 3 tens and 2 ones were required, she then added them as ones. She expressed "*2 and 3…2, 3, 4, 5… yes 5*" the false idea of 3 tens as 3 ones. She hadn't realized 3 tens mean 30.

Observation Class F

In an exercise that required the opposite strategy of decomposition, children had to combine 1 thousand, 13 hundred, 15 tens and 28 ones to find the formed number. All of them came up with a wrong answer. On the one hand it was difficult to realize that 13 hundreds, for example, have 10 hundreds. This can be transformed differently as 1 thousand, so the number would be 1300. On the other hand, teacher's explanations had no impact on students' perception as she talked solely, with no interaction with the class.

In subtraction 300-59 (vertically) some students placed the number 5 (tens) below number three (hundreds) and number 9 (ones) below number 0 (tens). In 10-8.35 (vertically) two students placed the number 8 (ones) below 1 (ten). In addition 1,084+586+896 (vertically) a student (P) placed the two last numbers one position ahead. In the place of thousands he wrote 5 and 8, in the hundreds the 8 and 9 and in the tens the 6s.

In multiplication 34x25 (vertically) a student (V) couldn't figure out where he had to place the 8 from the product 2x4, in the column of ones or tens. The teacher explained "*when we multiple 2* (tens)-*20 with 4* (ones), *it gives us tens*" and then he wrote it in the right column.

In addition 2735+700 (vertically) a student (Pg) had written down the number 700 one column ahead but had trouble with praxis 2,500+500, 1,220+200 and 1,800+200 (horizontally), because she couldn't figure out which numbers of the same value team to add.

A student (G) in addition 27+16 vertically explained to us "*7 and 6 are 13*" and wrote the whole number below. He continued by adding the tens by saying "2 and 1 are 3" and wrote it in front of 13 and formed the result 313.

- Many students had difficulties in naming or writing the numbers, especially when there was a zero involved.

Observation Class E

Difficulties perceived in number place value in large numbers. The difficulties were demonstrated in the patterns of number formation and position. For example, when a student (Par) failed to name the number 1,356 and the teacher pronounced it for her. The same student also falsely named the number 2,400 as "two hundred and forty

(240)”. Another two students -a girl and a boy- followed with the same mistake reading the numbers 2,900 as “*two hundred and ninety* (290)” and 2,260 as “*two hundred and sixty* (260)”.

Except from the verbal expressions, pupils’ errors were further spotted in the writing form. When two boys heard the numbers 1,280 and 2,400 they both wrote 128 and 20,400 respectively, another one heard the number 586 he wrote 5,86 “*five thousand and eighty six*”; making two mistakes at the same time. Furthermore, when a girl heard the numbers 1,050 and 1,075 she wrote 150 and 175 skipping the middle zero. The last one also wrote 2.8oo instead of 2.800 dealing the zeros as non-numbers whereas the teacher rigidly said to her “*Ch these are numbers, they are zeros not letters, make them larger as the previous numbers 2 and 8*”.

Observation Class F

The same difficulties were observed in this classroom. For example, a student (V) read the number 212 as “*two thousand and twelve* (2,012)”. A student (Pg) hesitated to read all the numbers presented to her and pronounced the numbers 2,500, 1,220, 1,800, 3,600, 2,735 as “*two hundred and fifty* (250)”, “*one thousand and twenty* (1,020) or *one hundred and twenty two* (122)”, “*eighteen* (18)”, “three thousand and sixty (3,060)” and “*two and seven hundred thirty five* (2 and 735)” respectively.

Students also couldn’t write the form of the numbers correctly. The number 106 he (J) wrote it as “*16*”, as well as the number 1,420 she (Pg) marked it down as “*142*” or 3,000 as “*3,0000*”, or 20,000 as “*2,000*”. In a different task, where the teacher told them to write some numbers and analyze them in thousands, hundreds, tens and ones, two students couldn’t find the right order to place each number to form the whole; for instance, the number 1,406 was written as 1,460 and 1,46; and almost all had trouble decomposing them. For instance, a student broke down the number 2,249 as 2 ones and suddenly stopped and asked for the teacher’s help saying “*2 ones and another 2, what is this? I didn’t understand how we’ll do it, Mrs. Come here, please*”. Teacher’s explanation generally was procedural and some students entirely followed her first paradigm, while others asked her or their classmates for help.

4th dimension ***Order/Cardinality***

- Some students of 4th class weren’t able to enumerate/count correctly (cardinality).

Observation Class D

For example, (Xru) when asked “*Which number is after 49?*” she hesitated to reply.

When enumerating she mixed the sequence of natural numbers.

- Students of 4th class furthermore had trouble in recognizing and ordering the numbers, while adding or subtracting.

Observation Class D

A child (Xru) often, as she was trying to transfer the numbers from the acoustic form to the writing form, she noted them in the opposite order, e.g. twenty five as “*52*”, twenty one as "*12*", etc. and wrongly in the digit of tens or in the last digit of ones, e.g. sixty three as "*43*", twelve as "*18*", etc. In additions also a few other children wrote the results of ones and tens in reverse, e.g. 25+20=54, 30+37=76, etc.

2nd dimension *Procedural difficulties*

Difficulties were noticed in the algorithmic operations and in actions taken to solve a problem, where actually in those areas teachers were most focused on. In algorithms, children made a lot of mistakes regularly because of the lack of connection with symbolic representations and confusion or unfamiliarity of operational steps. In problem solving, there were no adequate interiorized actions since they were waiting for their teachers to disclose the answers or were choosing operations by luck.

3rd dimension *Mistakes in typical algorithms*

In 4 major operational procedures, there were flaws and errors. Because they either didn't know at all the series of steps needed, or they didn't remember some steps and forgot other formulas.

4th dimension *Not familiar with the procedures*

Some of them didn't know or didn't remember how to begin executing an operation. They forgot or mixed the steps followed.

Observation Class D

A student (Tap) in subtraction 3.000-2.568 (vertically) failed to recall the steps needed and asked the teacher for help. In the middle of the process he began to perform addition.

Observation Class E

In division, all students got tangled with the steps of the praxis applying addition in lieu of subtraction or multiplication towards divisible and divisor respectively.

Observation Class F

The student (J) was stuck and mixed the priority series of multiplication algorithm (vertically and horizontally). Another student (Pg) in multiplication 27x46 didn't know how to begin and asked the guidance of the teacher. The same pupil came to the board to execute the multiplication 24x67, although instead of multiplication she performed addition but with consideration of multiplication algorithmic rules. She mixed the symbol x for +. The teacher stopped her, pointed out the names of the symbols and helped her carry out the operation altogether. The pupil, when later had to add the multiplication products 168+1,440 she, hadn't put the plus symbol and tried to perform multiplication again.

Pg: *7 and 4 equal 11. 7 plus 2 gives us 9…*

Teacher: *No, no stop. You don't do plus (+), you do times (x). This is called times. Again…*

(…)

Pg: *Now, 4 times 8…*

Teacher: *No, now you add, you add them. Put the symbol in front of 1,440.*

4th dimension ***4 praxes***

Students' solutions in typical written algorithms were inaccurate as they hadn't perfectly acquired the method taught in class in all 4 praxes (addition, subtraction, multiplication, division).

5th dimension ***With natural numbers***

- They were used in the carrying-lending digit method in addition, subtraction and multiplication but systematically had forgotten or mixed the digits. Examples from each class are demonstrated below.

<u>Observation Class D</u>

In addition 32+68 (vertically) children were bewildered with the carrying digit method and made mistakes during the process. Some of them came up with 90, while others didn't know what to do at all; staring mere at the whiteboard and listening to the teacher's justifications. However, they had ended sooner to the correct result mentally-using their minds.

<u>Observation Class E</u>

In subtraction 700-532 (vertically) one student said "*take away two from zero equals two*" instead of 'lending' a ten and saying that take away two from ten equals 8, and continued the procedure as the teacher guided him. A second student in addition 1,084+586+896 (vertically) at first when he added the ones (6+6+4=16) he didn't know what to keep as a carrying digit and what to place in the units column he then forgot to add the last carrying number to the one thousand and in the end he found 1,566 instead of 2,566. Another student (Pj) in addition 224+358 (vertically) in the unit column wrote 12, the whole sum of 4+8, asking then for the teacher's help since she didn't know how to continue the procedure and knew she somehow had made a mistake.

<u>Observation Class F</u>

The student (L) in subtraction 2,500-2,288 (vertically) said "*take away eight from zero equals eight*" instead of 'lending' a ten and saying that taking away eight from ten equals 2, as this was the method he had been taught. The teacher stopped him, reminded him "*the lending number"* and he started again.

In multiplication 57x32 (vertically) the student (O) started to multiply the ones. He said "*2 times 7 equal 14*" but had put the 1 (tens) on the section of units, just underneath 7 and 2 and kept the 4 as a carrying digit. That student had done the same mistake several times and the teacher often reminded him the so-called rules, that the units were placed underneath units, tens underneath tens and so on.

- Horizontally or vertically, they struggle to compute with zeroes at the end of the numbers, how many to add the correct number at the end of the number multiplication product and sometimes they didn't count zero in at all as a number that changes the value of the initial number.

Observation Class F

In multiplications with numbers ending in zeroes, all or merely all forgot to add the zeroes, in the multiplication product. For example, in 15x30 they calculated it as 45 instead of 450; in 22x300 they calculated it as 66 or 660 instead of 6,600.

5th dimension ***With decimal numbers***

There were similar problems with the operations with decimal numbers.

Observation Class E

Students hadn't put the decimal point at all or had been placing it in the wrong position. In the multiplication 1.40x3 he (Chri) hadn't placed the dot in the result (4.20).

A student (X) in multiplications with decimal numbers couldn't put the decimal point at the correct position. She often didn't set it at all. She hadn't acquired any understanding of that notion.

3rd dimension ***No adequate interiorized actions in solving a problem***

Normally pupils made unmethodical attempts in solving problems, and succeeded either by chance, or with the help of the teacher.

4th dimension ***By chance***

They chose a method or an operation with haphazard attempt to solve a problem quickly. That phenomenon was common in all classes and observed many times.

4th dimension ***Waiting for teachers' guidelines***

They didn't understand in depth the word problems and what was the actual question of the problem, since the answers were immediately given by the teacher. The children only asked for a restatement of the replies so they could write them down on their worksheets.

Observation Class E

For example, they constantly kept asking "*What did you say, Mrs.?*", "*Please say it one more time*", "*I didn't understand, what?*", "*Once again.*" "*What did you say - were lost, were left or were there*?" etc. Some of them left the section that required an answer blank. They were clearly saying, if asked by the teacher, that they didn't hear it or didn't understand it.

Language Difficulties

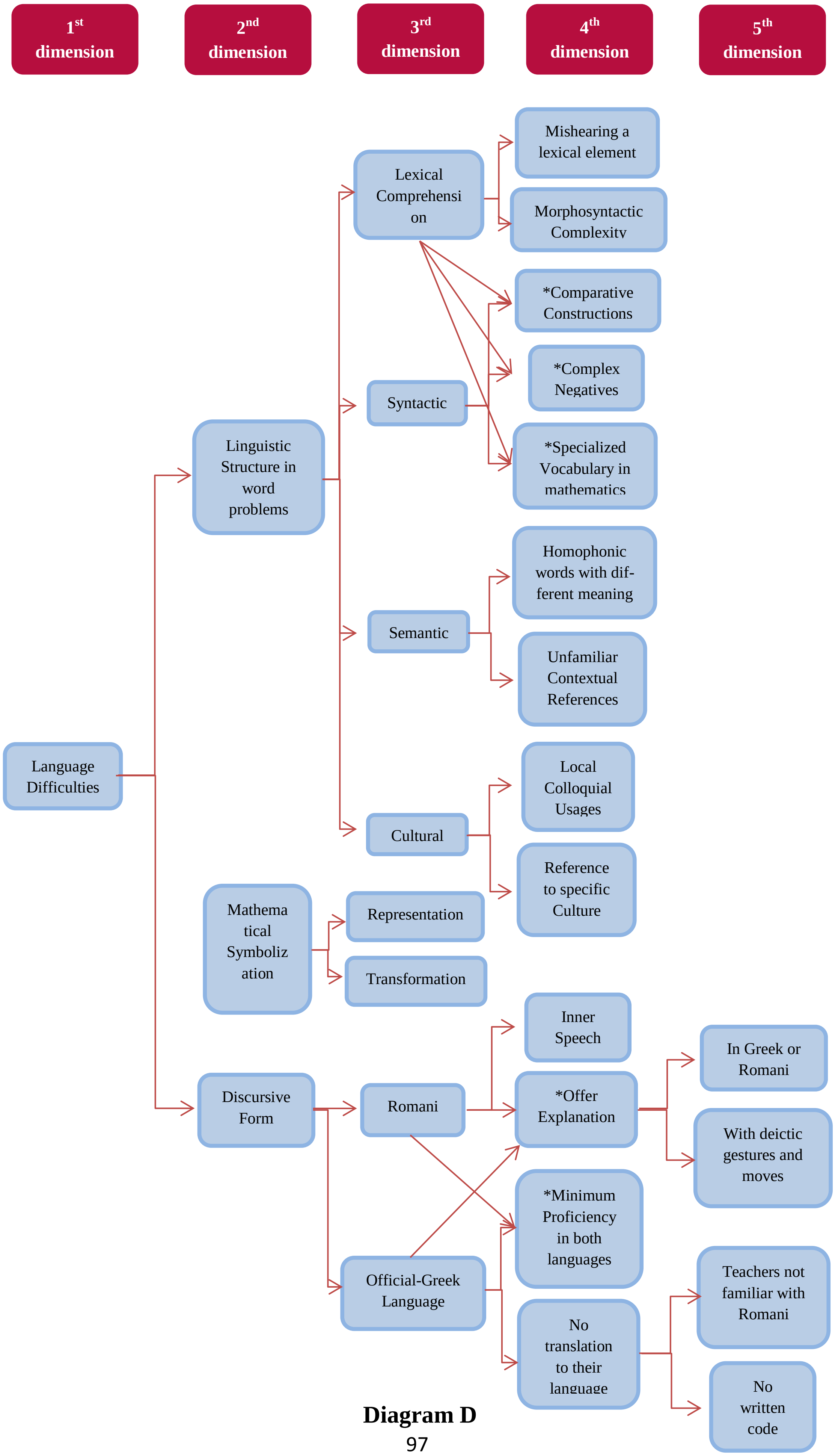

Diagram D

The symbol * indicates that these classifications belong to two categories

In the mathematics class, language spaces offer participation in learning. Nonetheless, particular contexts of text form or discourse mode create linguistic challenges for students who speak a different language from that of the school mainstream (Barwell, 2014).

In order to shape the above analysis of linguistic obstacles of Romany students in Greek maths class, we used partially the surveys of Varghuse (2009) and Barwell (2014) in decomposition of linguistic structure in word problems, symbolism and some elements of the discursive form. Consequently, the 2nd dimension is presented by linguistic structure in word problems, mathematical symbolization and discursive form. The further subcategories, which became visible in class, were combined with the two studies to end up in this schema analysis. The above diagram D depicts the categorization model up to 5th dimension (it reached the 6th dimension), whereas a more thorough examination is detailed below with a wide range of paradigms

Data Interpretation

For a better organization and possible interpretation of the data regarding students' language difficulties (1st dimension) we followed the analysis as shown in Diagram D with paradigms in various subcategories.

2nd dimension ***Linguistic Structure in word problems***

Linguistic structure, as a lexical, syntactic, semantic and cultural feature, may have significant impact on language translation and code switching, on distinct forms of errors despite students' mathematical skills and in comparison with other non Roma pupils.

3rd dimension ***Lexical Comprehension***

The lexical comprehension refers to difficulties in understanding lexical items in Greek (usually items not frequently used in every day speech).

4th dimension ***Mishearing a lexical element***

Students perceived one or more phonetic/phonemic features differently, mainly because of their unfamiliarity with mathematical or general vocabulary.

Observation Class E

The teacher introduced the word three-digit (=tripsifios) to the students in order to work on multiplication product analysis (e.g. 715x2 = (700x2) + (10x2) + (5x2)) When they heard that word they responded: "*What… tri- … what?*".

Observation Class F

The children couldn't easily repeat the words symmetrical axe (=axonas symetrias), numerator (=arithmitis), denominator (=paronomastis), decimeter (=dekatometro), centimeter (=ekatostometro), millimeter (=hiliostometro). They stopped in the beginning or in the middle of these words and it wasn't easy to recall them or to write them either.

4th dimension ***Morphosyntactic Complexity***

The morphosyntax of mathematical register used appears to be associated with constrains during the procedures of constructing meanings. Complex utterances like the suffixes of verbs [e.g. in Greek, verb suffixes are used to define the person who is doing something i.e I play (=paizo), you play (=paizeis), etc.-] were spotted (only a few) and created confusion to some children in the word problems, as the whole meaning instantly changed.

3rd dimension ***Syntactic***

The syntax of the problem plays a major role in conceptualization. An extremely sophisticated use of language, passive voice, superfluous phrases and unfamiliar words result in understanding leaps and discrepancy of information. Some syntactic difficulties were observed on comparative and negative complexions.

We should just elucidate that the 3 following difficulties do not only belong to syntactic structure but also to lexical; i.e. when someone would try to correlate or give meaning to single word or periphrastic comparative -which also requires different syntactic structure- registered in non-daily vocabulary.

4th dimension ****Comparative Constructions***

Expressions or words with the central meaning of comparative assumptions indicating minimum, maximum or in between sometimes blurred student's judgement about how to deal with the problem.

When there were phrases such as more than, less than, at least, between, faster, longer, smallest, etc. and some results required a translation from arithmetical data to mathematical statements of comparison or the opposite, students did not handle it as comparative form and moved to falsely assumptions and acts.

Observation Class D

For example, in a problem like "*Helen invited …* (unknown) *boys. The girls were less than boys by 2. How many were the kids?* Or *Helen invited 14 girls. The boys were 3…* (unknown) *than girls. How many were the kids?"* multiple modifications and solutions were possible. Children couldn't suggest any well-documented thoughts and the teacher guided them to the solutions.

In another problem "*Nick has 20 cars-blue, red and purple-. The blue cars are as many as the red cars. The purple cars are less. How many cars could he have?*" similarly, children hadn't noticed the wording 'as many as' and were calling out the numbers of Nick's cars inconsistently.

Observation Class E

For example in the problem "*John's family weighs 210 kilos in total. What is John's weight, if his father weighs 78,250 k., his mother 60,700 k. and his sister 26,150 k. less than her mother?*" the pupils hadn't taken into account the phrase 'less than her mother'. Although they should have come up with the sister's weight first, they instead added altogether the weight of the three members of the family and then they subtracted it from the sum of family's weight to find out John's.

Observation Class F

For instance in the problem "*Maria's family bought fruit and vegetables from the grocery shop: 2.7 kilos of apples, 1.8 kilos of cabbage, 3.2 kilos of grapes, 1.5 kilos of tomatoes and 1.6 kilos of oranges. 1. Look at the vegetables. Are they more than 3 kilos, why? How much heavier is the cabbage from the tomatoes?…"* less than half students were obtaining the answers mentally, which indicated that they understood the comparative references but the others couldn't fully comprehend the relationships bounded in them.

4th dimension ***Complex Negatives***

Phrases with connotations regarding double negations or negatives combined with comparatives (e.g. no more than, no greater than, no less than, not as much as, etc.) were present in some problems and tricked the pupils.

4th dimension ***Specialized Vocabulary in mathematics***

Specialized vocabulary, as any word or phrase that has a particular meaning in mathematics, is usually unknown to them, therefore, they are unable to understand its principals.

- **In operations:**

Every time the students had to choose an operation in order to solve a problem, they chose randomly as they couldn't understand the concept and couldn't connect the operation names with their functioning.

Observation Class E

They were commonly confused with the terms of addition, subtraction, multiplication and division. Almost all of them in division algorithm, which had more recently been taught to them, couldn't retain the terms divisor, divisible and quotient.

They often guessed the right phrases. For example, when the teacher asked "*What will we do to find out how many kilos of cherries were there?*" the students answered randomly "*Addition…Subtraction!*" until the teacher confirmed the right reply "*Yes, subtraction*". Or when she asked "*What do we want to find first? The loaves of bread sold. So, what will we do?"* they again answered "*Addition… Subtraction*.".

Observation Class F

Indicative dialogues demonstrated that hindrance once again:

Teacher: *What will we do?*

L: *Em, ee… how is it called? … ahm multiplication!*

Teacher: (nodded negatively)

O: *E, subtraction?*

(…)

Teacher*: To find out how many kilos of cherries were there, what will we do?*

Students: *Addition!*

O: *And, plus.*

Students: *Multiplication!*

L: *Em, how is it called?*

Students: *Subtraction!*

Teacher: *After you said it all, you found it.*

(…)

- **In fractions and decimals:**

The students couldn't remember certain mathematical terms, such as decimal point, decimal numbers.

Observation Class F

When the teacher asked "*Where do we put the decimal point? Do you know what the decimal point is?"* they all paused and tried to remember the term. After a while she responded "*Until now we know it mostly as dot… ok kids dot… the decimal point is dot*".

- **In geometrical shapes:**

Observation Class D

The children confused the term triangle with the term rectangle. There was a triangle sketched on the whiteboard and when the teacher asked "*How do we call this? Do you remember the houses with the roofs we talked about…*?" a pupil (Tap) raised his hands and made a triangle with his fingers but all answered "*a rectangle*".

3rd dimension *Semantic*

In semantic structure we observed how students were ascribing meaning to whole word problem or to isolated words, either general/daily, or mathematical, since they weren't familiar with the Greek vocabulary.

4th dimension *Homophonic words with different meaning*

A drawback detected was the poor vocabulary in the Greek language and the confusion of some homophone linguistic indications misleading students from the clear definition of a word.

There is a lack of vocabulary - lack of linguistic resources, so it becomes hard to respond appropriately. But at the same time it shows creativity in using the available linguistic resources.

Observation Class E

For example the word peasant (=yeoryos) which means "*the farmer, the one who digs the earth…*" was thought by the students to be the name George (=Yioryos) because they were homonymous as they stated "*yes Mrs. we know George, it means George*".

Students' Interviews

When the student (X) was asked how fractions were named, she responded "*crying…I don't know what fractions are*", she confused the word 'klamata' (=crying) with the homonymous 'klasmata' (=fractions). The same reaction was noticed from two more students, (Ag) saying "*those you cry*" and (Pj) "*that you cry!".*

4th dimension ***Unfamiliar Contextual References***

Words that are rather technical or scientific, not used on an everyday basis and therefore, unfamiliar to them, were often present in word problems. These words or phrases prevented kids from receiving full meanings since it was not easy for a lot of words to be explained or memorized. Most of the unknown words to them were explained by the teacher. In a particular case in class E, a small amount of words were also explicated by one girl.

Students' Interviews

One pupil (Ptw) said: "*For example, NASA was an unknown word and we learned it today…".*

Another one (Ch) said "*. For example, I asked the teacher what was "toutos* (this)*" and she told me it was "aftos* (that)*" and the children told me it meant me".*

Observation Class D

A pupil (M) didn't know what a pair meant. So, the educationalist was giving her an explanation by saying "*your mum and dad make a pair, how many persons are they?*". The student had answered "*ah, two*".

Observation Class E

The teacher explained unknown words, such as:

Filathlos (= sports fan) as "*someone who loves football, just like you kids who support a team*".

A student (Ch) explained unknown words, such as:

Tajier (=jacket) as "*skirt-blouse*" by discussing further relevant terms as suit and coat.

Loaves as "*that thing the bread* (gesture) *the whole piece of bread*".

Restauranteur as "*someone who runs a store, a store owner*".

Observation Class F

The teacher explained unknown words, such as:

Double room (=diklino) as "*a cline, it is a room when for example we want to book at a hotel a room for two persons*".

Infinite (=apeiroi) in axes symmetry as "*many, too many*"

The teacher explained to us during class how often she had to stop the flow of the lesson to analyze and define unknown words to them. She drew attention to the insufficient lexis of children and said: "*these students, Roma students, move on really slowly because they can't comprehend the Greek language and from the 1st grade they merely communicated with gestures and signs, couldn't work on books… they aren't familiar with many words… that's why we are in the 3rd grade materials and standards… even in history the vocabulary is so hard that I have to explain almost every word to them*".

3rd dimension ***Cultural***

The two teachers strictly followed the book structure which had not particular references to their culture and only few problems were related to their interests (mainly sports). One teacher employed word problems only with money exchange context because of children's involvement in merchandise but nothing further (no other types of problems).

4th dimension ***Local Colloquial Usages***

The problems were stretched with formal morphology usages, in which children weren't used to such conventionalized terms for the same thing, expressed by different synonyms for various socially defined groups.
Except that, they weren't familiar with more formal but less colloquial-intimacy pronunciations; they addressed the teachers in the second singular person instead of the second plural person (a typical rule of social nobility discourse).

4th dimension ***Reference to specific Culture***

We could say that the context of the problems was far of their habits and interests. From the 9 kids who ascribed a linked relation to their interests, only 1 student (Xval) gave a paradigm "*For example I go and buy a bicycle, it has it in* (the context). *Do you want to show you…?"*.

2nd dimension **Mathematical** ***Symbolization***

Another obstacle was that the students were not familiar with symbolical representation or transformation because they confused or completely forgot the symbols. Some of them didn't understand the meanings of those expressions at all and some mixed them with other symbols.

3rd dimension ***Representation***

They had trouble representing them in the writing form as symbols. There was no absorption of the operational symbols.

<u>Observation Class D</u>

The teacher depicted the repeated addition of the same numbers shapely and symbolically and introduced the new symbol of multiplication. For example, they wrote 6=6 instead of 6+6 while the instructor shouted "*and, and, plus, the cross*". Furthermore in the sum 6+6+6+6=24 he said "*How else can we call this?... We can say 4 times 6*" and wrote 4x6; "*that* (symbol) *is called times*". He expected that from the first time of rephrasing, representing and explaining, children could immediately remember and distinguish the new symbols and terms of multiplication. Many of them, as we asked, didn't understand the meanings of every symbol neither their purpose nor terminology, e.g. "*No, I don't know them, I don't understand them!*".

<u>Observation Class E</u>

Regularly they didn't know which symbol to choose in depicting operations typically and made mistakes. For instance, a student in addition 1,084+586+896 (vertically) put the symbol of multiplication instead of that of addition. The teacher corrected him by saying "*Hey, no x, plus-and; you don't perform multiplication but addition*". Two others made the opposite mistake; instead of the multiplication symbol they put the addition symbol in 38x42.

<u>Observation Class F</u>

The student (Pg) wrote the multiplication tables of 4 and 6 with the dot symbol (·). She didn't know how to depict the multiplication symbol afterwards, as an (x) or (·), ending with the symbol of division (:).

Pg: *Which is the times* (symbol) *now Mrs. I forgot. Is it one little dot or the x?*

Teacher: *It's both of them.*

Pg: *E, ok then, I'll put 2 dots. One dot, two dots, it's the same*.

Teacher: *No, one dot. Two dots is division, it's different*.

In every operation a student (G) didn't put any symbol or mixed them both in oral and in writing form. For instance, he wrote 14:100=1,400 instead of times (x) in a problem. Similarly the students (T) and (J) wrote 70:10=700 instead of times (x) and 700x7=100 instead of via (:) in a problem. Nonetheless, they had found the result mentally but couldn't depict it as an operation correctly.

The student (T) couldn't remember the symbol of subtraction and was stuck during the written operation 192-162; yet he had found the result mentally. When we showed the symbol to him, he wrote 192-30. At that point we clarified the number 30 was the result and then he wrote 192=30. He also forgot what the equality symbol represented. He clearly couldn't connect the meaning and the sequence of subtraction to a symbolization form. At last we explained that he ought to put them in order so it would make sense, "*from the 192 colors subtract the 162 and then have the result*".

3rd dimension *Transformation*

It was hard to transform the symbolic form into words. They couldn't recognize and relate the right symbol with the appropriate praxis.

Observation Class D

Almost all of them in every lesson confused the symbols of every operation they had learned. Some examples beneath illustrate that perplexity. When the teacher asked them "*how do we call this operation (-)?*" some students timidly answered "*it is the and-plus (+) and the equal (=)*". In that moment the teacher roughly corrected them, saying "*which equal kids? It's called out, we take out. Put and take out - addition and subtraction*". Another time students read 7+3 as "*seven minus three*", or 60-30 as "*sixty plus thirty*" or 9-7 as "*nine plus seven*", or read the 3x10, as "*three plus ten*" or 1x3 as "*one plus three*", etc.

Observation Class F

A student (G) couldn't distinguish the symbols, e.g. (+) from (x), (:) from (x), (+) from (-). For him they were quite the same, connected with no meaning and understanding, as he clearly told us "*No, Mrs. I do not know these, I don't understand them*".

Other pupils (O and P) couldn't recognize the function of symbols of multiplication (x) and the comma (,) we put on numbers up to 1,000. When he (O) heard the number 1,452, he wrote it firstly as 1,000x452 and then 1x452 instead of 1,452. The same happened with the number 2,249.

When she (Pg) had to mark down the comma (,), she didn't know where to put it; in number 30,000, she placed it one position ahead, like 3,0000.

2nd dimension *Discursive Form*

The interpretation of mathematical objects within dialogues and gestures or moves was obvious, either with the usage of their mother tongue or with their struggle of expressed thoughts in official language.

However, because of unfamiliarity with the Romani language, we can't thoroughly analyze any example of inner speech or explanations in Gypsy. We collected observations and students' interpretations.

3rd dimension *Romani*

All students used their first language many times inside mathematics classroom. They used it alone as inner speech, or in groups for explications.

4th dimension *Inner Speech*

They used inner speech as they were trying to translate Greek to Romani in order to grasp as many details as possible.

They were thinking out loud (whispering) in Romani, making efforts to connect the pieces of the text and to find a method to solve the problem. They were keeping track of the arithmetical results they had acquired by mental computations and by their methods of estimation.

4th dimension ****Offer Explanations***

Students offered explanations to each other or to teachers every time they were asked. Usually, to teachers they used Greek language whilst to students Romani language, even when sometimes the teachers asked them to explain in Greek.

The majority asked teachers more because of two main reasons. Firstly, because the rest of the children didn't know the definitions of certain words either or couldn't attribute efficiently the meaning of the problem or weren't sure about the correct operations chosen. Secondly, because of the teacher was seen as a prototype by them. Students trusted the teachers to explain everything accurately, adequately and more sophisticated.

5th dimension ***In Greek or Romani***

When a student asked for help, the others were trying to give explanations to him/her usually in Romani. It was the preferable language for many students.

6th dimension ***Acceptable or not by teachers-when***

As long as teachers were involved in discursive spaces, there were limited boundaries in what language to choose. Inside the classroom they imposed the official language on the pupils because they didn't know Romani so they wanted them to acquire language and mathematical vocabulary fluency.

They allowed them to speak in Gypsy only when the kids didn't understand the teacher's analysis. So, they had to explicate to each other in pairs or in groups what the problem negotiated.

Observation Class D

The teacher strictly prohibited all children to speak in Romani in school lessons. Whenever they mentioned any gypsy expressions he characteristically disapproved their language by verbal threats, like "*Do not ever hear you speak any gypsy in here, ok?*".

However, the pupils continued to ask each other for clarifications and answers in their maternal language, in many problems and exercises, in every math class we attended.

Also, when the teacher assisted a student (Th) in a textbook exercise where they were asked to paint the right number of columns in order to depict the multiplication results of 3x7, 5x7 and 6x7, he explained "Th you should paint the boxes as it says 6x7. Here you have 6 vertically and 7 horizontally, you paint them all inside, near each other". In that moment (Th) the pupil wondered "Near, what is near?" and another student (Tche) immediately translated it in their language as "peso".

Observation Class F

Particular groups of 4 or pairs of 2 often collaborated in order to solve the exercises of the school book. At a regular basis they used their mother tongue to explain to each other the problem texts and singularly words, the algorithmic procedures followed and the methods required to solve any task. The teacher allowed them to speak in Romani up to the point where their thoughts and actions in math class weren't sidelined by chitchatting-gossiping or copying each other. She commonly stopped them by saying "*kids that's enough; I allow you to collaborate but not to fool around and discuss about irrelevant matters and giggle*".

5th dimension *With deictic gestures and moves*

Occasionally, children used a lot of deictic gestures and moves to communicate their thoughts and simplify the mathematical clarifications towards their classmates or teachers.

Some indicative examples were presented below in dialogues:

Observation class E

Teacher: *Don't we have to figure out how much money did she paid for both the jacket and trouser?*

Students: *The plus (+) we are going to do Mrs.* (deictic gesture)

(…)

Teacher: *She gave 59 € and she has 300 €. We want to find how many she has left. So what are we going to do?*

Chri: *That with one line!* (deictic gesture)

Teacher: *That is called subtraction. So we will do subtraction.*

(…)

T: *What operation will you apply?*

Ch: *The one with the and (+)… uhm addition*. (deictic gestures and moves)

Observation Class F

L: *We do times.* (deictic gesture and moves)

Teacher: *No, it isn't times. We gather them all up.*

Students: *And… and!*

Teacher: *What is and?*

Students: *Addition!*

(…)

Teacher: The ones of *you who know… touch the piece of paper* (role representation as fruits). *Ok, you know how much you cost. So?*

O: *We will go!*

Teacher: *Yes, you go; which means, what operation?*

O: *Ehm, the line.* (deictic gesture)

Teacher: *How is it called?*

Students: *Aaahm… subtraction*!

3rd dimension ***Official-Greek Language***

In this part of analysis we rely basically on observation of school structure and legislation. The school system designates Greek as the official language.

4th dimension ****Minimum Proficiency in both languages***

There is no practice of their mother tongue from kindergarten to the last grade of primary school or systematic record of the language (so as not to be forgotten and replaced by other languages). Consequently, they could not reach a proficiency level in Romani. As a result they couldn't reach a similar high level in any official language.

4th dimension ***No translation to their language***

The education authorities involved didn't take preparatory measures for translation classes. That was of course extremely difficult because, on the one hand, there is no trained staff of educationalists that can talk Gypsy and, on the other hand, there is no written code of this Roma dialect.

5th dimension ***Teachers not familiar with Romani***

No teacher knew their dialect since no qualified staff prepared them to teach students with Greek as second language. There was no effort from them to learn some basic gypsy linguistic elements (two of the teachers had many years' experience in this segregated school).

5th dimension ***No written code***

Due to no writing form of Gypsy language, children experienced language loss.

Students' Interviews

More and more words, either common-every day or mathematical, are replaced by the equivalent Greek ones. As we may notice all students (33/33) explained that there are no mathematical terms in Gypsy and they had adapted the Greek terminology or phraseology of other places.

Formal-Informal Mathematics

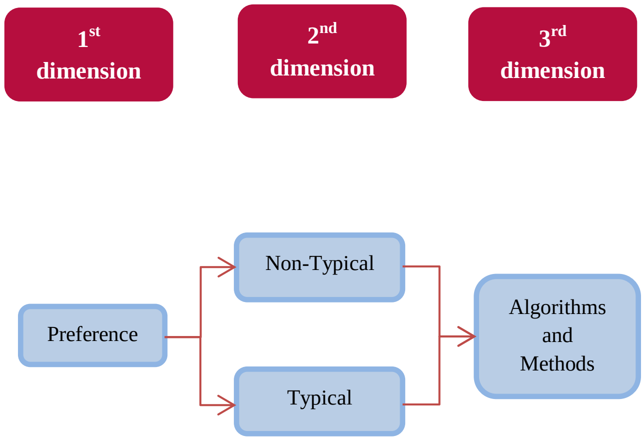

Diagram E

The 1st dimension reveals the preference of students on using typical or non-typical (2nd dimension) algorithms and methods (3rd dimension) inside math class.

Data Interpretation

We highlighted the grouped data related to formal-informal mathematics (0 dimension) which students prefer to use in and outside the school as shown in Diagram E with a few paradigms in the last subcategories.

1st dimension *Preference*

Students struggle with what mathematics they should or would use. A few employed typical methods mainly because teachers requested that. Many used a combination of typical and non-typical algorithms and others favored a combination of hand materials and non-typical algorithms and methods.

2nd dimension *Typical*

'Typical mathematics' refers to the curriculum designated and widely accepted methods and algorithms.

3rd dimension *Algorithms and Methods*

For example:

Observation Class E

A student (Pj) had done the operation 1,385-1,145 mentally by applying the typical addition algorithm, but then he rounded the numbers and found 300. Eventually, he turned to the written algorithm (vertically) obtaining 240 as the answer and said "*Oh yes, it was 240 after all*". He seemed to use firstly a mental computation and rounding method to reach an approximate result but in the end, he used the typical subtraction and came up with the exact amount.

2nd dimension *Non-Typical*

'Non-typical mathematics' refers to algorithms and methods which have been learned outside of school.

3rd dimension *Algorithms and Methods*

For example:

Observation Class D

The kids were occupied with an exercise of painting squares in columns in order to depict the multiplication results of 7 (3x7, 6x7, 9x7) as the multiplication results of 5 and 2 [3x(5+2), 6x(5+2), 9x(5+2)] and then found the product. A student (N) couldn't understand how to act since he was used to following teacher's orders. However, when we urged him to read it by himself and try to solve it, he used repeated addition and regrouping, using also the results he had already found. In 3x7 he explained "*7 and 7, 14 and 7, 21*", in 6x7 he used the previous result 21 as a double and said "*since it is 6 times it is half of 3, so 21 and 21, 42*". In 7x9 he utilized the previous results 21 and 42 as groups of 3x7 and 6x7 respectively for the larger amount 7x9 as 7x(3+6) and affirmed "*21 and 21 I had found 42 and another 21, 62…63*". Later on a similar exercise of painting and finding the multiplication products of 8 (3x8 or 8x3, 6x8 or 8x6, 9x8 and 4x9) he used repeated addition and regrouping. For example, in 3x8 he responded "*3 and 3 make 6, 6 and 6, 12 and 6, 18 and 6, 24*" and in 4x9 "*4, 8, 12, 16, 20, 24, 28, 32, 36*". He continued working on his own on the following exercises of the book, using his way of thinking and on the last problem "*A sea turtle has 4 legs. How many do 12 or 6 have?*" he performed the same procedure by saying "*we'll do 4 times 6, so 6 and 6 make 12 and 6, 18 and 6, 24…for 12 we have 12 times 4, so 4, 8, 12,…48*". In the last problem where there was no picture as a helpful optical tool, he used his fingers to keep track of how many times he added the amount of 4.

Observation Class F

When a student (T) was left to act alone on a word problem he achieved the result correctly by mental computation. He chose to multiply 6x27 and 8x24 by the method of repeated grouping. As additional help, he used the picture of rows and columns of the boxes with color tubes or bottles and drew lines and wrote some results in the textbook to keep track with the large sums. For the color tubes, in the first column, he wrote in every row-box the sums of repeated addition (6, 12, 18, 24, 30, 36, 42, 48, 54) and for the 3 columns, he added 3 times the number 54 (54+54+54=162). For the color bottles, he strikingly performed the same logically succession, since he wasn't convinced by the implicit suggestion of multiplication and went ahead with his initial method. He confirmed that he "*didn't know any other way*". So, he grouped two boxes in the first column (8+8=16) and wrote in every row-box the sums of repeated addition (16+16+16=48) and for the 4 columns, he added 4 times the number 48

(48+48+48+48=192). For the last additions, he explained that he initially counts the tens and then the ones in groups. For example, in 48+48+48+48 he adds the tens at first by regrouping 40+40=80, so 80+80=160 and the ones after 8+8=16, so 16+16=32 and at the end 160+32=192. Furthermore, when he wanted to find the difference between the tubes (162) and the bottles (192) in subtraction he utilized the counting-up method. Surprisingly, he said "*two and two are the same, so nothing; 100 and 100 are again the same, nothing; sixty to ninety it needs 30 more, so this*". He once more used the repeated grouping method to solve the next problem. He again symbolically depicted the 13 crates of 14 kilos of apples with 13 fourteens and drew lines to separate them in 3 groups of 4 and there was one fourteen spare [3x (14+14+14) +14= 56+56+56+14= 168+14= 182].

The student (V) who received our help was encouraged to use his own way to solve a word problem, so he used mental computations too. Interestingly, he first used decomposition through addition (545+303+218 and 583+294+305) to find the points of each player. He acutely added the hundreds, the tens and the ones. He afterwards subtracted the two sums (1,182-1,066) with the technique of counting-up in order to find the difference in points. He explained "*I added 100 to the zero to reach 100, 20 to 60 to reach 80; up to120 and from 6 to 2 I take out 4, so* (120-4=) *116*". He seemed more confident with this method because when he performed the operations later typically he was confused with the symbols, mixed the sequences of procedures and needed our help to execute them.

The students (T) and (O) in four word problems found the correct solution by mental computations but couldn't depict their thought in typical written algorithms. They only wrote the final results. For example, in the problems "*Fotis went on a theater play with 3 friends. The ticket costs 6 €. How much did they pay?*", "*Alex bought 4 boxes of watercolors and each box had 12 watercolors. How many were the watercolors?*" and "*A grandmother gave her 4 grandchildren 100 €. How much money did she give to all?*" they said 24, 48 and 400 correspondingly but couldn't explain their thought process thoroughly. They had applied the repeated addition method while also (O) stated the multiplication as a solution but weren't able to demonstrate it. The same happened with the problem "*I had 420 €. I bought a pair of trousers for 50 € and a blouse for 20 € . How much had I left?*". The student (O) answered orally 150 at first and then corrected it as 350 €. He used subtraction gradually saying "*I had 420 take out 20, so remains 400 and I also take out 50 and remains 150…350*". Nevertheless, he couldn't elaborate his words into symbolical representation.

The student (G) in the problem "*Workers in a farm picked up 400 apples. They put them in crates of 10 kilos each and placed them in rows of 10. a) How many crates will be filled in with 400 apples? b) How many rows of 10 crates will be formed?*" answered approximately 40 to 50 crates in the first question. In the second he said "*we'll have 10 in one row, 10 in the other, 10 and another 10*" but couldn't express his reasoning symbolically and find how many rows would have been created at last.

Two students once again preferred the mental calculation from written ones. The child (G) had to find in an exercise how much money was left from 5.70-3.20. He responded 2.50 € by taking out the euros first and then the cents as he told us. The same happened with the pupil (O) who had 3,500 kilos of oranges and squeezed 700 gr. by answering 2,800 kilos.

3.6 Findings

We will present briefly the findings resulted from the interviews and the classroom observations in order to acquire a complete picture of both sides about the actions, thoughts and obstacles in Romany education.

1st Research Question

Has diverse mathematical understanding of different sociocultural influences been leveraged as funds of knowledge or treated as barrier by teachers?

It was observed in the math lessons of all classes, from the early years, that Rom pupils obtain previous informal mathematical knowledge, mainly due to their occupation with their family jobs and businesses. Specifically, a large amount of students (82%) before entering school, articulated that they have learned from their fathers, mothers, elder siblings and by observing themselves, how to count, execute operations and manipulate money exchanges within their family work. Nevertheless, a disappointing 73% and 61% of teachers, who were aware of students' mathematical background (mainly from merchandising did not ask if they already knew something or how they think about solving a problem, respectively.

According to their didactical approach, the teachers acted in directive, focused or progressive manners. By directive actions, we are referring to a compulsive attitude of educationalists, aiming to steer students into typical ways and giving them hints without comprehension, or treat them as tabula rasa forgetting their preexisting mathematical knowledge. In that way they were advising pupils to abandon their strategies and confront with the typical, centered approaches through monolateral directions. By progressive actions we refer to teacher demonstration of strategies or solutions to problems by themselves, by utilizing examples, explanations and repetitions in order for children to memorize them. In addition, they were always assigning to pupils the simplest exercises and usually similar or lower grade level tasks. By focusing actions we refer to teachers' effort to look into details or maybe reasons behind an answer or idea of students' diverse knowledge. Mainly they rejected it. Sometimes, though, they confirmed it by rewarding comments or by letting them work mentally and then pass on other, new forms of solutions.

Many students (76%) also expressed that the math problems in class are not related to their interests and culture. Just 1 out of 3 teachers had been setting the frame of familiar activities, like money exchange in shops, agoras and newsstand, measurement in clothes.

2nd Research Question

If encountered as drawback, which obstacles, linguistic, math procedural or conceptual, racial practices and discourse or other, appear into mathematical classroom environment?

The Rom students' attainment in mathematics was low, regarding their supposed grade level, or average regarding the grade level being taught in accordance with an average non-Roma student. Some reasons reported, besides the blame of school, the unwillingness of pupils to do their homework, their erratic attendance, the low socioeconomic background, having the Greek language as second language and their parents' neglect and illiteracy level, were:

Discrimination phenomena

Mostly the teachers (79%) and other students (73%) treated students well, as both sides answered. However, there have been manifested discrimination phenomena through practices and discourses, mainly from teachers to students. Unfair social and racist behavior towards Rom pupils has been detected, as well as gender bias perceptions. The teachers had low expectations of Rom kids as they would be pleased simply if they would reach junior high school or even high school, and later find a better job. Generally, teachers felt comfortable reprimanding the Roma children and even sometimes exceeding the limits with minor physical or verbal attacks. Alongside, girls and boys weren't considered equal while the first were presented to lag behind the second in mathematics education. This was mainly due to neglect, disapproval of involvement, lack of help and of equally challenging tasks. More obstacles were also, preconceptions of weakness or biological inferiority or the unfamiliarity of their parents' occupation which triggers the mathematical learning, and lastly, the resistance of girls and their reactions to the above.

Mathematical knowledge difficulties

The majority of the students (91%) exhibited difficulties in mathematics, conceptual and procedural. Conceptually, it has been spotted that students didn't have neat understandings of numeracy and fractions, as those were the two major sections they've been occupied with in class. In operations, they made a lot of place value and order mistakes, whilst the relationships in the mathematical ideas were fragile and incoherent within problems, representations, and comparisons. Most of them could grasp the data presented in a problem and their relationships and could use logical arguments to support their answers and solutions to problems with empirical examples of everyday reality. But they didn't pay attention to the relevance of the context and the numerical data and were guided either by other clues (e.g. keywords, big-small numbers, etc.) they had marked, or by teachers' hints, explanations or reformulations of the problems into simpler forms. They also seemed unconvinced by the authenticity of a problem when the prices of objects -extraordinary numbers- involved were incompatible with the prices in the real market. False solving approaches were also caused by disconnection of concepts implied in them.

Procedurally hurdles have been detected in the algorithm executions and in actions taken to solve a problem, where actually in those areas, teachers were the most focused on. In algorithms, children made a lot of mistakes, regularly, because of the lack of connection with symbolic representations - they mixed up the symbols - and confusion or unfamiliarity with operational steps - they forget or didn't understand the steps/sequence - of the algorithm. In problem solving, there were no adequate interiorized actions since they were waiting for their teachers to disclose the answers or chose operations randomly. Some of them stated that they were feeling discomfort standing next to the whiteboard or getting bored and confused, copying from the board, while others did not understand words and representations.

Language difficulties

Although many pupils (70%) thought Greek language is easy, lots of them (86%) presented language difficulties in every problem with more sophisticated words and syntax. Furthermore, 79% didn't understand the whole problem while reading it and 88% said that they couldn't figure out what operation to apply in order to solve it.

Three basic factors, the linguistic structure of word problems, the mathematic symbolization and the discursive form could be recognized as linguistic obstacles. Firstly, the level of lexical comprehension caused difficulties in understanding lexical items in Greek (usually items not used frequently in every day speech), by mishearing some lexical elements and by constructing some constrains because of the morphosyntax of mathematical register used in texts. Secondly, the syntax of the problem played a major role in conceptualization. An extremely difficult use of language, passive voice superfluous phrases and unfamiliar words resulted in understanding leaps and discrepancy of information. Some syntactic difficulties were also observed in comparative - expressions indicating minimum, maximum or in between- and negative -regarding double negations or negatives combined with comparatives - complexions. Thirdly, the semantic structure of mathematical and common vocabulary unfamiliarity revealed a drawback in homophone linguistic indications and in words that are not used on a daily basis but are rather technical or scientifically misleading students from the clear definition of a word. At last, the cultural elements showed that the context of the problems was out of their habits and interests and that they weren't familiar with more formal colloquial usages. Symbols appeared as additional hindrances in transformation or representation of symbolic manipulation between writing and oral form. Discursive form referred to the interpretation of mathematical objects within dialogues in maternal language or in official language and deictic gestures or moves. All students used their first language as inner speech or in groups for explications. Generally, they (82%) asked for clarifications, 61% from teachers and 21% from their classmates, because they think that teachers are more trustful as prototypes. However, they (76%) preferred to hear the explanation in Romani, but there was no translation from one language to another while they had minimum proficiency in official language.

It is also noticeable that all of them (100%), with no exception, couldn't recall any mathematical term in their language, except for the names of the numbers, and some of them declared that Roma people do not know or apply any form of mathematics. Their language isn't static since they adapt words and phrases from foreign expressions and as a result their dialect evolves into a mixture of words of different origins. So many words and mathematical terms, like numeracy, fractions, addition, subtraction, multiplication, division, decimal numbers, geometry, etc. come from Greek as long as their homeland is Greece.

3rd Research Question

Which mathematics eventually, school or preexisting math, do students prefer to use in numeracy and problem solving tasks and why?

Students struggled with what mathematics they should or would choose to use. Only 1 to 2 students chose to apply written algorithms whereas more than half (58%) chose mind procedures. Particularly, it has been recorded that their main strategies were regrouping for addition, repeated addition for multiplication, counting upwards or downwards for subtraction, memorizing standard sums and quick estimations. Some used mental strategies in combination with paper (30%) or with their fingers (15%), in order to keep track of the procedure. The use of hands and materials were popular with pupils from the smallest grades, in our case 8 students from Class D. It was also noticed that 6 out of 12 girls (50%) exclusively utilized their hands in comparison with 2 out of 21 boys (9,5%). Or 3 out of 12 girls (25%) employed both their fingers and mind (in bigger classes) in contrast to 2 out of 21 boys (9,5%).

Nonetheless, the students' preference wasn't clear. Those who were employing typical methods showed a willingness to continue their academic careers as accountants, lawyers, doctors, mechanics and teachers (or whatever their family decides). Possibly, because teachers tried to convince them to use the school's standard methods as, often, their ambitions for Rom kids were limited to getting a junior high school or a high school diploma and finding a "decent" job. But most students preferred whatever it was easiest for them to handle (generally the above main strategies).

3.7 Constraints

Possible limitations:

Using a sociopolitical perspective to analyze mathematical meanings could have some strengths and weaknesses. On the one hand, it doesn't allow us to emphasize on the mathematical activity, as a cognitive perspective possibly would. On the other hand, it allows us to focus on sociopolitical issues related to mathematical policy, language and teaching.

The above research questions might have required a long-term data collection period to cover a range of foci (Cohen, Manion & Morrison, 2007) but the disposable time was limited to 3 months.

The results produced constitute one particular reading of the data rather than the only truth about the data (Wiling, 2013). It was a standpoint-specific.

The sample was small and as a participant observer the elements seen and structured may not have been totally objective.

Naturally, the research is non-generalizable since the transferability of the findings to other settings and applicability in other contexts cannot rigorously be adopted (Noble & Smith, 2015).

Discussion/Conclusions

It was obvious from the first to the last moment of the field work that the students' previous and out of school acquired mathematical knowledge was neglected from the teachers in a direct manner. The analysis revealed this attitude of pushing students to abandon their ways of thinking and adopt the school standard methods and procedures. Most teachers guided students' actions and thoughts through problem solving and written computation strategies while some students stated in interviews that they found it hard when the teacher explicates and writes the textbooks answers on the whiteboard, ending up in mere copying of the results.

Although the teachers knew that students had contact with some mathematical elements because of their involvement in their parents' work, they commonly ignored them or sometimes publicized them but proceeded mechanically with the school textbooks logic and methods. Sometimes though, when they were confused with the written algorithm, children were prompted to perform computations mentally, and to use their strategies to solve the problems.

As they moved on to greater classes, teachers urged children to adopt more formalistic approaches to deal with problems and algorithms, even though the programmed materials they utilized belonged to 2nd or 3rd grade, lower than pupils' normal class level. In accordance to this, the applied tasks were not challenging. Those had a simplistic form with the same solving styles but with different numerical data. Generally, the teachers followed a tactic of giving hints about the problems to students, revealing the answers and methods they thought necessary. Their approach was monolateral, with few extra solutions given and hardly ever did they let the children act alone in problem solving. They were leading the task without allowing time for the children to read the problem by themselves. They instantly stated the questions, afterwards gave the explanations and wrote the answers on the whiteboard, though with no comprehension.

This means that the teachers prevailed "*by lecturing, asking closed questions and allowing few opportunities for students to communicate their ideas*" (Brendefur & Frykholm, 2000: cited in Drageset, 2015). Quite often the classroom discourse was dominated by the teacher's monologue of demonstrations, explanations and repetitions of strategies and solutions of problems and exercises. It is also argued that they were normally engaged in a procedure-bound discourse, such as calculating answers and memorizing procedures (Drageset, 2014; 2015), giving little emphasis on students' mathematical thinking.

Consequently, the teaching methods seem not only to treat their previously acquired knowledge as a barrier and reject it, but also to separate students from any form of mathematics familiar to them, since teachers didn't allow them to implement or practice their techniques. Also they didn't give them the opportunity to improve those techniques or abandon them later by their choice, neither to acquire the required basic school centered mathematics, in order to become educated active citizens. It is like taking their knowledge but not giving them any other back!

Furthermore, the majority of teachers seem to believe that Roma could only reach up to a certain level of education and then drop out of school. In relation to mathematics, teachers lacked proper care and attention towards Roma students and especially towards girls. Their behavior style could be defined by effusive bursts resulting sometimes to some minor physical and verbal assaults, due to the disobedience of students, which was predominant in every lesson.

In respect of female students, their engagement was limited and teachers commonly disapproved of their involvement and concentrated mainly on boys. The eye contact and body gestures were unfolded towards boys. They cooperated with boys, addressing boys, teaching for boys. Sometimes they ignored the requests of girls for help or explanations and were easily pleased with the performance of girls as they strongly supported the idea of lower female mathematics skill. For that reason also, teachers motivated them to take part in procedural, not at all challenging and puzzling tasks while the most conceptually demanding questions rose towards boys. When the students were introduced to a new concept or procedure, the teachers usually assigned the execution of these new types of algorithms or of problems embedded with them, to boys. Moreover, this unwillingness to support girls or entrust them with equally difficult working tasks, had taken a “normal” form of discouragement and avoidance of mathematical learning with boys’ scornful comments as an extra ally. This sort of prepossession passed down to boys’ standpoint with similar demonstrated phenomena of undermining notion about girls’ mathematics aptitude too (Walkerdine, 2005).

Nonetheless, a few girls either protested loudly or renounced calmly to cooperate until proper attention would be given to them. They strongly resisted to those actions and repeatedly demanded more attention to all girls inside the classroom and less joking comments from boys. They wanted an equal treatment and fair chance in taking their pace to answer without the boys disclosing the answers.

So, this extravagant discrimination towards girls and generally Rom pupils was transparent from all 3 sides, race, gender and social class.

Another critical aspect was the mathematical knowledge itself. Developing strong knowledge about mathematics is characterized as an important asset of successful academic, economic, and social life, but many children, especially those from a low socioeconomic background or with dissimilar cultural beliefs, fail to become proficient in math (Rittle-Johnson, 2017). As a result, both conceptual and procedural mathematical knowledge should be well established but again Roma kids faced a lot of hurdles in these. In the conceptual difficulties, we initially spotted that the students did not have neat understanding of numeracy, as this was the major section they’ve been occupied with in class.

In addition, it was detected that there wasn’t a profound comprehension in the relationships of data in problems, representations and comparisons. Particularly children didn't pay attention to the relevance of the context and the numerical data and were guided either by other clues (e.g. keywords, big-small numbers, etc.) they had marked or by teachers' hints. They also seemed not convinced by the authenticity of a problem, when the prices of objects involved were incompatible with the prices in the real market. Falsely solving approaches were caused by the disconnection of concepts implied in them as well.

Whereas, in operations they made a lot of place value and order mistakes. Basically, all students of all classes had false assumptions about place value, made mistakes in typical operations and had difficulty naming or writing the numbers. In 4^{th} class also a few children wrongly identified the numbers by order, name or symbols.

In procedural knowledge, obstacles were noticed in the algorithm executions and in actions taken to solve a problem, where actually in those areas teachers were most focused on. In algorithms, children made a lot of mistakes regularly because of the lack of connections with symbolic representations; they either didn't know the series of steps needed at all or they didn't remember some steps and forgot other formulas. In problem solving, there were no adequate interiorized actions since they were waiting for their teachers to disclose the answers or were following unmethodical attempts and were choosing operations randomly.

To boot, the students had difficulties generally in language. It was naturally reinforced on the one hand, by the written form of mathematics (Varghuse, 2009) and on the other hand, by the discursive form of mathematics interaction (Barwell, 2014) between students and between students and teachers.

Firstly, because of the demanding structural form of mathematical texts, they had a disadvantageous position towards lexical, syntactic, semantic and cultural features. Specifically, it was hard to comprehend the meanings of lexical items either because of mishearing or of confusing the morphosyntax structure. Also in syntax it was difficult to comprehend the specialized vocabulary in mathematics, the comparative expressions indicating minimum, maximum or in between and the complex phrases with connotations regarding double negations or negatives combined with comparatives. Secondly, in semantics, a drawback was detected in unfamiliar contextual references and also in the meager vocabulary in the Greek language and the confusion of some homophone linguistic indications misleading students from the clear definition of a word. Thirdly, their cultural context of habits, interests and occupations did not match the majority culture displayed in school books.

Furthermore, a hindrance distinguished was that the students were not familiar with the symbolic representation or transformation because they confused or completely forgot the symbols. Some of them didn't understand the meanings of those expressions at all and some mixed them with other symbols. It was hard to transform the symbolic form into words and the opposite. They couldn't recognize and relate the right symbol with the appropriate praxis.

Except for the linguistic written form, the poor interpretation of mathematical objects within discourse, dialogues and body language was obvious, either with the usage of their maternal language or with their struggle of expressed thoughts in the official language. Children were permitted to talk in their first language, in order to obtain more information and neat explanations of the meanings of problems and tasks, whereas in other moments, they were not allowed a single gypsy word inside classroom. However, they preferred to utilize their mother tongue in clarifications and justifications. Occasionally, they used a lot of deictic gestures and moves to justify their thoughts and simplify the mathematical clarifications for their classmates or teachers.

Since there is no practice of their mother tongue from kindergarten to the last grade of primary school or systematic chronical of the language (so as not to be forgotten and replaced by other languages), they could not reach a high proficiency level in Romani. As a result, they couldn't reach a similar associative level in the official language. Because as many studies have shown, if there is poor linguistic efficiency in maternal language then it relates and has an effect on the level of efficiency in the second language (Barwell, 2014; Varghuse, 2009). That may lead to not acquire as speakers the grammar contour and advanced vocabulary use, even if they may be able to communicate and socialize well in particular contexts inside and outside school in their second language (Gee, 2008).

In addition, the competent education authorities didn't take preparatory measures for translation classes, even when a mediator expert in Romani to help in transition (Zachos, 2017) would be found (which is highly unlikely). Because, of course, of the strict official language policy of monolingualism and the linguistic devaluation of Romani (Kokkoni, 2017). At last, due to no writing form of Gypsy language children may experience language loss but also evolution of their language.

Nonetheless, there was no certain disposition of students in what mathematics they eventually used. Every student utilized whatever he/she found satisfying and easy. Specifically, they were mostly applying mind procedures -regrouping, repeated addition, count upwards or downwards, memorize standard results and quick estimations by rounding- and were comfortable with hand materials in problem solving and algorithmic tasks presented in all math class. Only a small amount of students preferred the typical written algorithms.

The teachers, on the other side, expressed that they, by themselves, were trying to prepare their students for the typical algorithms and methods by first concentrating on the elaboration of their informal mathematical knowledge in class, but the students continued to use the non-typical methods to solve the mathematical problems and especially their mental way of thinking. But as it was discerned, that was not the case here. They pushed the children to use the typical techniques established in school frames. Perhaps, because of their desire to see the Rom students reach the standards of mainstream students' success in faculties and job careers with high social and economic profits (Nutti, 2013; Pais, 2011) or they have not received further training in cultural-based teaching except for the fixed national teaching agenda, materials and textbooks or they are not trusted to verify the content significantly (Orey & Rosa, 2007) or any other hypotheses would be possible.

Finally, we should notice that those characteristics and relationships were driven out of this research within an interpretation of subjectivism but they might not be the only ones existing in the field. They were merely the elements we were capable of distinguishing. Howbeit, we hope it would add a small piece to a different perspective to the picture which still lies under survey.

References

Abreu, G. (2008). From mathematics learning out-of-school to multicultural classrooms. In L. D. English (Eds.), *Handbook of International Research in Mathematics Education, 2nd Edition* (pp. 352-383). NY: Routledge.

Abreu, G., & Crafter, S. (2016). Mathematics Learning In and Out of School Towards Continuity or Discontinuity?. In L. D. English & D. Kirshner (Eds.), *Handbook of International Research in Mathematics Education, 3rd Edition* (pp. 395-415). NY: Routledge.

Abreu, G., Crafter, S., Gorgorio, N., & Prat, M. (2013). Understanding Immigrant Students' Transitions as Mathematical Learners from a Dialogical Self Perspective. In B. Ubuz, Ç. Haser & M. Mariotti (Eds.), *Proceedings of the 8th Congress of the European Society for Research in Mathematics Education (CERME 8)*, 6-10 February 2013 (pp. 1648-1655). Antalya, Turkey. http://www.mathematik.uni-dortmund.de/~erme/doc/CERME8/CERME8_2013_Proceedings.pdf

Aguirre, J. M., Turner, E. E., Bartell, T. G., Kalinec-Craig, C., Foote, M. Q., McDuffie, A. R., & Drake, C. (2012). Making Connections in Practice: How Prospective Elementary Teachers Connect to Children's Mathematical Thinking and Community Funds of Knowledge in Mathematics Instruction. *Journal of Teacher Education*, 64(2), 178–192. doi: 10.1177/0022487112466900

Albert, G., Matache, M., Taba, M., & Zimová, A. (2015). Segregation of Roma Children in Education – Successes and Challenges. *2015 Annual Report*. Retrieved from
http://www.romaeducationfund.hu/sites/default/files/documents/segregation_of_roma_children_in_education_-_successes_and_challenges_-_final.pdf

Amit, M., & Qouder, F. A. (2017). Weaving Culture and Mathematics in the Classroom: The Case of Bedouin Ethnomathematics. In M. Rosa, L. Shirley, M. E. Gavarrete & W. V. Alangi (Eds.), *Ethnomathematics and its Diverse Approaches for Mathematics Education, ICME-13 Monographs* (pp. 23-50). Hamburg: Springer. doi: 10.1007/978-3-319-59220-6_2

Baba, T. (2002). Significance of ethnomathematical research: Towards international cooperation with the developing countries. In P. Valero & O. Skovsmose (2002) (Eds.). *Proceedings of the 3rd International MES Conference*, 2-7 April 2002 (pp. 1-11). Copenhagen, Denmark: Centre for Research in Learning Mathematics. http://mes3.learning.aau.dk/Papers/Baba.pdf

Baris, T., & Alexopoulos, C. (2002). The educational problem of Gypsy children Reality and emerging perspectives. In P. Georgogiannis (Eds.), *Proccedings of the 5th International Conference Intercultural Education Greek as the second language*, 12-14 July (321-327). Patras, Greece: Conference and Cultural Center of Patras University. http://6dim-diapelefth.thess.sch.gr/Greek/Ekpaidefsi_Tsigganopaidon/EishghseisEkpshsTsigg/EishghseisEkpshsTsigg2002/to_ekpaideftiko_provlima_ton_tsiganon.pdf

Barwell, R. (2014). Centripetal and centrifugal language forces in one elementary school second language mathematics classroom. *ZDM Mathematics Education*, 46(6), 911–922. doi: 10.1007/s11858-014-0611-1

Benekos, D. (2007). The education of special populations in Greece: The case of Gypsies. *Educational Issues Review*, 12, 60-68. http://www.pi-schools.gr/download/publications/epitheorisi/teyxos12/mpenekos.pdf

Bernstein, B. (1960). Language and Social Class. *The British Journal of Sociology*, 11(3), 271-276. http://www.jstor.org/stable/586750

Bernstein, B. (1973). *Class, codes and control Volume 1: Theoretical studies towards a sociology of language*. St Albans: Paladin.

Boot, S. A. E. (2013). *Promoting the social inclusion and academic progress of Gypsy, Roma and Traveller children: A secondary school case study* (unpublished Ph.D. Dissertation). University of Birmingham, UK. http://etheses.bham.ac.uk/3953/1/Boot13PhD.pdf

Bose, A., & Choudhury, M. (2010). Language Negotiation in a Multilingual Mathematics Classroom: An Analysis. In L. Sparrow, B. Kissane & C. Hurst (Eds.), *Shaping the future of mathematics education: Proceedings of the 33rd annual conference of the Mathematics Education Research Group of Australasia*, 3-7 July 2010 (pp. 93-100). Fremantle: MERGA. http://files.eric.ed.gov/fulltext/ED520854.pdf

Bose, A., & Subramanian, K. (2011). Exploring School Children's out of School Mathematics. In B. Ubuz, (Eds.), *Proceedings of the 35th Conference of the International Group for the Psychology of Mathematics Education*, 10-15 July 2011 (Vol 2, pp. 177-184). Ankara, Turkey: PME. http://mathedu.hbcse.tifr.res.in/wp-content/uploads/2014/01/AB-KS_2011_PME_explg-sch-childn-evrydy-math-kn.pdf

Brown, M., Askew, M., Baker, D., Denvir, H., & Millett, A. (1998). Is the National Numeracy Strategy Research-Based?. *British Journal of Educational Studies*, 46(4), 362-385. http://www.jstor.org/stable/3121833

Brown, M., Johnson, D., Street, B., Askew, M., & Wiliam, D. (2001). *Leverhulme Numeracy Research Programme: Progress Report*. London: King's College London.

Carraher, D. W., & Schliemann, A. D. (2002). Is everyday mathematics truly relevant to mathematics education?. In J. Moshkovich & M. Brenner (Eds.) Everyday Mathematics. *Monographs of the Journal for Research in Mathematics Education*, 11, 131-153. http://www.jstor.org/stable/749968

Cazden, C. B., & Beck, S. W. (2003). Classroom Discourse. In C. Graesser, Morton A. & Gernsbacher, S. G. (Eds.), *Handbook of Discourse Processes* (pp. 165-198). Mahwah, New Jersey: Lawrence Erlbaum Associates.

file:///C:/Users/dora_kap/Desktop/handbook_of_discourse_processes_chapter%205.pdf

Chirume, S. (2017). Using Indigenous Mathematical Knowledge and Innovations to Solve Community Challenges: A Case Study of the Shona in the Shurugwi County of Zimbabwe. *Africology: The Journal of Pan African Studies*, 10(1), 40-54. http://www.jpanafrican.org/docs/vol10no1/10.1-5-Chirume.pdf

Chronaki, A. (2005). Learning about "learning identities" in the school arithmetic practice: the experience of two minority gypsy girls in the Greek context of education. *European Journal of Psychology of Education*, 20(1), 61-74. doi: 10.1007/BF03173211

Chronaki, A., Mountzouri, G., Zaharaki, M., & Planas, N. (2016). Number words in 'her' language, dialogism and identity-work: the case of little Mariah. *Intercultural Education*, 27(4), 352-362. doi: 10.1080/14675986.2015.1078527

Chronaki, A., & Planas, N. (2018). Language diversity in mathematics education research: a move from language as representation to politics of representation. *ZDM Mathematics Education*, 1-11. doi: https://doi.org/10.1007/s11858-018-0942-4

Civil, M. (2002). Everyday Mathematics, Mathematicians' Mathematics, and School Mathematics Can We Bring Them Together?. In J. Moshkovich & M. Brenner (Eds.), Everyday Mathematics. *Monographs of the Journal for Research in Mathematics Education*, 11, 40-62. http://www.jstor.org/stable/749964?seq=1&cid=pdf-reference#references_tab_contents

Civil, M. (2007). Building on Community Knowledge: An Avenue to Equity in Mathematics Education. In N. Nasir & P. Cobb (Eds.), *Improving access to mathematics: Diversity and equity in the classroom* (pp. 105-117). New York, NY: Teachers College Press. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.487.3875&rep=rep1&type=pdf

Civil, M. (2008). Mathematics teaching and learning of immigrant students: A look at the key themes from recent research. (Eds.), *Proceedings of 11th International Congress of Mathematics Education (ICME)*, 6-13 July 2008, Survey Team 5: *Mathematics Education in Multicultural and Multilingual Environments*. Monterrey, Mexico. http://math.arizona.edu/~cemela/english/content/ICME_PME/MCivil-SurveyTeam5-ICME11.pdf

Civil, M., & Hunter, R. (2015). Participation of non-dominant students in argumentation in the mathematics classroom. *Intercultural Education*, 26(4), 296–312. doi: 10.1080/14675986.2015.1071755

Claveria, J. V., & Alonso, J. G. (2003). Why Roma do not like Mainstream Schools: Voices of a People without Territory. *Harvard Educational Review*, 73(4), 559-590. https://doi.org/10.17763/haer.73.4.k6807432592612j3

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education, 6th Edition*. London, NY: Routledge. Retrieved from https://gauravgaharwar.files.wordpress.com/2016/10/research-methods-in-education-sixth-edition.pdf

Csapo, M. (1982). Concerns Related to the Education of Romany Students in Hungary, Austria and Finland. *Comparative Education*, 18(2), 205-219. http://dx.doi.org/10.1080/0305006820180208

Cuevas, G. J. (1984). Mathematics learning in English as a second language, *Journal for Research in Mathematics Education,* 15(2), 134-144. http://www.jstor.org/stable/748889

D'Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics FLM Publishing Association Montreal*, 5(1), 44-48. http://flm-journal.org/Articles/72AAA4C74C1AA8F2ADBC208D7E391C.pdf

Daskalaki, I. (2003). Greek-Gypsy identity and the relationship between Greek-Gypsies and the state. In LSE European Institute (Eds.), *Proceedings of the 1st Hellenic Observatory PhD symposium on modern Greece*, 21 June 2003, Survey Team 10: *Facing the challenge of multiculturalism.* London, UK. http://www.lse.ac.uk/europeanInstitute/research/hellenicObservatory/Events/HO%20PhD%20Symposia/1stsymposium/phd03_Papers.aspx

Department of Basic Education. (2014). South African Sign Language Home Language. *National Curriculum Statement: Curriculum Assessment Policy Foundation Phase Grades R to 3.* Retrieved from http://www.education.gov.za/LinkClick.aspx?fileticket=%2BrzCcDZUb5k%3D&tabid

DEPPS-APS (Mathematics). (2003). *Cross-Curricular Study Framework*. Pedagogical Institute. Ministry of National Education and Religious Affairs, FEK 303B/13-3-2003. http://www.pi-schools.gr/programs/depps/

Derrington, C. (2016). Supporting Gypsy, Roma and Traveller Pupils. In G. Richards & F. Armstrong (Eds.), *Teaching and Learning in Diverse and Inclusive Classrooms: Key Issues for New Teachers, 2nd Edition* (p. 41-51). London, NY: Routledge.

Drageset, O. G. (2014). Redirecting, progressing, and focusing actions-a framework for describing how teachers use students' comments to work with mathematics. Educational Studies in Mathematics, 85(2), 281–304.doi: 10.1007/s10649-013-9515-1

Drageset, O. G. (2015). Student and teacher interventions: a framework for analysing mathematical discourse in the classroom. Journal of Mathematics Teacher Education, 18(3), 253–272. doi: 10.1007/s10857-014-9280-9

Dragonas, T. (2012). Roma mothers and their young children. Country report: Greece, *Bernard Van Leer Foundation*. Unpublished report.

Eisenhart, M. A. (1988). The Ethnographic Research Tradition and Mathematics Education Research. *Journal for Research in Mathematics Education*, 19(2), 99- 114. http://www.jstor.org/stable/749405

Esmonde, I. (2009). Explanations in Mathematics Classrooms: A Discourse Analysis, Canadian Journal of Science. *Mathematics and Technology Education*, 9(2), 86-99. https://doi.org/10.1080/14926150902942072

Feza, N. N. (2016). Basic numeracy abilities of Xhosa Reception year students in South Africa: Language policy issues. *Issues in Educational Research, 26(4), 576-591*. http://www.iier.org.au/iier26/feza.html

Feza, N. N. (2014). Inequities and lack of professionalisation of early childhood development practice hinder opportunities for mathematics stimulation and realisation of South African policy on quality education for all. *International Journal of Inclusive Education*, 18(9), 888-902. http://dx.doi.org/10.1080/13603116.2013.855266

Flouris, G. (1997). *Analytical Programs/Curriculum for a New Era in Education, 5th edition.* Athens: Grigoris.

Foster, B., & Norton, P. (2012). Educational Equality for Gypsy, Roma and Traveller Children and Young People in the UK. *The Equal Rights Review*, 8, 85-112. http://www.equalrightstrust.org/ertdocumentbank/ERR8_Brian_Foster_and_Peter_Norton.pdf

François, K., & Stathopoulou, C. (2012). In-Between Critical Mathematics Education and Ethnomathematics. The Case of a Romany Students' group Mathematics Education. *Journal for Critical Education Policy Studies*, 10(1), 234-247. https://www.researchgate.net/publication/258208381

Frankenstein, M., & Powell, A. B. (1994). Toward liberatory mathematics: Paulo Freire's epistemology and ethnomathematics. In P. L. Mc Laren & C. Lankshear (Eds.), *Politics of liberation: Paths from Freire* (pp. 74–99). London: Routledge. http://andromeda.rutgers.edu/~powellab/docs/proceedings/paulofriere_epis.pdf

Fremlova, L., & Ureche, H. (2011). *From Segregation to Inclusion: Roma Pupils in the United Kingdom A Pilot Research Project*. UK, Hungry: Equality and Roma Education Fund. http://equality.uk.com/Resources_files/From%20segregation%20to%20integration.pdf

Fundacion Secretariado Gitano. (2009). *Health and the Roma Community: Analysis of the Situation in Europe Bulgaria, Czech Republic, Greece, Portugal, Romania, Slovakia, Spain*. Madrid: FSG A.D.I. http://ec.europa.eu/justice/discrimination/files/roma_health_en.pdf

Gay, J., & Cole, M. (1967). The *New Mathematics and an Old Culture A study of learning among the Kpelle of Liberia. NY:* Holt, Rinehart and Winston.

Gee, J. P. (2008). *Social Linguistics and Literacies Ideology in discourses, 3rd Edition*, NY, London: Routledge. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.476.9477&rep=rep1&type=pdf

Gee, J. P. (2011). *An Introduction to Discourse Analysis Theory and Method, 3rd Edition.* NY, London: Routledge. Retrieved from http://uluslararasigundem.com/wp-content/uploads/bsk-pdf-manager/52_JAMES_PAUL_GEE-AN_INTRODUCTION_TO_DISCOURSE_ANALYSIS__THEORY_AND_METHOD-ROUTLEDGE_(2010).PDF

Gerdes, P. (1985). Conditions and strategies for emancipatory mathematics education in underdeveloped countries. *For the Learning of Mathematics FLM Publishing Association Montreal*, 5(1), 15-21. http://flm-journal.org/Articles/6CB054F3F6657BF0F545101EED7F71.pdf

Gerdes, P. (1986). How to Recognize Hidden Geometrical Thinking: A Contribution to the Development of Anthropological Mathematics. *For the Learning of Mathematics FLM Publishing Association Montreal*, 6(2), 10-12. http://flm-journal.org/Articles/9C2D73F45435A001FB092B669261.pdf

Gerdes, P. (xx). Mathematics Education and Culture in Third World Countries. In K. A. Paulsson (Eds.), *HÄFTEN FÖR DIDAKTISKA STUDIER Hur räknar du människa?* (pp. 24-27). Stockholm: Högskolan för lärarutbildning http://ncm.gu.se/pdf/namnaren/2427_89_4.pdf

Gerdes, P. (1996). Ethnomathematics and Mathematics Education. In A. J. Bishop, K. Clements, C. Keitel, J. Kilpatrick & C. Laborde (Eds.), *International Handbook of Mathematics Education Part 2* (pp. 909-945). Dordrecht: Kluwer Academic Publishers.

Georgiadou-Kabouridi, V., & Markopoulos, C. (2007). Mathematics Teacher's book Methodological Instructions for the Creative Use of Student's Books in the Supplementary Teaching Departments. Volos: Epta Lofos. https://www.ebooks4greeks.gr/dowloads/Ekpaideytika/Ekped.eidikwn.p.omadwn/Mathimat.Daskaloy.Downloaded__from_eBooks4Greeks.gr.pdf

Ginsburg, H. P. (1977). *Children's Arithmetic: The Learning Process*. NY: D. van Nostrand.

Gkofa, P. (2017a). Being Roma – being Greek: academically successful Greek Romas' identity constructions. *Race Ethnicity and Education*, 20(5), 624-635. http://dx.doi.org/10.1080/13613324.2016.1191700

Gkofa, P. (2017b). Promoting Social Justice and Enhancing Educational Success: Suggestions from Twenty Educationally Successful Roma in Greece. *The Urban Review*, 49(3), 443-462. doi: 10.1007/s11256-016-0393-6

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report*, 8(4), 597-606. http://nsuworks.nova.edu/tqr/vol8/iss4/6

González, N., Andrade, R., Civil, M., & Moll, L. (2001). Bridging funds of distributed knowledge: Creating zones of practices in mathematics. *Journal of Education for Students Placed at Risk*, 6(1-2), 115-132. doi: 10.1207/S15327671ESPR0601-2_7

Gorgorió, N. & Planas, N. (2005). Cultural distance and identities-in-construction within the multicultural mathematics classroom. *ZDM*, 37(2), 64-71. http://subs.emis.de/journals/ZDM/zdm052a2.pdf

Gorgorió, N., Planas, N., & Vilella, X. (2002). Immigrant children learning mathematics in mainstream schools. In G. Abreu, A. J. Bishop & N. Presmeg (Eds.), *Transitions between contexts of mathematical practices* (pp. 23-52). Dordrecht: Kluwer. https://www.researchgate.net/publication/226039461_Immigrant_Children_Learning_Mathematics_in_Mainstream_Schools

Gutierrez, R. (2013). The Sociopolitical Turn in Mathematics Education. *Journal for Research in Mathematics Education*, 44(1), 37-68. https://www.squeaktime.com/uploads/1/0/0/4/10044815/jrme2013-01-37a-2.pdf

Harding-DeKam, J. L. (2014). Defining culturally responsive teaching: The case of mathematics. *Cogent Education*, 1(972676), 1-18. http://dx.doi.org/10.1080/2331186X.2014.972676

Iphofen, R. (2013). *Research Ethics in Ethnography/Anthropology*. European Commission DG Research and Innovation http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/ethics-guide-ethnog-anthrop_en.pdf

Jones, P. E. (2013). Bernstein's 'codes' and the linguistics of 'deficit'. *Language and Education*, 27(2), 161-179, https://doi.org/10.1080/09500782.2012.760587

Jurdak, M., & Shahin, I. (1999). An Ethnographic Study of the Computational Strategies of a Group of Young Street Vendors in Beirut. *Educational Studies in Mathematics*, 40(2), 155–172. http://www.jstor.org/stable/3483082

Kaye, D. (2015). What do I teach? Mathematics, Numeracy, or Maths?. In A. H. Mason & S. Beeli-Zimmerman (Eds.), *Proceedings of the 21st International Conference of Adults Learning Maths-A Research Forum (ALM)*, 29 June-2 July 2014 (pp. 141-149). Switzerland: University of Burgergemeinde Bern. https://boris.unibe.ch/99613/1/alm2015-proceedings-alm21-complete.pdf#page=157

Kiprianos, P., Daskalaki, I., & Stamelos, G. B. (2012). Culture and the school: The degree of educational integration of Roma and Gypsies in the Peloponnese region of

Greece. *International Review of Education*, 58(5), 675-699. doi: 10.1007/s 11159-012-9326-0

Kisker, E. E., Lipka, J., Adams, B. L., Rickard, A., Andrew-Ihrke, D., Yanez, E. E., & Millard, A. (2012). The Potential of a Culturally Based Supplemental Mathematics Curriculum to Improve the Mathematics Performance of Alaska Native and Other Students. *Journal for Research in Mathematics Education*, 43(1), 75–113. http://www.akctm.org/wp-content/uploads/2008/12/jrme2012-01-75a.pdf

Klothou, A., Korda, A., Kosmanos, N., Lazou, E., Nizam, A., Potari, D.,…Christakis, I. (2008a). Mathematics Student's Book Teaching level A. Volos: Epta Lofos. https://specialeducationews.files.wordpress.com/2016/06/math1.pdf

Klothou, A., Korda, A., Kosmanos, N., Lazou, E., Nizam, A., Potari, D.,…Christakis, I. (2008b). Mathematics Student's Book Teaching level B. Volos: Epta Lofos. http://roma.pre.uth.gr/main/sites/default/files/roma_math_level_b.pdf

Klothou, A., Korda, A., Kosmanos, N., Nizam, A., Potari, D., Sakonidis, C.,…Christakis, I. (2008c). Mathematics Student's Book Teaching level C. Volos: Epta Lofos. https://specialeducationews.files.wordpress.com/2016/06/math3.pdf

Knijnik, G., & Wanderer, F. (2015). Mathematics Education in Brazilian Rural Areas: An analysis of the Escola Ativa public policy and the Landless Movement Pedagogy. *Open Review of Educational Research*, 2(1), 143-154. http://dx.doi.org/10.1080/23265507.2015.1052009

Kokkoni, N. (2017). *Exploration of linguistic attitudes towards Greek and Romani from the Rom populations of Patra, Antirio, Agrinio and educational extensions* (unpublished Master Dissertation). Patra University, Patra. http://nemertes.lis.upatras.gr/jspui/bitstream/10889/10489/1/Kokkoni_Nikolitsa_Language%20Attitides%20towards%20Greek%20and%20Romani.pdf

Kostadinova, G. (2011). Minority rights as a normative framework for addressing the situation of Roma in Europe. *Oxford Development Studies*, 39(2), 163–183. https://doi.org/10.1080/13600818.2011.570864

Lapat, G., & Eret, L. (2013). Application of the elements of Vedic mathematics in classes with Roma pupils. In M. Pavleković, Z. Kolar-Begović & R. Kolar-Šuper (Eds.), *Mathematics Teaching for the Future 4th International Scientific Colloquium Mathematics and Children How to teach and learn mathematics* (pp. 94-105). Zagreb: Element. http://files.eric.ed.gov/fulltext/ED542544.pdf

Lave, J. (1977). Cognitive Consequences of Traditional Apprenticeship Training in West Africa. *Anthropology and Education Quarterly*, 8(3), 177-180. http://www.jstor.org/stable/3216313?seq=1#page_scan_tab_contents

Lave, J. (1991). Situating Learning in Communities of Practice. In L. B. Resnick, J. M. Levine & S. D. Teasley (Eds.), *Perspectives on Socially Shared Cognition* (pp. 63-82). Washington, DC: American Psychological Association

Lerman, S. (2001). Cultural, Discursive Psychology: A Sociocultural Approach to Studying the Teaching and Learning of Mathematics. *Educational Studies in Mathematics* 46(1-3), 87–113. https://link.springer.com/article/10.1023/A:1014031004832

Leung, P. (2008). Chinese Culture, Islamic Culture, and Mathematics Education. In P. Clarkson & N. Presmeg (Eds.), *Critical Issues in Mathematics Education* (pp. 135-147). NY: Springer. https://link.springer.com/book/10.1007%2F978-0-387-09673-5

Leyva, L. A. (2017). Unpacking the Male Superiority Myth and Masculinization of Mathematics at theIntersections: A Review of Research on Gender in Mathematics Education. *Journal for Research in Mathematics Education*, 48(4), 397-433. http://www.jstor.org/stable/10.5951/jresematheduc.48.4.0397

Liegeois, J. P. (1994). *Roma, Tsiganes, Voyageurs.* Luxemburg: Conseil de l'Europe.

Lipka, J. (1994). Culturally negotiated schooling: Toward a Yup'ik mathematics. *Journal of American Indian Education, 33*(3), 14–30. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.500.1760&rep=rep1&type=pdf

Lipka, J., Andrew-Ihrke, D., Koester, D., Zinger, V., Olson, M., Yanez, E., & Rubinstein, D. (2015). Indigenous Knowledge Provides an Elegant Way to Teach the Foundations of Mathematics. In T. Bartell, K. N. Bieda, R. T. Putnam, K. Bradfield & H. Dominguez (Eds.), *Proceedings of the 37th annual meeting of the North American chapter of the International Group for the Psychology of Mathematics Education*, 5-8 November 2015 (pp. 2-18). East Lansing, MI: Michigan State University. https://msu.edu/~brakoni1/PMENA-2015-PROCEEDINGS-2015-11-04.pdf

Lipka, J., Hogan, M. P., Webster, J. P., Yanez, E. E., Adams, B., Clark, S., & Lacy, D. (2005). Math in a Cultural Context: Two Case Studies of a Successful Culturally Based Math Project. *Anthropology & Education Quarterly*, 36(4), 367-385. http://www.jstor.org/stable/3651363

Lipka, J., Sharp, N., Adams, B., & Sharp, F. (2007). Creating a third space for authentic biculturalism: Examples from *Math in a cultural context. Journal of American Indian Education,* 46(3), 94–115. https://jaie.asu.edu/sites/default/files/463_2007_7_lipka_et_al.pdf

Lipka, J., & Yanez, E. E. (1998). Identifying and understanding cultural differences: Toward culturally based pedagogy. In J. Lipka, G. V. Mohatt & the Ciulistet Group (Eds.), *Transforming the culture of schools: Yup'ik Eskimo examples* (pp. 111–137). Mahwah, NJ: Erlbaum.

Llopart, M., & Esteban-Guitart, E. (2018). Funds of knowledge in 21st century societies: inclusive educational practices for under-represented students. A literature review. *Journal of Curriculum Studies*, 50(2), 145-161. doi: 10.1080/00220272.2016.1247913

Lumpkin, B. (1987). African and African-American Contributions to Mathematics. *PPS Geocultural Baseline Essay b Series*, i-77. http://www.pps.k12.or.us/depts-c/mc-me/be-af-ma.pdf

Marantzidis, N., & Mavromais, G. (1999). Political Clientelism and Social Exclusion The Case of Gypsies in the Greek Town of Sofades. *International Sociology*, 14(4), 443-456. http://journals.sagepub.com/doi/pdf/10.1177/0268580999014004004

Marushiakova, E., & Popov, V. (2016). Roma Culture: Problems and Challenges. In E. Marushiakova & V. Popov (Eds.), *Roma Culture: Myths and Realities*. Munich: Lincom Academic Publisher. https://www.researchgate.net/publication/305298773

McNeil, C. K. (2015). *A Critical Examination of Diverse Students' Funds of Knowledge Inclusion in High School Mathematics: A Mixed Methods Study* (unpublished Ph.D. Dissertation). North Carolina State University, Raleigh. https://search.proquest.com/docview/1799291523

Ministry of Economics Hellenic Democracy. (2015). *Document: Description of the process and documents required for the provision of financial support to students of low-income families in compulsory education*. Number Protocol: 2/68744/0026. Retrieved from http://dipe-anatol.att.sch.gr/014/ee071013.pdf

Ministry of Education. (2015). *The State University Student Welfare Law of 2015*. (Law 203(I)/2015). Retrieved from http://www.moec.gov.cy/ypiresia_foititikis_merimnas/nomothesia/o_peri_kratikis_foititikis_merimnas_nomos_2015.pdf

Mji, A., & Makgato, M. (2006). Factors Associated with High School Learners Performance: A Spotlight on Mathematics and Physical Science. *South African Journal of Education*, 26(2), 253–266. https://www.ajol.info/index.php/saje/article/viewFile/25068/20738.

Moll, L. (2014). *L. S. Vygotsky and education*. New York, NY: Routledge.

Moore, N. L. (2015). *In a class of their own: The Bantu Education Act 1953 Revisited* (unpublished Dissertation). Faculty of Humanities of University of Pretoria, South Africa. https://repository.up.ac.za/bitstream/handle/2263/53445/Moore_Class_2016.pdf?sequence=1&isAllowed=y

Moreira, D. (2007). Filling the gap between global and local mathematics. In D. Pitta-Pantazi & G. Philippou (Eds.), *Proceedings of the Fifth Congress of the European Society for Research in Mathematics Education*, 22-26 February 2007 (pp. 1587-1596). Larnaca, Cyprus: University of Cyprus and ERME. https://repositorioaberto.uab.pt/bitstream/10400.2/5818/1/Moreira,%20D%20(2007)%20Filling%20the%20gap%20CERME5.pdf

Moreira, D., & Pires, G. (2012). O processo educativo das crianças ciganas e a aprendizagem da matemática. In A. I. Afonso (Eds.), *Etnografias com ciganos:*

Diferenciação e resistência cultural (pp. 69-87). Lisboa: Edições Colibri. http://antropologia.weebly.com/uploads/5/3/3/6/5336211/23_darlindamoreiraciganos.pdf

Moses, B. P., & Cobb, C. (2001). *Radical equations: Math literacy and civil rights*. Boston: Beacon Press.

Muijs, D. (2004). *Doing Quantitative Research in Education with SPSS*. London, California, New Delhi: SAGE Publications. http://www.modares.ac.ir/uploads/Agr.Oth.Lib.23.pdf

Mullis, I.V.S., Martin, M. O., Foy, P., & Hooper, M. (2015). *TIMSS 2015 International Results in Mathematics*, International Study Center: IEA TIMSS & PIRLS. http://timss2015.org/wp-content/uploads/filebase/full%20pdfs/T15-International-Results-in-Mathematics-Grade-4.pdf

New Program of Studies (NPS). (2011). Mathematics in Primary and Secondary Education - New School (School of 21st Century), Pedagogical Institute, NSFR ESPA 2007-2013. https://bit.ly/2qzONtY

Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence Based Nursing*, 18(2), 34-35. https://search.proquest.com/docview/1784000673?pq-origsite=gscholar

Northcote, M., & Marshall, L. (2016). What mathematics calculations do adults do in their everyday lives? Part 1 of a report on the Everyday Mathematics project. *Australian Primary Mathematics Classroom*, 21(2), 8-17. http://dx.doi.org/10.1080/23265507.2015.1052009

Nunes, T., Schliemann, A., & Carraher, D. W. (1982). Na Vida Dez Na Eschola Zero: Os Contextos Culturais da Aprendizagem da Mathematics. *Cardenos de Pesquisa*, 42, 79-86. http://www.fcc.org.br/pesquisa/publicacoes/cp/arquivos/588.pdf

Nunes, T., Schliemann, A., & Carraher, D. W. (1985). Mathematics in the streets and in schools. *The British Psychological Society*, 3(1), 21-29. doi: 10.1111/j.2044-835X.1985.tb00951.x

Nunes, T., Schliemann, A., & Carraher, D. W. (1987). Written and Oral Mathematics. *Journal for Research in Mathematics Education*, 18(2), 83-97. http://www.jstor.org/stable/749244?seq=1#page_scan_tab_contents

Nunes, T., Schliemann, A., & Carraher, D. W. (1993). What is street mathematics?. In T. Nunes, A. Schliemann & D. W. Carraher (Eds.), *Street Mathematics and School Mathematics* (pp. 1-12). USA: Cambridge University Press.

Nutti, Y. J. (2013). Indigenous teachers' experiences of the implementation of culture-based mathematics activities in Sámi School. *Mathematics Education Research Journal*, 25(1), 57-72. doi: 10.1007/s13394-013-0067-6

O'Donoghue, J. (2002). Numeracy and Mathematics. *Irish Mathematical Society Bulletin*, 48, 47–55. https://www.maths.tcd.ie/pub/ims/bull48/M4802.pdf

Office for Standards in Education. (2003). Provision and Support for Traveller Pupils. London: Ofsted publications. Retrieved from https://www.lancsngfl.ac.uk/projects/ema/download/file/grtaspdf/Provision_and_support_for_Traveller_pupils.pdf

O'Hanlon, C., & Holmes, P. (2004). *The Education of Gypsy and Traveller Children: Towards Inclusion and Educational Achievement*, Stoke on Trent: Trentham Books.

Orey, D., & Rosa, M. (2007). Cultural assertions and challenges towards pedagogical action of an ethnomathematics program. *For the Learning of Mathematics*, 27(1), 10–16. http://flm-journal.org/Articles/7E5EFFA4B24CB97110973C060200F3.pdf

Pais, A. (2011). Criticisms and contradictions of ethnomathematics. *Educational Studies in Mathematics*, 76(2), 209–230. doi: 10.1007/s10649-010-9289-7

Pattison, S., Rubin, A., & Wright, T. (2016). Mathematics in Informal Learning Environments: A summary of the Literature. *NSF caise, 1-11*. http://www.instituteforlearninginnovation.org/uploads/4/9/1/3/49134795/informalmathlitsummary_minm_03-23-16_v3.pdf

Pilz, M., Uma, G., & Venkatram, R. (2015). Skills development in the informal sector in India: The case of street food vendors. *International Review of Education*, 61(2), 191-209. doi: 10.1007/s11159-015-9485-x

Pires, G. (2005). *Cαlculo mental das crianηas ciganas. Ideias silenciosas a serem ouvidas* (unpublished Master dissertation). Universidade Aberta, Porto.

Pires, G., & Moreira, D. (2005). Cálculo mental: estratégias de "escape" dos alunos ciganos ao uso dos algoritmos escolares. In J. Brocardo, F. Mendes & A. Boavida (Eds.), *XVI SIEM Actas 2005* (pp 253- 272). Lisboa: Associação de Professores de Matemática. http://www.livred.info/clculo-mental-estratgia-de-escape-dos-alunos-ciganos-ao-uso-do.html

Planas, N., & Gorgorió, N. (2004). Are different students expected to learn norms differently in the mathematics classroom? *Mathematics Education Research Journal*, 16(1), 19–40. doi: 10.1007/BF03217389

Planas, N., & Valero, P. (2016). Tracing the Socio-Cultural-Political Axis in Understanding Mathematics Education. In A. Gutiérrez, G., C. Leder & P. Boero (Eds.), *The Second Handbook of Research on the Psychology of Mathematics Education. The Journey Continues* (pp. 447-479). Rotterdam: Sense Publishers. http://pagines.uab.cat/nuria_planas/sites/pagines.uab.cat.nuria_planas/files/Planas%20Valero%202016%20authorized,pdf.pdf

Posner, J. K. (1982). The Development of Mathematical Knowledge in Two West African Societies. *Child Development*, 53(1), 200-208. http://www.jstor.org/stable/1129654?seq=1#page_scan_tab_contents

Ridgeway, C. L., & Correll, S. J. (2004). Unpacking the Gender System A Theoretical Perspective on Gender Beliefs and Social Relations. *Gender & Society*, 18(4), 510-531. 10.1177/0891243204265269

Rios-Aguilar, C., Marquez Kiyama, J., Gravitt, M., & Moll, L. C. (2011). Funds of knowledge for the poor and forms of capital for the rich? A capital approach to examining funds of knowledge. *Theory and Research in Education*, 9(2), 163–184. doi: 10.1177/1477878511409776

Rittle-Johnson, B. (2017). Developing Mathematics Knowledge. *Child Development Perspectives*, 11(3), 184-190. doi: 10.1111/cdep.12229

Rittle-Johnson, B., & Schneider, M. (2015). Developing Conceptual and Procedural Knowledge of Mathematics. In R. Cohen Kadosh & A. Dowker (Eds.), *The Oxford handbook of numerical cognition* (section 60). England: Oxford University Press. https://www.uni-trier.de/fileadmin/fb1/prof/PSY/PAE/Team/Schneider/RittleJohnsonSchneiderInPress.pdf

Rosenthal, C. (2017). Numbers for the Innumerate: Everyday Arithmetic and Atlantic. *Technology and Culture*, 58(2), 529-544. doi: https://doi.org/10.1353/tech.2017.0046

Sakonidis, C. (2015). Learning in Multiplex Environments: Socio-cultural and Political Characteristics of Mathematics Education of Children of Muslim Minority in Thrace. In D. Desli, I. Papadopoulos & M. Tzekaki (Eds.), *Proceedings of the 6th Panhellenic Conference of the Association of Researchers of Mathematics Teaching (ENEDIM),* 4-6 December 2015 (pp. 53-74). Thessaloniki, Greece: Aristotle University of Thessaloniki. http://enedim6.web.auth.gr/wp-content/uploads/2015/12/PRAKTIKA_ENEDIM6_2015.pdf

Sakonidis, C. (2017). The Mathematical Education of Children of Muslim Minority in Thrace: Social, Cultural and Political Parameters. *Research on Didactics of Mathematics*, 10, 27-54. http://ejournals.epublishing.ekt.gr/index.php/enedim/index

Sakonidis, C., & Potari, D. (2014). Mathematics teacher educators'/researchers' collaboration with teachers as a context for professional learning. *ZDM Mathematics Education*, 46(2), 293–304. doi: 10.1007/s11858-014-0569-z

Saliaris, D. (2009). *The role of the headmaster in the process of applying and evaluating the curriculum in secondary education in the islands of Chios and Rhodes* (unpublished Master Dissertation). Aegean University, Rhodes. http://hellanicus.lib.aegean.gr/bitstream/handle/11610/14153/file0.pdf?sequence=

Saxe, G. B. (1981). Body parts as numerals: a developmental analysis of numeration among the Oksapmin in Papua New Guinea. *Journal of Educational Psychology*, 77 (5), 503–513. http://www.jstor.org/stable/1129244?seq=1#page_scan_tab_contents

Saxe, G. B. (1988). The Mathematics of Child Street Vendors. *Society for Research in Child Development*, 59(5), 1415-1425.

http://www.jstor.org/stable/1130503?seq=1&cid=pdf-reference#references_tab_contents

Scottish Curriculum for Excellence. (2017). *Numeracy across learning* (pp. 38-52). Scotland: Scottish Government, HMIe, SQA, LTS. https://www.education.gov.scot/Documents/all-experiences-and-outcomes.pdf

Septianawati1, T., Turmudi, & Puspita, E. (2017). Ethnomathematics study: uncovering units of length, area, and volume in Kampung Naga Society. *Journal of Physics Conference Series*, 812(012021), 1-7. doi: doi:10.1088/1742-6596/812/1/012021

Setati, M. (2005). Mathematics education and language: Policy, research and practice in multilingual South Africa. In R. Vithal, J. Adler & C. Keifel (Eds.), *Researching mathematics education in South Africa: Perspectives, practices and possibilities* (pp. 73-109.) Cape Town: HSRC Press. https://bit.ly/2M8VU8L

Setati, M. (2008). Access to mathematics versus access to the language of power: The struggle in multilingual mathematics classrooms. *South African Journal of Education*, 28(1), 103-116. http://www.sajournalofeducation.co.za/index.php/saje/article/view/150/99

Sharma, S. (2013). Qualitative approaches in mathematics education research: challenges and possible solutions. *Educational Journal*, 2(2), 50-57. doi: 10.11648/j.edu.20130202.14

Skourtou, E. (xx). The education of Roma children. Retrieved from https://eclass.uoa.gr/modules/document/file.php/PRIMEDU390/roma8.pdf

Smith, L. M. (2015). Numeracy Across the Middle School Curriculum. In D. A. McAllister (Eds.), *Culminating Experience Action Research Projects, Volume 15, Part 2*, Fall 2009 (pp. 48-61). USA: The University of Tennessee at Chattanooga. https://files.eric.ed.gov/fulltext/ED555266.pdf#page=48

Souviney, R. J. (1983). Mathematics achievement, language and cognitive development: Classroom practices in Papua New Guinea. *Educational Studies in Mathematics*, 14(2), 183-212. https://link.springer.com/article/10.1007/BF00303685

Stathopoulou, C. (2003). *The Connection between Cultural Context and Teaching/Learning of Mathematics: An Ethnographic Study on a Class of Romani Students and on their Community of Origin* (unpublished Ph.D. Dissertation). Aegean University, Rhodes. http://thesis.ekt.gr/thesisBookReader/id/14475#page/1/mode/2up

Stathopoulou, C. (2004). Mathematical Cognition in and out of School for Romany Students. In F. Favilli (Eds.), *Ethnomathematics and Mathematics Education Proceedings of the 10th International Congress of Mathematics Education Copenhagen, 4-11 July 2004* (pp. 149-156). Italy: Tipografia Editrice Pisana. http://people.dm.unipi.it/favilli/Ethnomathematics_Proceedings_ICME10.pdf

Stathopoulou, C. (2017). Once Upon a Time… The Gypsy Boy Turned 15 While Still in the First Grade. In M. Rosa, L. Shirley, M. E. Gavarrete & W. V. Alangui (Eds.), *Ethnomathematics and its Diverse Approaches for Mathematics Education ICME-13* (pp.97-123). Hamburg: Springer. https://doi.org/10.1007/978-3-319-59220-6_5

Stathopoulou, C., Govaris, C., Applebaum, P., & Gana, L. (2014). Bringing students out- and in- school knowledge: teaching young Roma children mathematics and language through their everyday experience. In A. Gilles (Eds.), *Proceedings of CIEAEM 66 Conference,* 21-25 July 2014 (pp. 322-326). Lyon, France: University of Lyon.

Stathopoulou, C., & Kalabasis, F. (2002). Teaching mathematics to first grade Romany children through familiar every day money dealings. (Eds.), *Proceedings of the 3rd International Conference on Mathematics Education and Society*, 2-7 April 2002, Helsingør, Denmark. http://mes3.learning.aau.dk/Papers/Charoula_Fragiskos.pdf

Stathopoulou, C., & Kalabasis, F. (2007). Language and Culture in Mathematics Education: Reflections on Observing a Romany Class in a Greek School. *Educational Studies in Mathematics*, 64(2), 231-238. doi: 10.1007/s10649-006-4496-y

Stathopoulou, C., & Moreira, D. (2013). Diversity in European school populations: A Study in Portugal and Greece with particular attention to Romany cultures. *MENON: Journal Of Educational Research*, Issue 2b, 20-31. http://www.edu.uowm.gr/site/content/charoula-stathopoulou-darlinda-moreira-diversity-european-school-populations-study-portugal

Stemler, S. E. (2015). Content Analysis. In R. Scott & S. Kosslyn (Eds), *Emerging Trends in the Social and Behavioral Sciences An Interdisciplinary, Searchable, and Linkable Resource*. NY: John Wiley & Sons. http://sstemler.faculty.wesleyan.edu/files/2016/09/Stemler_Emerging_Trends_in_Content_Analysis_2015.pdf

Stylianidou, A., & Biza, E. (2015). Difficulties of minority primary school students in mathematics. In D. Desli, I. Papadopoulos & M. Tzekaki (Eds.), *Proceedings of the 6th Panhellenic Conference of the Association of Researchers of Mathematics Teaching (ENEDIM),* 4-6 December 2015 (pp. 618-627). Thessaloniki, Greece: Aristotle University of Thessaloniki. http://enedim6.web.auth.gr/wp-content/uploads/2015/12/PRAKTIKA_ENEDIM6_2015.pdf

Tomlin, A., Baker, D., & Street, B. (2002). Home and school numeracy practices: Where are the borders and overlaps? In P. Valero & O. Skovsmose (Eds.), *Proceedings of the 3rd International MES Conference*, 2-7 April 2002 (pp. 1-10). Copenhagen, Denmark: Centre for Research in Learning Mathematics. http://mes3.learning.aau.dk/Papers/Tomlin_et_al.pdf

Turner, E. E., & Drake, C. (2016). A Review of Research on Prospective Teachers' Learning About Children's Mathematical Thinking and Cultural Funds of Knowledge. *Journal of Teacher Education*, 67(1), 32–46. doi: 10.1177/0022487115597476

Ukpokodu, O. N. (2011). How Do I Teach Mathematics in a Culturally Responsive Way? Identifying Empowering Teaching Practices. *Multicultural Education*, 19(3), 47-56. https://eric.ed.gov/?id=EJ955945

Varughese, A. N. (2009). *Language Difficulties In Mathematics Courses For Students From Non-English Speaking Backgrounds In The Transition From Secondary To Tertiary Education* (unpublished Ph.D. Dissertation). RMIT University, Melbourne. https://researchbank.rmit.edu.au/eserv/rmit:7518/Varughese.pdf

Vavougios, D. (2008). *Education of Gypsy children External Evaluation of the Project: Final Evaluation Report*. Volos: Thessaly University, Omas Synergon Ltd. http://repository.edulll.gr/edulll/retrieve/1045/201.pdf

Walkerdine, V. (2005). *Counting Girls Out Girls and Mathematics 2nd edition.* London, NY: Routledge Falmer.

Walliman, N. (2011). *Research Methods The basics.* London, NY: Routledge. http://www.dphu.org/uploads/attachements/books/books_2531_0.pdf

Walshaw, M., & Anthony, G. (2008). The Teacher's Role in Classroom Discourse: A Review of Recent Research Into Mathematics Classrooms. *Review of Educational Research*, 78(3), 516–551. doi: 10.3102/0034654308320292

Wikipedia. (2017). *Bantu Education Act, 1953*. Wikimedia Foundation, Inc. https://en.wikipedia.org/wiki/Bantu_Education_Act,_1953

Wilding, D. (2008). The Educational experiences of Gypsy travellers: the impact of cultural dissonance. *Reinvention: a Journal of Undergraduate Research*, 1(1). https://warwick.ac.uk/fac/cross_fac/iatl/reinvention/issues/volume1issue1/wilding

Williams, J. J., Tunks, J., Gonzalez-Carriedo, R., Faulkenberry, E., & Middlemiss, W. (2016). Supporting Mathematics Understanding Through Funds of Knowledge. *Urban Education*, 1-27. doi: 10.1177/0042085916654523

Willig, C. (2013). *Introducing Qualitative Research in Psychology*. New York, NY: Open University Press McGraw-Hill Education. file:///C:/Users/dora_kap/Downloads/CarlaWillig-Introducingqualitativeresearchinpsychology-OpenUniversityPress2013%20(2).pdf

xx. (2016, December, 16). Disclosure: 577.000 legal immigrants from 150 countries live in Greece. *iefimerida* Greece. Retrieved from http://www.iefimerida.gr/news/307859/apokalypsi-577000-nomimoi-metanastes-apo-150-hores-zoyn-stin-ellada

xx. (2017, March 21). The total number of refugees and migrants currently in Greece. *newsthatmoves (NTM)*. Retrieved from http://bit.ly/2vT9cNQ

xx. (2017, June). Refugee and Migrant Children in Europe Accompanied, Unaccompanied and Separated. *UNHCR, UNICEF and IOM*. Retrieved from http://migration.iom.int/docs/Interagency_Factsheet_on_Refugee_and_Migrant_Children_Q1_2017.pdf

Zachos, D. T. (2017). Roma, Curriculum, and Textbooks: The Case of Greece. *Creative Education*, 8(10), 1656-1672. doi: 10.4236/ce.2017.810112

Zaslavsky, C. (1970a). Mathematics of the Yoruba People and of Their Neighbors in Southern Nigeria. *The Two-Year College Mathematics Journal*, 1(2), 76-99. http://www.jstor.org/stable/3027363?seq=1#page_scan_tab_contents

Zaslavsky, C. (1970b). Black African traditional mathematics. *The Mathematics Teacher*, 63(4), 345-356.

http://www.jstor.org/stable/27958390?seq=1#page_scan_tab_contents

Zaslavsky, C. (1973). *Africa counts: Number and pattern in African culture*. Boston: Prindle, Weber & Schmidt.

Zaslavsky, C. (1994). "Africa Counts" and Ethnomathematics. *For the Learning of Mathematics*, 14(2), 3-8. http://flm-journal.org/Articles/3B80E796AE71BCD65E9962F33C839.pdf

Appendix

- ***Tables of students' Interviews***

Table 1a

Students/Questions	Qa	Qb	Qc
	Class B		
Male (1) Hrb	**10b** *Yes* (I like it).	**18b** *To learn reading and writing and to be good.*	**20b** *Yes.* **22b** *Basketball* (player).
	Class D		
Females (7) Prsk	**191d** *Yes, I like it.*	**194d** *That's why we come to school to learn. I like that we learn and when I don't understand something the teacher realizes it and say to me what didn't you understand. I like that much and I want to come to school.*	**201d** *Yes, I will study.* **203d** *An accountant.* **205d** *Because I like it.* **208d** *I like that I have to elaborate some papers of the people.*
Pic	**310d** *Yes* (I like it). **314d** (I like that) *we read, we learn. I have my friends here, the teacher.*	**320d** *Yes* (much).	**324d** *Yes. My mum doesn't let me study but I want to study. She wants to cut me off, to finish this* (primary education school) *and then stop.* **326d** *A hairdresser.*
Xru	**460d** *I like it but we don't play much. We play one game for a day.* **464d** *(I like) the reading, the painting, the English…*	**470d** *Yes* (much).	**472d** *I won't go to Gymnasium because my mother doesn't let me.* **476d** *A hairdresser I would like to become.*
Xval	**585d** *It was really good* (in her previous school) *just like here.*	**599d** *Yes* (much).	**603d** *I don't want to study, to do some jobs but maybe yes. Yes I'll study.* **605d** *I would like to become a police officer.*
E	**1017d** *It's nice.* **1019d** *Everything* (I like).	**1027d** *Yes.*	**1035d** *Yes.* **1037d** *A hairdresser.*
M	**1796d** *Yes.* **1798d** *We do lesson, play, and make friends.*	**1806d** *To learn writing and reading.*	**1814d** *I don't know if my parents let me.* **1816d** *I don't want to study.* **1818d** *Eventually nothing. I want to continue school only.* **1822d** *No* (she doesn't want a job later). **1826d** *I want to stay home all day* (after finishing school).
Txou	**1981d** *Yes, I like it.* **1983d** *I like the lessons, in breaks we play.*	**1991d** *To learn writing and reading.*	**1999d** *Yes.* **2001d** *A hairdresser.*
Males (8) Tap	**10d** *I like it very much!*	**36d** *Yes* (much).	**24d** *Yes.* **32d** *Yes, an accountant!* **34d** *Because they earn too much money.*
Tche	**749d** *It was ok* (previous school). **755d** *I like the classrooms, the football, the gymnastics, the mathematics, the letters* (language).	**771d** *Yes* (much). **757d** *To learn!*	**763d** *Yes.* **765d** *Craftsman… to repair cars, motorbikes…*
N	**894d** *Good.* **896d** *I like it but… it's ok.*	-	**908d** *Yes.* **910d** *I don't know yet.*
Than	**1154d** *Yes, we like it.* **1156d** *How can I say it now… gymnastics, the lessons… the school outside* (schoolyard).	**1166d** *To learn reading and writing.* **1168d** *Yes, yes* (much).	**1170d** *Yes, I want.* **1172d** *A doctor.*
S	**1300d** *I like this school! It's*	**1306d** *To learn writing and*	**1312d** *Yes, I want too much!* **1314d**

	really good.	*reading.*	*A police officer.*
Spe	**1483d** *It is good, it is nice.*	**1491d** *To learn reading and writing.*	**1493d** *Yes.* **1495d** *I will study in order to get a job or play football.*
Tft	**1659d** *Yes, it is nice.*	**1661d** *To learn writing and reading.*	**1665d** *Yes.* **1667d** *A police officer.*
F	**2165d** *I like it more here* (from his previous school)	**2177d** *To do lesson, to learn English, mathematics and…*	**2185d** *No, I'll go until junior high school and then stop.* **2189d** *I would become a footballer and a lawyer.*
	Class E		
Females (4) Tbl	**159e** *I like the school, the kids, the friends, the teachers.*	**163e** *I want to learn reading and writing, to read nicely and to become the best student in class.*	**149e** *I basically like the Greek language and when I'm going to study I want to become a teacher. I want to speak Greek; I want to learn really good Greek.*
Par	**438e** *There* (in her previous schools) *wasn't nice, here is better.* **440e** *There were only a few Roma and many Balamos* (non-Roma). **442e** *It wasn't nice, I wasn't playing, I didn't like it.*	**462e** *Yes* (much). **464e** *To learn even better literacy, mathematics, to learn* (other) *languages.* **466e** *Yes, it will help me* (to find a job).	**458e** *Yes.* **460e** *I wanted to become a hairdresser.*
X	**615e** *It's nice but there are not so good kids here* (in her previous schools) **621e** *A, I liked the school, the teachers… I like the teachers here too. There they weren't speaking badly of us, they were playing with us and there was a cafeteria! Ehm, at* (her previous school) *I didn't like it, they were bad kids.*	**657e** *Aha, yes I believe that…* (school can give her much). **659e** *It gives them, to learn reading and writing, to studying after, the teachers look after them.*	**641e** *I want to but my grandpa doesn't let us* (her and her sister). **651e** *Aha, Yes!* **653e** *A hairdresser.*
Ch	**1112e** *No, I didn't* (like it the previous school) *but I went to school.* **1116e** *Really, really good* (here)*… I don't have any complaints.*	**1126e** *Love, studying, many things*	**1118e** *I want but my mum doesn't let me… after elementary school I won't continue.*
Males (6) Ag	**816e** *Yes, it's nice.* **820e** *Everything is nice.*	**822e** *ah ok, it's nice.* **828e, 832e** *Yes* (it's beneficial and would help him become an accountant).	**824e** *Yes.* **826e** *An accountant.*
Pj	**1223e** *Yes.* **1225e** *I like playing on the breaks, reading, do mathematics and other things.*	**1231e** *Much to do, yes.* **1233e** *To read and write the language, to do math, English…*	**1237e** *Yes.* **1239e** *An accountant.*
An	**967e** *Yes.* **969e** *I have fun. I'm pleased here.*	**971e** *To do math, to read, to write… learn geography …that.*	**973e** *Yes.* **975e** *A police officer.*
Chri	**8e** *Eh, a little* (I like). **10e** (Because) *There are many Roma. This is what I don't like.* **12e** (I would like to be) *With Greek* (Balame) *and a few Roma.* **14e** *A little, yes* (it would be helpful). **16e** *In reading, in mathematics, but I know mathematics.*	**26e** *To learn writing and reading.*	**38e** *Yes.* **40e** *I? My father said a lawyer.*
Ptw	**317e** *It's perfect here…* **319e** *Our teacher is the best because I went on the 1st*	**327e** *Oh, yes, so many, many many!* **321e** *Because I want to learn*	**323e** *Yes!* **325e** *I want to become an accountant!*

	grade and the teacher there hadn't taught me anything. It was awful, they didn't learn to me anything and they just gave me sheets for painting. The teacher always said paint and whenever we went on the back (schoolyard) one (slap) on the hand and one on the ash, and just kept painting and painting.	*to read, to speak and we have fun here.*	
Val	**1390e** *Yes* (I like it). **1392e** *My friends, the children, the school, the teachers.*	**1394e** *To learn writing and reading. Ehm, for that.*	(not sure)
	Class F		
Females (1)			
Pg	**320f** *Yes.* **323f** *I like that the teachers are nice, good and I like that the school is close by, near the Gypsies.*	**328f** *To learn writing and reading. I mean I know writing and reading. Also to learn and to become not like you a teacher but …hmm*	**330f** *Yes.* **336f** *An accountant, yes!*
Males (6) J	**12f** *I like it!*	**20f** *To learn writing and reading.* **22f** *Yes* (much).	**24f** *Yes.* **26f** *I don't know yet.*
O	**149f** *Nice, good.*	**155f** *To learn reading and writing.*	**159f** *Yes, I will study!* **161f** *I'll become either a police officer or a footballer.*
L	**467f** *Eh, yes* (I like it). **469f** *Because school is nice, I like the teachers who teach us.* **471f** *I have* (friends), *yes.*	**479f** *To do lessons, what else? To learn something, some experiments… those staff.* **485f** *Em, yes certainly* (it would benefit him to become a policeman).	**483f** *Yes, I want to study! I want to become a police officer.*
V	**639f** *It was ok, nice* (in his previous school). **643f** *They are nice* (here too).	**651f** *To learn writing and reading, to learn Greek language, histories from old times…*	**657f** *Yes!* **661f** *I don't know, whatever my fath… But I'll decide at last.*
G	**776f** *It's good, ok.*	**784f** *Yes, much.*	**780f** *I would and I told my father that. He said you'll go and become a police officer and that's what I say too…*
T	**897f** *I think it's good.* **899f** *Because I learn more*	**911f** *Yes, much.*	**913f** *Yes.* **915f** *I want to become an accountant.*
Students (33)	**33 (answer: yes they like school)**	**32 (answer: yes school offers much)** **1 (no answer)**	**31 [answer: yes, (8) accountant, (1) doctor, (2) lawyer, (6) hairdresser, (1) teacher, (1) mechanic, (3) athlete, (7) police officer, whatever their family decides (2)]** **1 (answer: no)** **1 (answer: don't know)**

Source: Excerpts of Students' interviews

Table 1b

Students/Questions	**Qd**	**Qe**
	Class B	
Males (1) Hrb	**16b** *Others bad, others good.*	**16b** *Others bad, others good.*
	Class D	
Females (7)		

Prsk	**197d** *Yes, they treat me well.*	**194d** *The students not so much because they have no respect but it's ok, they will learn it.*
Pic	**316d, 318d** *Good.*	**316d, 318d** *Good.*
Xru	**466d** *Yes* (good).	**468d** *And the students* (good).
Xval	**593d** *They were really good. They had manners (in her previous school). I also had manners but now we've gone bad…*	**597d** *My classmates, some I don't like because… they are boys and girls (I don't like) but simply last year we were good, but now we turned sour because the boys said bad things. But now the things become favorable.*
E	**1025d** *Sometimes good, sometimes not.*	**1025d** *Sometimes good, sometimes not.*
M	**1800d** *They are good.* **1802d** *Yes*	**1804d** *And the students* (treat her well).
Txou	**1985d** *They are all good.* **1987d** *Fine.*	**1989d** *And them, fine. We play, we do things.*
Males (8)		
Tap	**16d** Good.	**18d** Some are good.
Tche	**751d** *Good* (in previous school) **753d** *And here too… a little.*	**751d** *Good* (in previous school) **753d** *And here too… a little.*
N	**906d** *Very good.*	**906d** *Very good.*
Than	**1158d** *Yes.* **1160d** *Really good.*	**1162d** *Them too* (good).
S	**1304d** *So and so.*	**1304d** *So and so.*
Spe	**1487d** *Good.*	**1487d** *Good.*
Tft	**1655d** *Good.* **1657d** *They are good, all.*	**1657d** *They are good, all.*
F	**2171d** *Good. We were having mathematics, we did many things. We had a nice time* (there). **2173d** *Really nice* (here).	**2167d** *Here are the kids, my friends. There I didn't have. They didn't treat us well.* **2169d** *We were fighting.* **2175d** *Good* (in this school).
	Class E	
Females (4)		
Tbl	**161e** *Yes*	**161e** *Yes.*
Par	**448e** *And the teachers are nice here.* **450e** *Yes* (they treat her well). **452e** *There too* (in her previous schools), *they simply hadn't given much attention.*	**446e** *It's nice here, I've got friends it's very enjoyable.* **444e** (There, in her previous schools) *We didn't have any* (interaction-company) *with the girls there Mrs., bonding*
X	**637e** *It is nice, our teachers are good, our classmates too…* **639e** *Yes* (they treated her well in all three schools).	**625e** *Yeah* (in a previous school). **631e** *Girls were fighting; they locked those* (girls) *in the toilet, they weren't good kids, they swore…* (in another previous school). **633e** (in this school) *I like it, just from 6th and 3rd grade they aren't good kids.* **635e** *Because they speak ill of others.*
Ch	**1128e** *Really nice. The teacher is very nice and the classmates respect me. We tease each other of course, but anything you ask from them they will help you.* **1126e** *All the teachers behave nice to me, they teach me things… and in* (the previous school) *they taught me too…*	**1110e** O*h, yes I went for 10 days… in* (another school) *… I went daily…and I was sick and I had gone through a lot… the Greek children there made fun of me, they were saying you are tsigana* (gypsy), *you are tsigana.* **1128e** The *classmates respect me. We tease each other of course, but anything you ask from them they will help you.*
Males (6)		
Ag	**818e** *They are good.*	**840e** *All of them nice.*
Pj	**1227e** *Good.*	**1229e** *It's ok… I like them all.*
An	**85e** *Good. The teachers shout us a little.*	**985e** *Good.*

Chri	**20e** *My teacher and the teacher…*(good)	**22e** *So and so. There are Ag, Par and X…*
Ptw	**317e** *It's perfect here. I've got my friends, we have a great time.*	**317e** *It's perfect every day and with our teacher.*
Val	**1402e** *Good.* (all of them).	**1402e** *Good.* (all of them).
	Class F	
Females (1)		
Pg	**326f** *Really nice.*	**326f** *Really nice.*
Males (6)		
J	**16f** *All good.*	**16f** *All good.*
O	**151f** *Fine!*	**151f** *Fine!*
L	**469f** *I like the teachers who teach us.*	**491f** *Oh, yes sure! If they weren't good at me I wouldn't socialize with them or befriend them.*
V	**641f** *They were nice too, but when we made a fuss, slaps were fallen.* **645f** *Good.*	**645f** *Good.* **647f** *Yes* (he has friends), *they are all outside.*
G	**778f** *The teachers good, they taught us writing and reading, we reached this far…* **794f** *The teachers changed* (new teachers), *previously we were better. Now there are some teachers who turned sour…how can I say it… they took liberties with us, they hit us, don't talk polite but intense and moodiness.*	-
T	**901f** *Good.*	**903f** *They treat me nice.*
Students (33)	**26 (answer: yes/good)** **7 (answer: both/good and bad)**	**24 (answer: yes/good)** **1 (answer: no/bad)** **7 (answer: both: good and bad)** **1 (no answer)**

Source: Excerpts of Students' interviews

Table 2

Students/Questions	Qf	Qg	Qh
	Class B		
Males (1)			
Hrb	**30b** *All, I like them.*	**32b** *Easy.*	**34b** *No, they aren't difficult.*
	Class D		
Females (7)			
Prsk	**210d** *I like all the subjects we do here. Only mathematics a little I don't like, but I try to learn them and write them.*	**212d** *Because it's really hard.*	**212d** *You have to count, to stand up on the board and to me this isn't likable. That's why I try to learn.*
Pic	**330d** *The language* (favorite). **334d** *Mathematics* (worst).	**336d** *I like it too but it's a little difficult.*	**338d** *In numeracy*. **342d** *Yes* (in executing praxis). **350d** *I have to stay for a while and count with my hands and then I'll say the word*. **372d** *Yes* (large number computations). **362d** *I don't know them* (problems).
Xru	**480d** *Subjects. I like them all.*	**482d** *Mathematics a little* (I like). **484d** *Yes,* (it is) *a little* (hard).	**488d** *Yes, to count, to do operations, there.*
Xval	**609d** *I mostly like language and mathematics.* **611d** *The worst is Religion.*	**615d** *Easy. Even if it is hard, it seems easy to me.*	-

E	**1039d** *My favorite is English*. **1041d** *The Religion* (worst).	**1043d** *It's nice.* **1045d** *Easy.*	**1077d** *Yes, it is difficult* (vertical operations). **1081d** *No* (don't know what symbols mean). **1087d** *Yes* (the procedure is difficult to follow).
M	**1834d** *I like the language.* **1836d** *I don't like… how is it called, I forgot… mathematics.*	**1842d** *Do you know why? Because when I'm up* (on board) *children are talking to each other and the teacher shouts and I don't understand a thing. Then I sit down and he* (the teacher) *tells me again to stand up and then I tell him I don't want to and leave it aside.*	**1846d** *To combine the words, the numbers, those.* (in problems). **1868d** *It is a little difficult* (the execution of operations).
Txou	**2003d** *I like language, English, mathematics and gymnastics.*	**2005d** *Easy*. **2007d** *No, it is not difficult*. **2009d** *Yes* (understanding of the problems). **2011d** *Yes, I don't have a problem with mathematics* (in operations).	-
Mαles (8)			
Tap	**42d** *I like mostly mathematics and I don't like… how it is called… environmental studies.*	**44d** *Easy!* **46d** (I stuck) *a little in hard ones.*	**48d** *In 20*. **50d** *2 times 20, 3 times…*
Tche	**777d** *The mathematics.*	**779d** *No, it's easy.*	-
N	**912d** *My favorite is writing and reading*. **914d** *The drawing* (the worst)	**916d** *I like it too.* **918d** *Some are easy, some are difficult.*	**920d** *It is difficult for me the copying* (from the board). **924d** *Yes. But without seeing it is also difficult* (the symbolization and written form of the book).
Than	**1174d** *We like all the subjects.*	**1176d** *To learn mathematics I want*. **1178d** *Easy*.	**1180d** *No.*
S	**1320d** *The language is my favorite*. **1322d** *Mathematics* (the worst).	**1326d** *Yes*. (difficult). **1324d** *I'm bored Mrs. I do some but the other half I can't do them Mrs.*	**1328d** *When the teacher writes on the board and tells us to write them too, I'm bored to write them.*
Spe	**1503d** *Mathematics* (worst).	**1505d** *The worst, because I'm confused.*	**1507d** *When I write, I'm a little confused*. **1509d** *When the teacher says write this, write that, there I'm confused*.
Tft	**1673d** *The language* (his favorite). **1677d** *Mathematics* (his worst).	**1681d** *Yes, a lot* (is difficult in mathematics).	**1687d** *Words yes* (mathematical in problems). **1689d** *Yes, there I'm confused*. **1723d** *I haven't learned them* (the written algorithms)
F	**2193d** *My favorite is the language and the mathematics.*	**2195d** *A little difficult, it is difficult.*	**2201d** *Yes* (in operations). **2203d** *No. Only a little up.* **2205d** *Up that you put up* (as the numbers grow bigger). **2207d** *Yes, I'm troubled.*
Females (4)			
Tbl	**171e** *I like the most the Greek Language… and German.*	**173e** *I like a little the mathematics, but not too much.* **175e** *It is difficult!*	**177e** *I'm having trouble, I can't manage them* (in typical algorithms-operations) **187e** *Yes*.
Par	**468e** *My favorite subject is computer lesson and gymnastics.* **472e** *My worst is geography and history.*	**476e** *I like it!* **478e** *Some are hard, some easy.*	**480e** *Aaa yes, the other which is like this, the line… not the cross neither the x, the other I find it a little hard*

			(subtraction).
X	**661e** *I really like the language, history on the other not at all. Em, also math I like it a little.*	**663e** *I like the numbers…* **665e** *Hard.*	**667e** *The subtraction.* **669e** *For example 1.000 and 1.000* (addition) *what is the amount… I can't do it, I find it difficult when the numbers get larger and I can't count them.*
Ch	**1130e** *The worst is that we do lessons/courses for a long period of time every day, at most 2 to 3 hours or even 4; 4 is too much. If we do more than that, we can't. But writing, reading… the books are full, are finished.*	**1132e** *It's one of the difficult lessons; I can't understand it. But some easy… it's ok.*	**1134e** *For example, those you put together or take out, etc. I don't understand them at all. But some additions if you put me I'll do them, I'll learn them.*
Males (6)			
Ag	**844e** *English is my best and German my worst.*	**846e** *It is nice too.*	**848e** *Nothing is difficult for me.* **850e** *I don't have any problem. Everything is easy for me. I know them all.*
Pj	**1245e** *The language and English… I like them all.*	**1247e** *It's easy.*	-
An	**989e** *My favorite is… everything…*	**991e** *It's fine. It's easy cake.*	**993e** *No, I find a little difficult the larger numbers.* **995e** *How can I say this… the staff you are doing I know them all… how can I say it… ahm the subtraction… in subtraction I have a difficulty.*
Chri	**42e** *The language and mathematics are the best for me… and gymnastics.* **44e** *I don't like that I write too much and I don't like music. I don't like singing… that's all.*	**46e** *Some are difficult, some are easy.*	**48e** *A little the division* (the procedure). **52e** *Yes, to what to do* (the steps).
Ptw	**329e** *My favorite is language and my worst is history.*	**333e** *Mathematics it's also perfect, I like it.* **335e** *Yes, in a degree it is hard but all the others in math are easy cake for me.*	**337e** *In division.* **339e** *Yes. The most difficult is the times, which think we write times… multiplication, that one.* **341e** *In praxis.*
Val	**1404e** *Mathematics is my best.* **1406e** *Because I liked them previously but I now forget them all. I liked them very much, I was very good.*	**1408e** *Hard and easy. For me it was easy for a long time but now I forget it so it's a little difficult.*	**1416e** *Nowhere. Now I have trouble with everything.* **1418e** *Yes, in operations.*
	Class F		
Females (1)			
Pg	**348f** *The language I like a little.* **350f** *Gymnastics is all my strength! I also like gymnastics and mathematics too. Because from mathematics I understand more.*	**356f** *Mathematics seems to me a little difficult.* **352f** *I mean how we did here, I want to learn the fractions and those ones, tens and hundreds. I want to learn these.*	**358f** *Yes, here in fractions, but some are easy.* **360f** *These are easy for me now, because I learned them from the teacher. The first time she taught those to us, when you also came in and see it, I didn't understand them. I said what it is going on here. I hadn't understood them.*
Males (6)			
J	**30f** *Mathematics I like too much and the language… physics and history.*	**32f** *Easy!*	**36f** *A little when it is difficult but I learn it once then I can make it.* **38f** *A little the*

			operations.
O	**165f** *My favorite is history.* **167f** *The music* (the worst).	**169f** *Mathematics, I like it.* **171f** *It's a little difficult, a little easy.*	**175f** *It's a little difficult this to do.* **185f** *Nothing* (is difficult).
L	**496f** *My favorite subjects are math, language, history and English.* **498f** *Religion's subject and art lessons, where we can't play*	**502f** (I like it) *Aaa, because I know how to do it. That's it!* **504f** *Yes, it's easy!*	**508f** *Nothing* (is difficult). …
V	**663f** *To read… language and English… we have also French.*	**667f** *It is easy cake Mrs.*	**673f** *Yes… ahm, the…* (operations)
G	**796f** *I like French because we play football we don't do anything… 2 hours football. Also I like gymnastics and reading, the language, history, etc. But I don't want the English. I don't want with my thought to learn English.*	**798f** *Some are difficult Mrs. I ask from my classmates some help.*	**828f** *…subtraction and multiplication, yes. Addition it's ok, I understand it but in subtraction I get confused… I put also plus* (+)*… especially when the kids speak to each other and I talked to them too and write nonsense…*
T	**921f** *My favorite is the language and the worst geography.*	**923f** *I think it's good! I learn.* **925f** *A little bit difficult.*	**927f** *In multiplication tables and a little in… how is it called? I forgot it* (division)…
Students (33)	**20 (answer: like math)** **7 (answer: don't like math)** **6 (no particular answer about math)**	**13 (answer: easy)** **14 (answer: difficult)** **6 (answer: both)**	**5 (answer: have no trouble)** **5 (answer: it is discomfort standing on board or boring and confusing copying from the board)** **18 (answer: difficulties in praxis)** **5 (answer: confusing symbols)** **1 (answer: no understanding of words)** **1 (answer: no understanding of representations)** **4 (no answer)**

Source: Excerpts of Students' interviews

Table 3

Students/Questions	**Qi**	**Qj**	**Qk**
	Class B		
Males (1) Hrb	**52b** *With the paper, with the mind.* **56b** *First with the mind and then I write it.*	**54b** *If I want I can put the large (numbers) in the mind and the smallest* (numbers) *in the hand.*	**58b** *This is times… ehm I forgot* (mixes the symbols). **72b** *36* (23+13, hadn't used the typical algorithm as suggested in that case).
	Class D		
Females (7) Prsk	**224d** *I usually do them with my hands.* **226d** *I first do them with my hands and then with mind and then I write them on paper.* **228d** *Yes, I do them with my hands and then I write.*	(Let's say we've got 15 and another 10. How much do we have?) **236d** *25* (She counted with her fingers one by one)	**238d** *It confuses me… I can't use my hands there, I'm a little embarrassed because my classmates would tell me something…* **240d** *Nothing (confuses me).* **242d** *I do it with my hands and he tells me this is it, well done.*
Pic	**354d** *Yes with my hands.*	**350d** *I have to stay for a while and count with my hands.*	-
Xru	**498d** *With the mind* (hands).	**502d** *Yes. (uses her fingers first and then writes it).*	**504d** *I don't understand the operations.*

Xval	**617d** *In my mind!* **621d** *Always (I use the fingers). But sometimes yes and sometimes no. When I don't know it, I use fingers.* **669d** *Yes, yes, with the mind and fingers* (I prefer).	**665d** *I know to count much with fingers and with mind.* **667d** *(100+30) 130 because I know to say 100 and 30 are 130.*	-
E	**1057d** *With the mind* (hands).	**1071d** *No, only with fingers.*	**68d** *On paper I write a bit.* (no example)
M	**1870d** *Sometimes with my mind, some other times on paper.*	**1878d** *With the fingers.*	**1087d** *Yes* (the steps are difficult). **1083d** *No* (don't know the symbols' meaning).
Txou	**2047d** *With the mind I do them, with the mind and I put my hands also. I say how much, 22 and 33, I count and find it with the mind.*	**2049d** *22 and 33, 20, 30, 50, 55.* **2051d** *The large ones* (first), *I leave the small ones and then I put them.* **2059d** *From 55 I take out 10 and was left 45* (the same way).	**1872d** *Not exactly because I forget them* (the symbols). **1876d** *No* (she doesn't know the algorithmical steps). **1882** *I counted first from 2* (tens) *and I said 15 and 2… 15, 16, 17… then I were in 5… so 22* (example of written addition 15+25, with mind).
Males (8)			
Tap	**66d** *Yes* (with the mind).	**74d** *5 times 8… 40!* **76d** *Aa, I said 8 times 1 are 8, and 8 are 16, (and 8) 24 and then 32 and 8 are 40.*	**2075d** *Yes. 5 and 6, 11, 7 and 3, 10.* **2077d** *10 and 11, 21.* (example, he adds 75+36 with the written algorithm, with mind)
Tche	**799d** *With the mind!* **801d** *Yes, and in and out.* **803d** *Yes* (more convenient).	**805d** (an example 30+25) *55.* **807d** *They say 30 and put another 20, 50 and 5, 55.*	-
N	**930d** *Yes… written.* **932d** *A little* (with the mind). **934d** *Nothing, none of the two.* **954d** *Yes* (uses fingers).	**936d** *55 and 10, 65* (with mind).	**811d** *It confuses me… how can I say it… when the teacher writes there (on board) then I do, I write…* **814d** *…Hm, yes* (hesitation of understanding the symbols).
Than	**1188d** *With the mind* (hands). **1190d** *Yes.* (more convenient).	**1196d** *15 and 10… 28* (fingers). **1198d** *Yes, yes.* (he uses his hands).	**948d** *A little* (confusing in written algorithm). **950d** *It's hard that I count like this …* **952d** *Yes. But I know to count… but until I count I'm late, I make mistakes.*
S	**1346d** *With the mind.* **1400d** *The mind and when I'm confused I use my hands.*	**1348d** *I? 10, no 11* (5+6). **1356d** *Yes, this is how I do it! 5 and 5, 10 and 1, 11!* **1392d** *The subtraction yes, I go back, count downwards.*	**1210d** *Yes.* (in a written vertical algorithm of addition he again choses to use his hands).
Spe	**1569d** *Yes.* **1555d** *With the mind.*	**1551d** *15 and 25, 40.* **1565d** *Yes* (… 25 and 5, 30 and another 10, 40). .	**1396d** *Yes* (the written algorithms are difficult). **1358d** *Yes, yes* (the multiplication is hard). **1370d** *8 and 8 make us 16 and 8, 24* (3x8, he also counts with his fingers).
Tft	**1693d** *With hands.*	**1725d** *I count 1, 2, 3… like this* (with his fingers). **1727** *I don't know. From 1 to 23 I can and then I continue 24, 25…* (23+13).	**1626d** *No* (doesn't recognize the symbols). **1634d** *Yes* (doesn't know the algorithmical steps-he apply it mentally).
F	**2209d** *With the mind.*	**2223d** (22+63) *40, 50, 60.* **2225d** *3, 63… 65, yes, no.*	**2235d** *It is a little difficult* (the steps of typical

Females (4)	*Class E*	**2227d** *Yes, 65.* **2231d** *Yes, I first put the big ones and then the small ones.*	algorithm)
Tbl	**189e** *Yes, on paper* (in class when she's been told to). **195e** *Whatever the teacher gives us, I do them.* **197e** *With the mind I do them.*	**193e** *The small and the large as long as they are too simple.* (with mind).	**177e** *I'm having trouble, I can't manage them.* (the written algorithms).
Par	**534e** *With my mind.* **536e** *Both, with fingers and with mind.*	**538e** *Look, now I'll do 10… I'll put this* (symbol) *like I count to 1.000… with my mind I do it, I mean 1, 2, 3, 4, 5, 6, 7 until 1.000… with my hands I can't count* (when the numbers grow bigger). **540e** *Aa, I'll do it 25…* (10+15). **542e** *I use my fingers* (in large numbers). **544e** *No, first with my hands and then I write the correct answer.* **546e** (But if the numbers are large) *A, I have to write it first and then do it.*	**486e** *This one, this, this…*(she had written down the symbols of multiplication, division and addition). **488e** *Which, this?* (She mixed the symbols)*… a, I know it* (confuses the steps followed to each algorithm). **500e** *When I have to do a problem that says Dora has…then I don't know what to do* (with the numbers*) for example 5, 15, 10… what to do them all. That confuses me.*
X	**671e** *I use fingers, a paper to write…* **679e** *In paper and also in my mind, but most with paper.* **681e** *Yes.* (with the mind when the numbers are small)	**673e** *Aha, I say one ten I put it here… I think a little with my head too.* **685e** *I say, I keep 6 in my mind and 7, 8, 9, 10, 11, 12* (counted with fingers). *This is how I do it. I keep 6 in my mind and put another 6…*	**695e** *I ask the teacher* (in operations with large numbers). **699e** *Look, let's say 200…* **701e** *We put the cross* (symbol of addition instead of subtraction-mixes the symbols)… **709e** (to take out 10, there are left) *100.* **711e** *Eh, wait… there would be left 80* (doesn't use the written algorithm at all, doesn't remember the procedure).
Ch	**1144e** *With my hands, because I add or take out with hands and it's easiest.*	**1146e** (35+35, with her mind)*…That, ahm approximately.* **1148e** *With my hands* (counts).	**1150e** *When I was on board the teacher wanted to write with my mind* (execute typical algorithms) *but I couldn't and I used my hands… I counted them…* **1154e** *With my hands and after I write it in the paper.* (she also chooses subtraction in large numbers besides the problem content).
Males (6) Ag	**864e** *Yes, I use my mind too, I solve them.* **866e** *With large* (numbers) *too.* **876e** *The writing form* (mostly uses). **882e** *It's easiest to me.*	**872e** *I said 157 and 17, 7 and 7 are 14, 162 and 10, 172…* (He first broke down 17 as 10 and 7, after he added 7 in 157 and then the other 10)	**882e** *It's easiest to me.* (the written typical algorithms)
Pj	**1265e** *Yes.* (with mind outside school). **1275e** *Sometimes in the mind and some others on the paper.* **1277e** *On the paper* (he prefers).	**1267e** *156 and 13… 156 and 10 are 166, and 3 more* (whispered), *169* (with mind).	**1281e** *The hard ones!* **1283e** *The praxis, the subtraction…* (the operations)
An	**1017e** *The paper.* **1019e** *Some with my mind too.*	**1021e** *The small and the large, but mostly the small ones* (with	**1025e** *6 times 5…*(mixed the symbols-instead of

		mind).	subtraction). **1039e** *A, no I don't know* (procedure of division). **1041e** *Yes* (I have been taught), *but I can't understand it.*
Chri	**80e** *With the mind.* **82e** (it is easier) *Yes.* **92e** (in large numbers) *A little with the mind, a little in writing.*	**88e** *With my mind, I think and… I say 23 and 15, it goes 20 and 10, 30 and 5 and 3, 8, so 30 and 8, 38.*	**84e** (he mixed the symbols of addition) *Times?*
Ptw	**355e** *Yes* (mentally). **357e** *Less, less* (mentally). **359e** (More comfortable) *Oh, yes in paper!* **361e** *Both, large and small. But if I find it difficult I can't, I want paper. Then I watch it from the board and copy them.*	-	-
Val	**1428e** *With mind!* **1430e** *Yes* (more convenient). **1456e** *No, both* (forms in large numbers).	**1442e** *I think, I do it and then remember.* **1444e** *Yes. I say* (in 151+43) *50 and 40 together and then I put 100 and come out.*	**1452e** *Yes, I'm a little confused* (in written algorithms)… **1454e** *Yes* (in symbols), *two to three times.*
	Class F		
Females (1) Pg	**378f** *With my mind and on paper. The teacher also helps me.* **382f** *Yes. Yes with my fingers.*	**384f** *I would say I have 15 in my mind and another 25…* **386f** *Yes I'll count them.*	**388f** *When I was looking at them yes they are difficult but when someone else is doing them they seem easy.* **390f** *Wait, this (+) is for putting together. It helps me more this for putting together instead or taking out.* **394f** *Yes, this is what I forget. But now I learned a little bit* (the procedure of algorithms).
Males (6) J	**48f** *With the mind.* **50f** *Yes* (more helpful).	**62f** *13 and 17.* **60f** *1 and 1, 2 and… 3 and 7, 10… 20 and 10, 30.*	**66f** *Nothing.* (confusing in the written algorithms)
O	**227f** *With carrying digits, with the mind.* **229f** *Yes, a little of this and a little of that.*	**213f** *15 and 25, 35.* **219f** *I putted 20 with 10 and became 30 and… 5 and 5, 10… so 30 and 10, 40.*	**207f** *5 times 5, 25. Is this correct? Are they multiplications?* (mixed the symbols of addition and multiplication) **209f** *And? Is this and* (15+25)*?* **211f** *Ok. 10, 13 altogether* (confused the procedure of addition algorithm, but mentally found it correct). **235f** (13+14) *I'll write on paper 10 and 10, 20* (wrote the whole number). **237f** *The whole. I'll 20 and then the 7* (wrote 207 instead of 27).
L	**538f** *Whatever they ask me to do it! If they tell me this way, I'll do it this way.* **540f** *In the paper it's better!* **524f** *With my mind of course* (easier). **526f** *Firstly in my head to see if it is ok and then I write it.*	-	**530f** *What* (symbol-plus) *do I put?* (mixes the symbols)
V	**701f** *With my mind outside and with paper here.*	-	**693f** *Division* (he chooses in large numbers besides the problem content). **697f** *The sequence a little* (confusing).

G	**814f** *Not in the paper, in my mind.* **830f** *For me both. But I can't write them here, in my head I'm more comfortable. I don't believe in paper. In my mind I do them and then write them.*	**834f** *Aaa*, (he used decomposition looking mere the numbers from the sheet) *153 and 2 are 155 and 5 are 160* (153+25).	**820f** *In large numbers* (typical algorithms) *the other children help me. When they are too big and I don't know them, I say to a particular kid I want you to teach me that…* **826f** *Yes* (the steps they teach him). *I get tangled in … how they are called, those 3 things* (operations).
T	**953f** *With my mind.* **959f** *Yes, it works for me.*	**955f** *Yes* (the way of decomposition and regrouping he showed me on a problem he had applied).	**963f** *The sequence, the sequence* (he confuses)*!* **967f** *In addition I know everything… in division I have a little trouble…*
Students (33)	**1 (answer: paper)** **9 (answer: mind)** **10 (answer: both paper and mind)** **8 (answer: fingers)** **5 (answer: both fingers and mind)**	**2 (answer: apply typical algorithms on paper)** **10 (answer: apply counting with fingers)** **19 [answer: apply mind procedures (regrouping for addition, repeated addition for multiplication, counting downwards for subtraction, memorizing standard sums and quick estimation)]** **2 (no answer)**	**27 [answer: have difficulties in typical algorithms (mix the symbols, forget or don't understand the steps/sequence of the algorithm, make place value errors and cope uncritically from the board]** **3 (answer: have no trouble)** **3 (no answer)**

Source: Excerpts of Students' interviews

Table 4a

Students/Questions	**Ql**	**Qm**	**Qn**
	Class B		
Males (1) Hrb	**38b** *Yes* (counting and operations). **40b** *Nobody* (taught him). **42b** *Yes* (on his own). **50b** *Yes* (he learned to give changes at work).	**76b** *No.*	**78b** *No.*
	Class E		
Females (7) Prsk	**214d** *Yes, to count*. **216d** *My dad*. **218d** *No, only in Romani and here I learned them in Balamanes* (Greek) **222d** *Until 20 because it was too difficult for me, I was little I didn't know.*	-	**244d** *I don't remember if they asked me, no. But they might have asked me, they might not. No, I don't know because I don't remember.*
Pic	**374d** *No.* **376d** *No one. Only my mum taught me to read.*	**382d** *No.*	**378d** *No!*
Xru	**492d** *No.*	**508d** *No.*	**510d** *No.*
Xval	***627d*** *My mum, my dad and my sister.* **631d** *Aa, yes, yes.* **633d** *Until 20.* **635d** *Later, after I've learned till 20, they taught me to reach till 40.*	**643d** *No.*	**663d** *No, they don't ask me.*
E	**1055d** *Yes.*	**1089d** *I don't think so. No.*	**1093d** *No.*
M	**1884d** *When I was little, my father taught me to count, one, two, three.* **1886d** *In Roma and in Greek.* **1888d** *Until 10, when I was little.* **1904d** *The five cents, one euro* (money exchanges). **1918d** *At home, yes. But*	**1922d** *Me, no. I don't know about the others.*	**1932d** *They ask us, yes.*

	when we had gone to newsstand, I was very little and I didn't know back then. I gave him 1 euro and take something cheap as you said and costed 50 cents and then he gave that (50 cents) *to me. So, I said with my mind look, now I learn properly.*		
Txou	**2013d** *Yes.* **2015d** *Until 10, until 20.* **2017d** *Yes, in Greek too and in Romani.* **2019d** *Yes, yes* (operations also). **2035d** *Yes, yes. My father was showing me too.*	**2041d** *Yes.* **2043d** *If I went to any other school, if I knew to read. When I went to the teacher* (of 1st grade) *I knew how to read a little and to do a little mathematics.* **2045d** *Yes, they were telling me, did you know that?*	**2083d** *No, they only say to us how to do it, so we learn.*
Males (8) Tap	**52d** *Mathematics? A, yes my mum.* **54d** *To count up to 100, and I counted. I was confused a little but I learned them.* **56d** *Yes* (in Greek and in Romani). **58d** *Yes* (operations also) **60d** *I did 10 times 5, such that and I learned.* **96d** *My father tells me… I have… he gave me 20 euros and I went to the shop and I bought staff for 1 euro. He gave me back 19 euros.*	**90d** *No.*	**98d** *Nothing.* **100d** *No.*
Tche	**783d** *My dad said count to ten, then I said 1, 2, 3…* **785d** *Yes* (in Romani and in Greek). **787d** (Praxis) *And others.*	**793d** *Yes, in Volos.*	**818d** *Yes* (how he have done it) **820d** *Yes* (how he acted on problems).
N	**928d** *No.*	**946d** *No.*	**956d** *No.*
Than	**1182d** *No, I didn't know something.*	**1216d** *No, no.* **1220d** *(They say) do you know mathematics? Do you know to write, to read?*	**1222d** *No.* **1226d** *They say you'll do it like this.*
S	**1338d** *No one, myself* (I learned). **1340d** *Yes* (by observing). **1342d** *5 and 6, yes* (he knew some simple operations).	**1374d** *No.*	**1376d** *I don't remember.*
Spe	**1527d** *Yes. In that yes* (to manipulate money). **1577d** *They told me to get to him the changes, how much is it I've seen, 4 and 4 for example and then I understand.*	**1571d** *No.*	**1573d** *No.*
Tft	**1707d** *I know. I knew* (to count). **1709d** *On my one* (I learned). **1711d** *Yes like this* (by observation).	**1731d** *No.*	**1731d** *No.*
F	**2259d** *A little. What is this he says, 10, 5 I say? I was little.* **2261d** *Yes.* **2263d** *Until 20, 30.* **2265d** *I had a little board, my mother bought it and she was teaching me.*	**2269d** *No.*	**2271d** *No.*

Class E

Females (4)			
Par	**524e** *A, no when I was little in my head I did… for example for 10 I counted in my head like I was using my fingers… from a very young age I learned* (to count) *until 100.* **677e** *I knew to count until 30.* **691e** *I knew a little bit. Then I had my sister, she taught me some and also a few Balamos, they came to us* (at school) *and help us…*	**568e** *No.*	**556e** *Aa, no they don't ask that.*
X		**725e** *No.*	**717e** *No, they don't ask us often…***721e** *They ask us how you found it and then we answer.* **723e** *Let's say we have 10 and 10, the teacher asks how you found it and we answer that we have 10 in our mind and 10 in our hands, we count them and we found 20.*
Ch	**1142e** *Nothing, nothing!... Only my father and my mother helped me at home* (with homework).	**1172e** (In the previous school) *they asked me but I told them I didn't know and they get me on the board and I was afraid. I was crying from my upset.*	**1162e** *They never asked me something like that, because I wasn't often on board and I copied what I had seen…*
Males (6)			
Ag	**860e** *No.*	**890e** *No.*	**888e** *No…once in a while.*
Pj	**1249e** *Yes.* **1253e** *Aaa, my dad.* **1255e** *Yes until 50, somewhere there.* **1257e** *Yes, both* (in Greek and Romani). **1259e** *Yes* (some operations his father taught him). **1261e** *On paper.*	**1295e** *Ehm, no I don't know.*	**1303e** *Yes* (with hesitation)*… I don't remember any example.*
An	**1009e** *My father.* **1011e** (he taught him) *To count, to read a little, to write some letters… these.* **1013e** *A little he showed me* (to apply operations). **1015e** *On paper.*	**1047e** *No.*	**1043e** *No.*
Chri	**54e** *Yes. I was counting up to 50.* **58e** *Yes I knew to count.* **60e** *By myself. From my father, my mother…* **62e** (in Greek and in Romani) *Yes.*	**96e** *No.*	**100e** *…No… our teacher a little.*
Ptw	**345e** *From my own I started a bit with my father of course and then I came to school and the teacher taught me.* **347e** *A little bit different* (way), *yes.* **349e** *Yes…* (He stood up, went to the board and wrote the addition vertically 245+156). *My father taught me this. When I started to go to school he told me and when I wrote it he said it was perfect. It was like this, an addition, for example this one.*	**373e** *No, only our teacher.* **375e** *She told me to find them in my mind and I couldn't, I was young of course very young then and next she helped me.*	**381e** *Yes.* **383e** *For example, when I write, teacher tell me did you find it; and I say one moment Mrs., now I write it down. Then the teacher asks as did you write it and checks if it is right.*
Val	**1422e** *No*	**1468e** *Yes.* **1470e** *They ask what you are doing… They ask me different staff, now I don't remember them.*	**1466e** No, *they don't ask me.*
	Class F		
Females (1)			
Pg	**362f** *My sister, my dad.* **364f**	**404f** *No.*	-

	They didn't teach me. They count until 20, 100… **366f** *In Balamane, in Greek. I was in 5th class, the teacher counted until 100 and we had to go backwards.* **368f** *Aah, before* (school). *In mathematics no, but I was listening to them.* **370f** *Yes, I learned* (by listening), *but until 100 I didn't know.*		
Males (6)			
J	**40f** *My dad.* **42f** *To count till 10, till 20.* **44f** *Yes* (in Romani Greek) .	**72f** *No.*	**74f** *No.*
O	**187f** *A little* (I knew). **189f** *Until 30 to 40, somewhere there.* **191f** *Yes* (his parents taught him). **193f** *Yes* (in Romani and Greek). **195f, 199f** *Yes* (with mind).	**245f** *No.*	**247f** *No.*
L	**516f** *No, I learned them at school.*	**554f** *No, nothing like it, nothing at all.*	**546f** *No!* **548f** *Usually they tell me how I did it* (he means the operations); *that's all, only that.*
V	**677f** *No one, but to count my father taught me a little…* **681f** *Yes, addition.* **683f** *On paper. It was also my cousin, who* (taught me and) *now is a high school student but now he's at Cyprus.*	**709f** *Many things.* **711f** *They were saying do you know that… do you know division?*	**705f** *No, only at the classroom they ask do you know that, do you know this… those questions.*
G	**808f** *Yes, my father firstly told me… he first taught me how to express words not numbers… and then all the teachers I had at school…* **812f** *Not from school, by myself. I learned the language and then the numbers. I could do anything… I learned by myself.*	**844f** *They tell me. When I first come to a class they ask do you know that… and at high school they would… and we say we know this, we don't know that…* **846f** *Yes.*	-
T	**933f** *Yes, my mother.* **935f** *She taught me to write my name and count.* **937f** *Both, Greek and Romani.* **951f** *Until 10 or 20… I don't remember quite good…*	**943f** *Yes, they ask me.* **945f** *Do you know mathematics? Do you know division or subtraction or addition?*	**987f** *Yes.* **989f** *They say… How do you solve the problem? How do you do this, subtraction…? Those two questions.*
Students (33)	**27 [answer: yes, (20) knew counting and further (13) also knew operations /paper-money exchanges]** **6 (answer: no)**	**6 (answer: yes but with few examples)** **24 (answer: no)** **1 (answer: don't remember)** **2 (gave no answer)**	**8 (answer: yes with the most examples concentrating in operations)** **20 (answer: no)** **3 (answer: don't remember)** **2 (gave no answer)**

Source: Excerpts of Students' interviews

Table 4b

Students/Questions	**Qo**	**Qp**
	Class B	
Males (1)		
Hrb	**118b, 124b** *No* (related to interests and	**120b** *Yes.* (he would like to be related only to

	culture).	his interests).
	Class D	
Females (7) Prsk	**284d** *Yes, I like them* (related to interests). **288d** *Yes, some* (culture). **298d** *No, I don't remember* (no example)	-
Pic	**439d** *No.*	**445d** *Aaa, yes, yes.*
Xru	**564d** *No* (related to interests). **568d** *No* (related to culture).	**570d**, **572d** *Yes.*
Xval	**719d** *Yes* (related to interests). **721d** *For example I go and buy a bicycle, it has it in (the context). Do you want to show you…?* **723d** *Yes* (related to culture). **725d** *An example I don't have.*	-
E	**1141d** *No* (related to interests). **1143d** *No* (related to culture).	-
M	**1954d** *No* (related to interests and culture).	**1962d** *Yes* (interests). **1964d** *No* (culture). **1966d** *I don't like it.*
Txou	**2137d** *No* (related to interests). **2140d** *No* (related to culture).	**2142d** *Yes.* (interests and culture). **2144d** *I would read that too.*
Males (8) Tap	**170d** *Aa, yes* (related to interests). **180d** *No* (culture). (no examples)	-
Tche	**880d** *No* (related to interests).	**884d** *Yes* (he would like those problems).
N	**1002d** *No* (related to interests). **1004d** *No* (related to culture).	**1006d** *Yes* (he would like to be related to those).
Than	**1278d** *No, no* (related to interests). **1282d** *No* (related to culture).	**1284d** *Yes* (he would like to be related to those). **1286d** *Yes* (helpful).
S	**1466d** *Aaa, no, no.* (related to interests). **1470d** *I don't know* (related to culture).	**1468d** *Yes* (he would like to be related to his interests)
Spe	**1638d** *No* (related to interests). **1640d** *No* (related to culture).	**1642d** *Yes* (he would like to be related to those). **1644d** *Yes* (helpful).
Tft	**1773d** *Yes* (related to interests). **1777d** *No* (related to culture).	**1783d** *Aaa, yes.* (he would like to be more related to those).
F	**2303d** *No* (related to interests). **2311d** *No* (related to culture).	**2313d** *No.* **2315d** *I don't like it.*
	Class E	
Females (4) Tbl	**280e, 296e** *No* (related to interests and culture).	-
Par	**590e** No! (related to interests).	**600e** *A, yes that I like* (she would like to be referred to her interests). **604e** *Yes, yes.* (and also her culture).
X	**799e** *Aha, yes besides hairdressing, but a few times* (related to interests). **803e** *Not so much* (related to culture).	**805e** *I would! I'd liked that, yes* (she would like to be more referred to her interests and culture).
Ch	**1210e** *A little bit* (related to interests and culture).	**1212e** *Yes, very much* (she would like to be more referred to her interests and culture).
Males (6) Ag	**952e** *No* (related to interests and culture).	**954e** *Yes* (he would like to be more referred to his interests and culture).
Pj	**1359e**, **1361e** *Yes* (related interests and culture). **1363e** *I don't know* (examples).	-
An	**1093e** *No.* (related interests and culture).	**1095e** *Yes.* (He would like to be referred to his interests and culture).

Chri	**136e** *A little* (related interests). **146e** *I don't know*…(related to culture)	-
Prw	**421e** *Only a little.* (related interests and culture).	**423e** *Yes! Yes!* (He would like to be referred to his interests and culture).
Val	**1520e** *No* (related interests and culture). *Class F*	**1522e** *Aaa, yes.* (He would like to be referred to his interests and culture).
Females (1) Pg	**484f** *No* (related interests and culture).	**458f** *Yes* (She would like to be referred to her interests and culture).
Males (6) J	**132f** *No* (related to interests and culture).	**134f** *Yes* (he would like to be referred to his interests and culture).
O	**299f** *Yes* (related to interests). **305f** *About mine no* (related to culture).	**307f** …*Yes* (he would like to be referred to his interests and culture).
L	**614f** *My hobbies, no.*	**618f** *With me* (related)… *Yes!...*
V	**761f** *No* (related to interests and culture).	**763f** *You mean in my work…. No.*
G	-	**84f** *Yes, I would Mrs.*
T	**1067f** … *No* (related to interests and culture).	**1069f** *Yes, I would* (he would like to be referred to his interests and culture).
Students (33)	**7 (answer: yes)** **25 (answer: no)** **1 (no answer)**	**24 (answer: yes)** **2 (answer: no)** **7 (no answer)**

Source: Excerpts of Students' interviews

Table 5a

Students/Questions	Qq	Qr	Qs
	Class B		
Males (1) Hrb	**80b** *Easy.*	**110b** *Aaah, yes.*	**7114b** *Like this* (in Greek)…
	Class D		
Females (7) Prsk	**246d** *It's easy.*	**270d** *Yes, I would like that.* **272d** *Yes, it would help me.*	**278d** *Aaa, those words no! We don't have.*
Pic	**390d** *Easy.*	**423d** *Aaa, yes!* **425d** *Yes* (it would help me).	**429d** *No.* **437d** *I don't know* (if we took them from other places-languages).
Xru	**514d** *Good.* **516d** *Hard and easy.*	**546d** *Yes.*	**560d** *No* (the same as Greek). **558d** *Addition* (is prosthesi).
Xval	**671d** *No, it's easy.*	**701d** *Yes! It would be my pleasure and his pleasure too.*	**705d** *We say them as you* (in Greek) (*addition, subtraction, multiplication, division).*
E	**1099d** *Yes* (easy).	**1131d** *Yes.*	**1133d** *Addition* (the same as Greek). **1135d** *No* (don't have such words). **1952d** *The same in Greek* (addition, numeracy, mathematics).
M	**1936d** *Easy.*	**1940d** *No, I don't want that.* **1942d** *Because when I have trouble somewhere, the teacher helps me and then I understand them.* **2125d** *Yes.*	**2131d** *We don't say them.* **2133d** *Like this we say them, the same. Because the* (word) *five we say it also five* (in Greek) *in Balamanes.*
Txou	**2089d** *Easy, we read, we*	**148d** *Yes.*	**162d** *From other places.*

	learn.		***164d*** *Yes* (addition, subtraction, multiplication, division… are like Greek)
Males (8) Tap	**110d** *A little hard.*	**850d** *To learn it!* **852d** *Yes* (it would be helpful).	**864d** *Like this* (as in Greek). **866d** *Aaa, no* (don't have such words). **868d** *Yes* (adapt them from other places-languages).
Tche	**822d** *It's difficult for me.*	**988d** *Yes.*	**996d** *Yes* (as in Greek). **998d** *No… addition is addition, we say it as you.*
N	**960d** *A little difficult.*	**1264d** *Yes I would like that.*	**1272d** *Normally.* **1274d** *Yes* (the same as Greek). **1276d** *Yes* (adapt words from other places-languages).
Than	**1228d** *Easy.*	**1436d** *No, I know Greek and Romani.* **1438d** *No.*	**1440d** *In Romani it is the same Mrs. It's just the language different*. **1442d** *Yes, yes* (the same as Greek).
S	**1402d** *No Mrs. Not at all. The Turkish yes.*	**1618d** *Yes.*	**1620d** *The same.* **1622d** *Yes.* (from Greek).
Spe	**1586d** *Easy.*	**1761d** *Yes.*	**1763d** *Mathematics we say them too.* **1765d** *Yes* (the same as in Greek).
Tft	**1735d** *Easy.*	**2293d** *Yes.*	**2301d** *The same* (as in Greek).
F	**2273d** *Easy.*	-	-
	Class E		
Females (4) Tbl	**250e** *Yes* (easy).	**270e** *Yes…*	*Mathematics, like this* (as in Greek). **278e** *Yes* (adapt them from Greek and other places-languages).
Par	**518e** *No.* (it's easy).	**578e** *No, I don't like it.*	**582e** *Aaa, it's not. No, no we don't have.*
X	**729e** *No, it's easy.*	**773e** *Yes.*	**791e** *No.* **793e** *Yes* (adapt them from other places unaltered). **1208e** *The same* (as in Greek).
Ch	**1176e** *Yes and no.*	**1196e** *I know, yes very much.*	**946e** *Yes.* (the same as Greek)
Males (6) Ag	**900e** *No* (it's easy).	**930e** *Aa, yes I'd like that.*	**1351e** *Aaaa, multiplication… the same*. **1353e** *We name them the same!* (as Greek). **1355e** *Yes* (adapt them from other places).
Pj	**1305e** *No* (it's easy).	**1335e** *Yes, I would.*	-
An	**1053e** *A little easy and a little hard.*	**1089e** *Yes.* **1091e** *Very much.* (it would help him connect Greek to Romani).	**132e** *Yes* (the same as Greek). **134e** *Yes* (adapt them from other places-languages).
Chri	**106e** *So and so.*	**126e** *Yes.*	**411e** *Pollaplasiasmos, the same* (multiplication). **413e** *Dieresi, like that (division).* **415e** (Adapt words) *from you some and we have many.*
Ptw	**389e** *The Greek? No!*	**395e** *Yes, that would be*	**1516e** *Like that, the same*

	(it's easy).	*perfect!*	*multiplication (pollaplasiasmos). Some things in our language are changing.* **1518e** *Yes* (they adapt them), *from other languages and places.*
Val	**1472e** *No* (it's easy).	**1510e** *No, I don't want that.*	-
	Class F		
Females (1) Pg	**430f** *Difficult. In Romanes I don't know to tell a word like…*	**466f** *Yes, I would like that.*	**472f** *Fractions* (as in Greek klasmata). *There is no other word to say it.* **474f** *Yes. Just like you say it, we say it too.* **476f** *Yes* (adapt words from other places-languages).
Males (6) J	**76f** *Easy.*	**108f** *No.* **110f** *I know them. It is again the same.* **112f** (Because I have) *The kids!* **114f** *Yes.*	**122f** *Yes* (the same as in Greek). **124f** *Yes* (adapt words from other places-languages).
O	**249f** *It's a little difficult.*	**279f** *Aaa, yes.*	**289f** *Yes* (the same as Greek). *But those who come to school they know them, but the others that don't come they don't know them.* **291f** *No. they* (Roma) *don't know.* **293f** *Yes* (adapt words from other places)
L	**558f** *No! It's easy.*	**594f** *Aaa, yes! Yes, I would want that. Then I could say it in Greek.*	**584f** *Em, yes* (same as Greek). **606f** *Normally, decimal numbers* (dekadiki arithmi) *this is how we say it, not I a different way.* **608f** *Yes, from Greek we adapt them like that as they are.*
V	**723f** *Yes* (easy).	**743f** *If they are Roma, because Balamos can't tell me.*	**757f** *No, we can't express them.* **751f** *Roma don't know anything from those, only us who come to school we learn.*
G	**852f** *Em, ok I don't know them all, but to communicate with a person I can.*	**872f** *I would like that, yes. I would like to give me exegeses only...*	**876f** *We Mrs. our people don't know what fractions are. Only the kids here* (at school) *know… in our language we don't know these staff.*
T	**991f** *A little difficult.*	**1031f** *Yes.*	**1049f** *Yes* (same as Greek). **1051f** *Yes* (adapt them from other places-languages).
Students (33)	**23 (answer: easy) 6 (answer: difficult) 4 (answer: both easy and difficult)**	**27 (answer: yes) 5 (answer: no) 1 (no answer)**	**33 (answer: no mathematical vocabulary-adapt them from Greek)**

Source: Excerpts of Students' interviews

Table 5b

Students/Questions	**Qt**	**Qu**
	Class B	
Males (1) Hrb	**88b** *I do it by myself.* **90b, 92b** *No.*	**86b** *No* (he doesn't ask).
	Class D	

Females (7)		
Prsk	**248d** *No, I raise my hand and ask the teacher and he tells me it's this.* **252d** *They are general, in mathematics too and in language.* **254d** *Yes, I ask.*	**256d** *From the teacher.* **258d** *My classmates yes but if they don't know too then we all ask the teacher.* **262d** *Yes, in my language… and if they know…if they don't I ask the teacher.* ***266d*** *They also have difficulties in mathematics.*
Pic	**395d** *Some words. **397d** General.* **399d** (she asks) *The teacher.* **414d** *Yes. My cousin helps me.*	**401d** *I ask my classmates too.* **403d** *The teacher* (more). **417d** *Classmates more but the teacher too.* **405d, 407d, 419d** *Yes.* (more convenient in Romani)
Xru	**520d** *No* (don't understand the problem completely). **522d** *Yes* (some words are difficult). **526d** *Yes.* (simple words). **542d** *Yes* (asks what operation to apply).	**528d** *(I ask) the teacher or the classmates.* **530d** *Yes* (in her language). **532d** *Yes.* (it's more helpful). **538d** *The two girls, Prsk and Pic* (asks mostly).
Xval	**675d** *yes* (words that don't understand). **677d** *Eh, yes… both* (mathematical and general). **695d** *Yes* (asks what operation to apply).	**687d** *Yes* (more helpful in her language). **689d** *Yes, either my classmates either the teacher.* **691d** *To tell the truth I ask mostly the teacher.* **693d** *Yes, yes. I ask them a word and the teacher is shouting it's not that. I trust children but sometimes they make mistakes.*
E	**1101d** *Mathematical* (words). **1105d** *Some I know, some I don't know* (general words). **1119d** *Ah, yes* (asks for explanations). **1125d** *Yes* (asks what operation to apply).	**1111d** *And the kids sometimes.* **1113d, 1114d** *Yes* (more helpful in her language). **1107d, 1121d, 1127d** *The teacher* (the most).
M	**1852d** *Yes.* **1854d** *Mathematical* (words). **1860d** *Yes, yes* (asks for explanations). **1864d** *Once in a while I ask* (asks what operation to apply).	**1854d** *I ask the teacher, the kids.* **1856d, 1858d** *Yes* (more helpful in her language).
Txou	**2099d** *Aah, yes* (some unknown words). **2121d** *I ask, yes* (what operation to apply).	**2103d** *I ask the teacher, because if I don't know it, the children don't know it too.* **2109d** *When I'm confused I always ask the teacher.* **2119d** *Yes, yes* (more helpful in her language).
Males (8)		
Tap	**116d, 124d** *Yes.* **118d** *Mathematical.* **136d** *A little, if I don't know it they tell me.*	**126d** *The teacher* (more). **128d** *No, because they* (children) *don't know mathematics.* **140d** *Yes* (the children and the teacher). **146d** *In Romani.*
Tche	**824d** *Yes* (don't understand some words). **826d** *Not mathematical, the other* (general). **838d** *Yes, to do it right* (he asks for explanations). **846** *Yes* (asks what operation to choose).	**840d** *From my classmates and the teacher* (both). **834d** *Yes, yes, in mine* (language). **836d** *I learn to say it, they help me* (more convenient).
N	**962d** *Yes* (don't understand some words). **964d** *No, they are general.* **976d** *If I don't know it* (the problem), *I ask* (for explanations)	**978d** *I ask sometimes the teacher, some girls.* **970d** *At most I ask Pic* (a student). **972d** *Yes* (in his language). **974d** *Yes* (more convenient).
Than	**1232d** *No, no* (he understands the words in Greek). **1236d, 1250** *Yes* (he asks for explanations of the problem). **1252d** *Yes* (asks what operation to choose).	**1240d** *The teacher* (I ask). **1242d** *Yes* (the students too). **1244d** *Yes, in Romani.* **1246d** *Better from the teacher.* **1248d** *Yes* (more convenient).
S	**1404d** *I'm confused Mrs* (in words). **1406d** *Mathematical.* **1414d** *When I write and get confused I tell the teacher look here what have I done and then he tells me how to correct them.* **1416d** *I tell the teacher I can't read it… Let's do it together he tells me* (asks for explanations and help in problems). **1432d** *Yes, yes to the teacher.* (asks what operation to choose).	**1418d** *No, not the children. Only the teacher.* **1422d** *Some* (children) *don't know them the truth is.*
Spe	**1588d** *Yes* (some words). **1590d** *Mathematical.* **1606d** *Yes* (asks for explanation in the problem). **1610d**	**1592d** *I ask.* **1594d, 1616d** *The teacher* (the most-more certain). **1596d** *No* (not the kids). **1598d** *A little only my cousin helps me*. **1600d**

	Yes (asks what operation to choose).	*No, not in Roma.* **1602d** *In Greek.* **1604d** *Yes* (more helpful).
Tft	**1737d** *Mathematical* (words). **1751d** *No, I try by myself* (doesn't ask for explanations to the problem). **1753d** *Yes, I ask there* (for what operation to choose).	**1743d** *No. I ask the teacher* (mostly). **1759d** *Because he is older and knows more.* **1745d** *Sometimes I ask* (the students). **1747d** *Yes* (in his language). **1749d** *Yes* (more convenient).
F	**2275d** *Yes* (some words). **2277d** *Mathematical, no, no, general.* **2285d** *Yes* (asks for explanations to the problem). **2289d** *Yes. They tell me why you stuck. I'm having trouble I tell* (asks what operation to choose).	**2279d** *I ask* (the students). **2281d** *Yes* (in Romani). **2283d** *Yes* (more convenient).
	Class E	
Females (4)		
Tbl	**260e** *Yes, those I don't know, I ask them and they help me* (with the problem and unknown words). **262e** *Mathematical.* **266e** *Yes, I ask.* (what operation to apply).	**252e** *I ask the teacher.* **254e** *Yes* (the children too). **256e** *Yes* (in Romani). **258e** *Yes* (more helpful).
Par	**502e** *No, I'm not confused by the words.* **506e** *No* (she doesn't ask for explanations in the problem). **508e** *Ehm, the teacher writes on the board and then I copy it.***514e** *A, yes I ask that* (what to choose).	**516e** *No, only the teacher* (she asks).
X	**733e** (the problem is) *Not completely!* (understandable) **741e** (some words) *A little…* (complicated). **751e** *If I don't understand it, then I ask the teacher and she tells me.* **759e** *Yes* (asks what operation to choose).	**7753e** *I usually ask the teacher.* **45e** *Aha, yes* (asks the students). **747e** *Yes* (in her language) **771e** *Both, but more in Romani.* **749e** *Yes* (understand it better). **765e** (the students) *They explain it after in your language too.*
Ch	**1178e** *I don't know the words* (vocabulary), *but the most I know, and what other people say. If someone expresses a new word, unknown to me, I wouldn't understand it and asked teacher to explain it.* **1180e** *Both* (mathematical and general words). **1186e, 1190e** *Yes* (asks for explanation in the problem and what operation to choose).	**1182e** (I ask) my *classmates, and the teacher to be certain.* **1184e** *In Romani* (the students), *but sometimes they don't know either and I ask the teacher… they explain it wrongly. For example, I asked the teacher what was "this* (toutos)*" and she told me it was "that* (aftos)*" and the children told me it meant "me". So, then I didn't trust the children much.* **1188e** *The teacher* (mostly). **1194e** *Yes* (in Greek she prefers).
Males (6)		
Ag	**902e** *A little.* (he doesn't understand some words). **904e** *Simple, everyday words.* **926e** *Yes*(asks for explanations and what operation to apply).	**922e** (Asks more his) *Classmates.* **918e** *In Romani.* **910e** *I ask, yes.*
Pj	**1307e** *Sometimes yes* (don't understand some words). **1309e** *Mathematical and every day.* **1319e, 1327e** *Yes* (asks for explanations and operation to choose).	**1313e** *I ask my teacher.* **1315e** *No, only the teacher.* **1321e** *My teacher, the children a little too.* **1323e** (he asks the students) *In Greek and sometimes Gypsy.* **1325e** *The Gypsy.*
An	**1057e** *Yes* (don't understand some words) **1059e** *Everyday words.* **1079e** *Yes.* (asks explanations and what operation to choose).	**1069e** *Yes, the teacher* (he asks the most)**.** **1081e** *Yes, but most the teacher.* **1071e** *Sometimes, yes* (he asks the students). **1073e** *Yes (in Romani).* **1075e** *A little bit more yes.*
Chri	**108e** *Yes, sometimes* (don't understand some words). **110e** *Mathematical.* **118e** *Yes. I ask the teacher or the kids if I have a mistake…* (in explaining the problem). **120e** *Yes* (asks what operation to choose).	**112e** *Yes, I ask.* **114e** *Yes, the teacher and the classmates.* **116e** *In Greek and in Gypsy.* **122e** *Yes* (more helpful in Gypsy).
Ptw	**397e** *A little bit, yes* (unknown words) **403e** *Yes, I ask the teacher when I don't understand something. For example, today NASA was an unknown word and we learned it today. I ask the teacher when the other reads it aloud and then I ask her directly.* **407e** *A little bit, certainly* (for	**393e** *No, I just ask my teacher what is this and she translates directly.* **405e** *My classmates do not know also, we ask the teacher and then…*

	what operation to apply). *But not for long… We call for her for a while and then we act lone by ourselves.*	
Val	**1480e** *Sometimes I don't understand* (words). **1482e** *Mathematical…* **1486e, 1496e** *Yes.* (asks for explanations of the problem and what operation to choose).	**1498e** *Not so much from the teacher but from my classmates.* **1492e** *Yes, in my language.* **1494e** *Yes* (more comfortable). **1502e** *Yes. The Greek one I confuse it a little.*
	Class F	
Females (1) Pg	**438f** *Aah, in mathematics. Yes.* **440f** *General, mathematical, I don't know.* **450f** *I go to the teacher* (to explain the problem). **456f** *Yes, I ask the teacher* (what operation to choose).	**442f** *The teacher and the kids, but mostly I ask the teacher* (mostly). **444f** *Because the teacher knows more.* **446f** *Yes* (she asks the children in her language). **448f** *Yes* (more helpful).
Males (6) J	**78f** *Yes* (don't understand some words). **80f** *Everyday words.* **94f** *No* (doesn't ask for explanations on the problem). **98f** *Yes* (asks for what operation to apply).	**86f** *The teacher* (asks more) **102f** *Because they also go to the teacher.* **88f** *Yes* (the kids too in his language). **90f** *Yes* (more helpful).
O	**251f** *Yes. I read, I read, I underline them* (words) *and when I finish I tell it.* **263f** *Some general, some mathematical.* **265f, 269f** *Yes* (asks for explanations to the problem and what operation to choose).	**253f, 261f** *The teacher, Yes* (mostly). **271f** *No, not the others. I just sometimes I ask them* (students). **273f** *Yes* (in his language). **275f** *Yes* (more helpful).
L	**564f** *Eh, to one or two* (words), *yes.* **566f** *No, mathematical no.* **576f** *No, I don't ask her that* (what operation to apply).	**570f** *No, I don't ask them.* **572f** *I ask the teacher!*
V	**725f** *No, when there are other words I don't understand it… we ask the teacher and we learn them.* **737f** *Yes, I ask the teacher and my classmates… if I don't know I ask from the teacher then* (in the problem). **739f** *Yes* (what operation to apply)	**729f** *When I don't know something I ask my classmates.* **733f** *Yes, we speak a little Romani…* **735f** (Easier) *In Roma*.
G	**856f** *…When it's a difficult word we say it all.* **862f** *The teacher explains it* (the problem) *to us. She tells us it says that, this … and then with our mind decide what to do…* **868f** *I read the problems 2 to 3 times. If I don't understand them I go to the teacher and she says you'll do this* (operation)…	**856f** *I say the teacher not the children because they don't know either sometimes… I first go to the teacher and she says read and whatever we don't know tell her.* **864f** *Yes* (asks also students in his language). **866f** *Yes Mrs. is easier than your language.*
T	**999f** *Words as you said at first* (general). **1011f** *Yes, for the whole problem* (asks explanations). **1025f** *Yes.* (asks what operation to apply).	**1005f** *Yes* (asks both). **1007f** *Yes* (in his language). **1009f** *Yes, it is easier.* **1017f** *From my classmates* (mostly). **1019f** *Because they're Roma and I'm Roma and we communicate better.*
Students (33)	**30 [answer: didn't understand words/particularly 9 (mathematical), 9 (general), 12 (both)]** **26 (answer: didn't understand the whole problem)** **29 (answer: didn't know what operation to apply)**	**25 (prefer in Romani)** **2 (prefer in Greek)** **20 (ask the teacher)** **7 (ask the classmates)** **4 (ask both)** **2 (no explanation)**

Source: Excerpts of Students' interviews

- ***Tables of teachers' interviews***

Table ST$_{eacher}$

Questions/ Teachers	**Teacher G**	**Teacher A**	**Teacher E**
Mathematical teaching design	**16t** *First of all we never do the class in which they normally attend to. If for example they are in 4th grade, we'll do* (the subjects) *analogously their level, perhaps of 2nd grade, perhaps 3rd grade, like this.* **18t** *Certainly, certainly easier exercises because they can't even in the next grade to manage it.* **24t** *Yes, yes! But the curriculum wasn't completed at all. Then I saw that you should teach them the language subject of 2nd grade and the math subject of 3rd grade while they were attending 6th grade for example.* **60t** *We try to find a way closer to their facts, anyway.* **86t** *No guidance, explanation. Let's say the problem is formulated with the words we know. You have to explain the words better. For example, it says discount and they might not know it. He/she will ask you what is that? You have to explain it to them, the meaning, with example mostly. Let's say you sell a potato sack for 5 euros and I came and you make a discount to me 1 euro. They say what is this and you reply but I'm your teacher, wouldn't you give it to me cheaper? Aah, so you say…* ***102t*** *Mostly I have to say that we adapt to them instead of trying to adapt them to us. I mean if someone has that background you'll tell him/her do that in your mind first and then write it.*	**151t** *Yes, how I treat them. Well, generally the Roma kids are a particular group of children, so they have no relation with other schools and students. They have a different treatment, because generally the kids here I put them in groups and then I teach them the subjects normally of their class, where this year I have 5th grade, but with lesser exercises, the simplest exercises. Let's move on to the subject of mathematics. I have those kids now for 5 years, because I took them from 1st grade. They were 3 years in the 1st class because when they came, they didn't know at all the Greek language. So, it was like kindergarten the 1st class. They have to be acclimatized also… yes, I concentrated more in language. So, now in 5th class I work with mathematics of 3rd, 4th class and a few of the 5th class.* **153t** *No, not from the books, I work with mine because the book of 5th class is difficult to correspond to it and as a result I create problems and exercises of my own.* **159t** *Yes, yes, too much. At first when I came I was very strict because of the other schools I went the kids had greater demands. So, I had figured I needed to treat these kids here with greater demands too. For example, I gave them exercises for homework, I was giving them the books normally, but then I realized that none of these things happened. It was mattered only what was happening inside classroom, there was no chance of taking the book back home and of staying to study there. Because of their habitat, they are poor and live in prefabricated buildings with many family members, parents, siblings and grandparents. It is impossible to study. As a result I changed my behavior, meaning whatever we do; we do it here at school and the books stay at school because 2 days after when they get home, they come without books.* **183t** *Certainly different, because we are not following the flow of the book as it would be to a normal school.* **185t** *Yes, yes according to book! Here we do not follow the book. We depend on the peculiarity of students. I should say that the girls are doing lower mathematics than boys according to their knowledge. The boys for example can execute a division. Now they've learned the division with two digits but the girls can't.* **197t** *Yes, with explanations and repetitions! They say, ah we know that you've told us yesterday, ah yes, yes we*	**286t** *I have the 6th grade this year. Definitely my class doesn't respond to the level of the 6th grade of other schools. I do the lessons of 3rd grade, but up to these lessons I adjust the knowledges analogously how I can find the terrain* (suitable). *I give extra things or subtract also from the school material of 3rd class.* **292t** *I always treat them with love because they are spontaneous kids. But sometimes I have to be strict because they have to go into molds and these kids can't be put in molds even as much we try! I react analogously, as much possible the kids could acquire the knowledge or behave nice.* **294t** *Yes, yes undoubtedly. At first I was very strict, but then I started to approach them very differently, to go near them and make jokes. They even taught me how to steal in a supermarket and they did lessons to me* (laughing). *But of course, I explained to them that this isn't right, it could lead them to prison and all these. I also take lessons from these kids.* **320t** *For example, to teach the meaning of multiplication, because they had learnt it by rote memory without understanding, we did this game we putted 2 books in the desk, again another 2 in the other… just to understand what it means, the meaning of multiplication… when I wanted to teach subtraction, because it is difficult for them that also, I had a group of children here and I get 2 of them outside the door to understand the meaning of subtraction.* **326t** *Yes, with examples, explanations, with theatrical-gaming form. There is no other way!* **359t** *Yes, yes. It helps* (to use their knowledge). **361t** *Ehm, in the carpets selling when we were discussing and I asked them to get me a discount as their teacher by joking, they told me Mrs. we'll get you a 10% discount. This 10%, we worked it so much and they know it as an oral picture. For example in 100, I will give it to you 90, as praxis… they knew the discount of 10% and 50% but didn't know what it was.*

		understood it. **227t** *Yes, I've changed it. I try this intelligence not be found only in their minds but also to write it down.* **229t** *First of all he/she has to learn the numbers. I mean he/she may know that 15+15 equal 30 but didn't know how to write it. He/she didn't know to write the numbers, for example he/she was writing the 1 ups-down, or the 2 didn't know at all. So, we had to learn the written form of the numbers. The 7 made it upside down, the 9 also, or the 30 instead of 3, he/she used the Greek letter ε (e). So we firstly learned how to write the numbers and then slowly we learned.*	
Level of attainment	**42t** *Low!* ***46t*** *Yes, again it is low.* **48t** *I think that there is no help from home, not at all. These kids spent 5 hours a day here at school and only those hours they are trained. Then* (they do) *nothing, they don't open any book, they don't catch a notebook, a pencil, nothing. We put them copying for homework and they do it here, the next day. In the whole year from this class, maybe 2 or 3 kids did have done it from 18.* ***96t*** *They need much patience until they understand it-what we ask, but it is this* (difficulty) *there is not regular attendance and things that you'll say today, you'll say them tomorrow and the day after tomorrow for the others who weren't here and for the others who forgot and… this is not learned in the required time.*	**171t** *Look. I understand what you said, to a normal student of 5^{th} grade. From those 10 kids here, the half as long as the boys are concerned and 1 girl could manage in a normal class with Greek kids. The other 4 no they can't, they are too low.* **173t** *Yes, in 5^{th} class but without so many exercises.* **175t** *Yes, in a good level.* **177t** *Yes, I'll tell you. They are in a mediocre to good level.* **181t** *Yes, the home.*	**304t** *For their standards I would say middle in another class. Of course, I can't completely compare because I have in fact 3^{rd} class students.* **306t** *No, it would be middle… but not low, I have a good class. Because they can't sit many hours in house to give it a try or if we sit 3 hours of intense reading in class they want to go outside and play, but all children want that, but those a little more. They try nevertheless. They went back home and they don't hear our language, no parent care about them from their own they wake up to come to school. They weren't usually woken up by the mother with a breakfast. The conditions are difficult. Whatever they accomplish, they deserve congratulations* **308t** *Their minds are sharp, they all are merchants! They are really smart kids. The Roma girls are a little inferior in this but I think* (non-Roma) *the other girls are also inferior in mathematics, the boys are trying. I have a student who can't read but if I give him any problem he could solve it… he is very clever but has dyslexia. I have realized it… and he can't read well but he's really smart.* **310t** *First of all they don't speak the same language. Their first contact with Greek language was at school. The parents at home don't care about their notebooks, book. Only a few lately* (care about) *and the may be those who had come to education programs earlier. They are kids who work their bodies, they are more relaxed and they have learned to find their food and money with an easy way. But this is changing slowly, I've seen it.* **312t** *The home and the school. What can I say about my co-teachers* (resentment)*? A good school helps to change their behavior and if the house it has an order even if they are illiterate, they help the child*
Ambitions/ Inspiration	**34t** *Mine?* **36t** *No! No, because they* (Roma kids) *don't study at home. So, they can't manage it only by*	**165t** *Ah, yes. For these kids who I have now, I aim high because of the good level of the class even for Roma*	**298t** *For their standards I want them to achieve high. I would be glad for them to finish high school.*

s	(the help) *of school.*	*kids. For Roma students I want to finish primary school and then continue to junior high school and later high school because they have the potential some of those. In this way to find later a job, to get out of jobs like junk dealer and street sellers. I mean to obtain a different mentality-attitude, which they will pass over to their children I think.*	*But one cuckoo doesn't bring the spring* (Greek saying). *They all have to help, from 1st grade until the last. I want these kids to finish high school also. Their stance will change towards life as far as their early marriage is concerned. We make conversations about that. In the age of 12 and 13, what marriage could make? I want them not to think only about marriage, but to educate themselves, the girls and also the boys, 15 years old the boys and 12 years old the girls. That is tragic here! I think with my students I work on that. I say to them be patient until your military service is over. I want all of them who pass through my hands to get a junior high school diploma and if I see someone with a high school diploma I would be very proud. It's like I see the other* (non-Roma) *kids to succeed in passing to medical school. Something like that.*
Language and terminology	**52t** *They have* (difficulties) *because at home they use a lot the Roma (language) and…***56t** *These kids can't even tell plus and minus but (in simpler words) to put in and put out.* ***58t*** *Yes, yes.*	**187t** *Yes, I'll tell you. Now, there aren't. They can read really well now. To tell you an example today that was raining… I had to give them yesterday a pray to learn for the Easter but I forgot and today I gave it to them to read it in the school pray hour. I was pleased because one child read it in front of others really well and it was a difficult* (text) *for a gypsy child. That means… yes in purist Greek with circumflex and… that means the kids know to read really well. So, they read it decently.* **191t** *I'll tell you. They have a lot of unknown words. Words that we say it is possible to not know this word for example. Today we had a lesson that even if they could understand from the context the meaning… that someone who watches a lot of television, eats too much, chocolates, candies, hamburgers and becomes obese. I ask them what obese means and they reply we haven't heard that word. I said yes but if you eat many chocolates, candies, hamburgers and sodas, what will we become? They said, fat and this is how they comprehend it. But we wonder a 5th grade student not to know the word obese? Another time we were saying the olive tree is evergreen and they said what the tree was. I said is it possible to not know what the tree was I asked them don't you know the tree platanos we have outside? Yes, they replied, platanos. They didn't know it was a* (subcategory of a) *tree. In a paragraph, in the school book of 5th grade which is difficult, it has difficult vocabulary. We have to explain every unknown word. And their problem is the following, to highlight to you; when they read something, from 10 children, only one child will understand it and will tell me the meaning of this.* **193t** *Yes, they again*	**322t** *Yes, many difficulties, many. We don't speak the same language. I do Greek language and of course I don't have the time to teach them many verbs. I do a few things present, past tense, past continuous… I explain in order to understand what they read.* **324t** *I use the same there. The book of 3rd grade has many examples.* **328t** *Not so much but I insist. For example the minus I would combine it with getting some of those out, or the plus by hugging them, or the multiplication by come and go. The word quotient I haven't used much. I think they should learn the substance and stay a little behind the terminology.*

		have a difficulty and we analyze them and we are always explaining them because they haven't seen them before. **207t** *Yes, the formulation and the words. For example we could say something (a word), which is easy for us, a fabric merchant, but they would be like what this is. Something like that, so they need help.*	
Mathematical background	**98t** *Informal yes, because we've said with the interaction* (of their family work)*…* **100t** *I know their parents take them with them in the works but I also observe it. I mean you see it when you tell them do that operation, they first think of it and then write it.*	**223t** *Yes, that I said earlier. They have a mathematical knowledge because they are from an early age in merchandising with their parents. When a child (Roma) comes to school and don't know how to write, but knows how to count, it surprised me. A little kid of the age of 6 knows to count until 100, knows to calculate. I mean if you told him/her 15+15, he/she will reply 30, or 12+25 he/she will find it, but could not talk in Greek at all. So, they have a better mathematical knowledge.* **225t** *I tested by observation.*	**351t** *Yes, yes. They are children that are occupied with merchandising… and I think the colleagues what they've done until now, because I had them in 6th grade and I had many years to encounter Roma children I think they paid attention to mathematics because they consider that in this way the children's life would be developed with merchandising, where their parents would do it and the children would continue it…* **355t** *Yes, yes. They are kids who without knowing that this is addition or subtraction with that terminology, they can give the changes, they think of the discount they would offer to a product, for example to a carpet, to clothes or shoes. Yes, I've seen it.*
Logical argumentation	**66t** *Logical arguments yes, deductive reasoning no.* **70t** *For example, you had 10 euros and you bought one bread which costed 1 euro. How much money is left? Like this, the simplest.* **72t** *Empirically they say it.* ***76t*** *I've gone to the bakery, I gave 5 euro, the bread costed 1 euro and he/she gave me back 4 euro. They don't say changes, they don't know it. Empirically, as we speak daily.*	**199t** *That is hard, really hard! … I have to explain it to them, to understand it. We are telling it once or twice and then they understand it.* **203t** *To 10 kids, yes. I could tell you that the 3 of those are good, they can give logical answers, but the other 7 are unable.*	**330t** *Yes, yes!* **332t** *The kids take part in conversation of solving a problem, they understand what they have to do and I see their solutions. Their solutions are logical. They use more examples from their real life… yes, they use deductive reasoning also, everything. I don't have an example right now, but they use… They are not lacking in anything in relation to other* (non Roma) *kids. They just didn't yet understand that… I don't know if this is good or bad… that they have to learn some staff from school and this will enlighten their life. There were many kids that only came to benefit their parents the subsidy of the state. I think they had lack of food and sent their children to take that allowance of 300€ the year. So they were becoming spoil but not that the allowance is not valid very few force their children to come to school. That dissatisfy me but the lack of food. If those people secure the creditor, then I suppose they would take care of their children more. For example, at spring the schools become empty because the children go with their parents to sell around, to do merchandising. The kids who work from 10 years old…can't be not smart. They just aren't careful… they are selling flowers, chairs, etc. and in the autumn carpets in big fests. The kids are inside life.*
Relationships/data	**78t** *I think not. These children no, not even in bigger classes I could*	**205t** *I do have to help them! No, from their own, no. we have to explain the*	**334t** *Yes, they realize it. They conceive them really well. The kids*

understanding	*say, because I've taught also in bigger classes. The data as we express it to them, they understand it empirically.* **80t** *If it is formulated as in book (in more formal way), I don't think so. They need simpler words and easier.*	*data of the problem, the data presented and the data requested, only like this. If I give them a test they need help, they can't from their own. It is too difficult, they need explanation.*	*I have now in 6th grade I consider that yes they can.*
Algorithmic computations	**44t** *Whereas they know empirically, they can't attribute it in writing. For example, a previous year you were telling them to do an addition on the board or on their notebooks but they were mere sitting and did it with their minds. I had a large class and we were trying to learn the change in the tens with carrying digits, but nothing. They were doing it with the mind. But they were getting it correct.* ***88t*** *Mostly mental. Because this how they've learned it. Because the majority of their fathers is in merchandising and they take them with, so they (kids) all use this way.* ***92t*** *Certainly the written ones but also the hands or materials, etc. but as they understand.* **94t** *Yes, certainly. The written ones* (I suggest) *but to reach there with all the others…*	**209t** *Look. They prefer their intelligence. I mean they use their minds. They understand what the problem says and what the problem asks and they find it with their minds immediately without doing the operation.* **211t** *Yes mental, because this is how they've learned from an early age. They go outside and say how much these carpets cost. They say 20, so 3 carpets 60. They don't know that they have to do the multiplication 3*20, they find it spontaneously with their minds, their intelligence.* **213t** *I suggest them the practical way, to think, to read the problem 2 to 3 times, to understand what it says, to put the data in order what is being given and what is being asked and then find the appropriate operation. Ok, I know they might find it with their minds but I want them to present it to me also written to see how they reached to that, what they know.* **219t** *Yes, I convince them as follows. I tell them since you are coming to school, you have to learn how to write. Ok, you learn this outside when you go with your parents and sell, but here this is why we have the pencils and the notebooks, as I also gave you pens this year now you're in a big class, because we have to learn writing. They like it, they realize it! Now, I have given them also colorful pens in order to write the solution with a different color, the answer with another color and they like it. They write solution and answer.*	**338t** *Yes, they love the Chinese* (grocer-bacalica) *mathematics, but I don't mind as long as the result is correct. I explain to them the schoolbook way of mathematical solution, but I am accepting it too. I explain also their way.* **340t** *Always, yes! When we have a difficulty we use everything in order to solve a problem.* **342t** *Their fingers! But we also have some sticks, many books and colored pencils. We put everything out at desk and work with those, beans, everything… I don't use them so much but here in the mathematics of 3rd grade actually we use them.* **344t** *The mental and the materials I have them for preparation to see how their minds rev up, how is their perception. The written way confirms if they are right. I think that the written equals as 10 times much as the oral. Because when you write it and the mind follows it is a better work. But the mind needs practice. I also like the mental when the kids practice their minds and when they face difficulties to use the materials to distinguish and understand the knowledge. All the ways are acceptable in order to achieve my goal…* **346t** *At the end either way we write the solutions in the book, because I think that a book should be written in order to go back and see it again and it should be written correct. I can't let them with wrong solutions or thoughts. It helps.* **349t** *They have realized that after all that work the thing that must happen is the thought and the knowledge acquisition to be imprinted in the paper. They consider that is the right thing now… Yes, I suggested that to them after every example and conversation we had. We ended in the writing of the problem in the school textbook or the notebook…*
Mathematics as important asset	**106t** *Yes.*	**231t** *Yes, of course! A great asset to be included in the society. Without mathematics, without multiplication, without those, how else would a child move on? Also as we are talking about Roma students who are accompanying their parents and they are selling in order not to lose the money, it is natural consequent. With mathematics the child could be integrated in every sector. I mean we are saying, he/she has a mathematical mind.*	**365t** *Mathematics, I think up to the point needed to them in merchandising, in transactions they are good, they have the knowledge, maybe not specialized but it is something that their parents know it well and they will learn it well too. The thing that they need along with mathematics is the practice in language and in mentality/attitude of life.* **367t** *It is of course. The money is something that includes everyone, everywhere, that's true. All the others are in second degree.*

			Actually me as a person gave weight in the concepts, in Greek language, because they all were teaching them mathematics the whole 4-5 years and as a result they have many unknown words…
Promoted prepared	**108t** *No. they don't have the same assets with a non-Roma kid and that is I think due to their lack of attendance.*	**235t** *Properly prepared for junior high school after the primary here, no they aren't. This fact is undeniable! However, because in junior high school they* (teachers) *know the inadequacies of those children, they treat them differently. That's why in junior high school they make it easier for them as we do also in primary school, where we subtract exercises. This is also the case for junior high school, as I understand from a conversation I had with a literature professor. She told me in a class there are Roma and non-Roma children. She had 4 Roma students in her class and she treated them differently. For example if the others were taking an ancient Greek text of 10 lines, the Roma kids would take 2 lines. So, they treat them differently and at the end in the exams they give them questions together with answers. They are telling them you will read this and this and they pass… they might score 17/20 and you would be surprised. But yes. They reveal them the tests in mathematics final exams. They are telling them this is what we'll put you. They give them the answers.* **237t** *Yes, yes, different. Completely different! This is how they promote them*	**369t** *No! I have* 6^{th} *grade. Alas! But I don't know who is to blame. I don't know. There are schools, there are teachers, why don't they come? But how can someone concentrate when he/she is hungry, or how can they keep up with school when their attitude is different, or when the stealing and the occasional opportunity is the street smarts? How can someone organize the life with tactical knowledge? I don't know. That troubles me a lot. I don't know if they can be integrated those kids. But with years their attitude has changed but only to those who had come to school. The others didn't change and they are many.*
What should be reformulate d	**110t** *But it requires constant attendance.* **112t** *If they come regularly at school, if they were helped at home, not too much at least a little is enough. Because I think also the parents don't give them the push, the push to come to school.* **114t** *Look, today we had that talk in the school pray and one of them said why you don't send the papers to one father, to one father that is enough, and you'll see that the school will fill up and you wouldn't have any place to put them all. He meant one father to be sent to the police for not sending his child to school and then everyone would come.* **116t** *Certainly! If they don't come, from where else would they learn them?*	**239t** *To continue smoothly they have to start from kindergarten, to start going to kindergarten for two years as they are obliged to. So, they can learn the simple mathematical concepts, the numbers, those in order to come more complied to* (primary) *school. That's what I think, to start firstly at kindergarten, then continue at primary school, because here in primary school we have to stay 2 to 3 years* (in 1^{st} class) *to learn all that and their age is above the class.* **241t** *First of all I would have made school books for gypsies, different from those* (of non-Roma kids)*. The books they have now are difficult. They can't manage it. These books have different terminology, they could use some gypsy style terms. I mean pictures of them, of their culture, so they can love the books. They think those books very foreign to them.* **243t** *Yes. I had participated in a program in Volos 5 years ago for Roma students with another teacher. We went and they had given us some books for Roma students, books of language and mathematics… and I did them remediation classes after school hours…* **245t** *Yes, I'll tell you. These books were about* 1^{st} *grade only and certainly I used them because they*	**371t** *Many things happen. I've heard that in their* (Roma) *houses teachers had approached to educate the parents with programs. There is a school for those. We should change their perception and send their children to school, to be their primary concern as it was for our parents. Whatever happened we send our children to school. But for them only if the child wants to go to school, he/she would come. Very few parents motivate their children to come to school and by the first chance they take them away. It is clearly a matter of survival. A people full stomach would be involved in reading, but if they are hungry they would find a daily pay and leave from one place to go to another. There are many blames. I don't know if it is being the proper use of share funds to take care of socialization of those people and to stay in a place. I don't know if their philosophy of life could keep them in a place. Nevertheless, there are diligent efforts from everywhere. The result couldn't be perfect from one day to another, so gradually.* **373t** *Ehm, I would mind those kids to come to school, all of them since there is the*

		couldn't make it until 5th class. They adored those books, because they were referring to gypsies and their marriages and others. It was something they liked about. I would change the books and mathematics books, with different and easier problems. Because of integrating the gypsies we have to change the math material of the books. I mean I try to find problems that could handle, they can't deal with the official school textbook of mathematics. **247** *Yes, on purpose, related to their fathers' occupations.* **249t** *Yes, yes. It facilitates them and it is likable to them.*	*law also. I would apply it… If they would come, definitely their mind would be different, it would open… to be complied with the law as all the others (non-Roma)… we are saying it's ok, they don't have food they have to travel. They don't care if they stay at the same class… there are many things. At least if were in charge in schools, I would wanted to work right.*
Entrance in universities /technical faculties	**122t** *Look of the whole school, if they continue like this, then 2 or 3 may go higher. I see them with good mood, they want to come, they don't always think about how to play or slip out of class. 2 or 3 will manage it.*	**255t** *Ah, ok. I'll tell you about the kids of my class. From my kids, the 4 out of 10 could finish high school and then enter somewhere. But in a low* (according to their average score in final passing exams) *faculty. Yes, because I don't know exactly the exam system of gypsy children. I've heard they want to change it, not in high school, but in Greek national exams which determines their entrance in a university. Because they were given the opportunity to pass as teachers and police officers. So, they would certainly have a different school material, different scoring criteria, etc. with my mind I put them in that group, otherwise no one could pass.* **263t** *I think if he/she enters in a university it would be really good and easier to find a job.* **265t** *I think they would help them because they also want to integrate Roma into society. I've watched in television that some Roma kids take administrative positions. So, if they pass in a faculty, they would have a good resulting.*	**375t** *Many of them could enter, many. I would be happy if 3 of my kids would go, but I know that none would make it. That's what I think! I hope to end up a liar. I hope and I try. I mean the diploma of high school to obtain (I would be happy), but again…*
Interaction with parents	**126t** *They don't come. The principle has invited them so many times but they don't come.* **128t** *With a few.* **130t** *Those, the Roma parents we are trying to convince to bring their children to school. A thing that is defacto with the non-Roma to bring their child to school.* **132t** *To convince them that they have to send their children to school. And not only this, we have gone to their community and gather the kids, door by door.* **136t** *When you speak with the parents, they are not negative but when you ask them why you don't send then, they reply that their children can't get up this early in the morning.*	**257t** *Look. There is no cooperation with Roma parents, because as many times we have said… basically most of them don't even know what grade their child is. When they come here we phone call them* (to ask) *why the kid didn't come to school or they don't know who the teacher of their child is. They don't cooperate well.* **259t** *Oh, yes, with other* (non-Roma) *parents we had an excellent cooperation, of course. Because of the non-Roma parents are directly at their children, they take care of them, they know everything. But here there is no good cooperation with the gypsies because they don't care, they don't come, they don't ask* (about their children progress), *they don't even know whose teacher is in charge of their children.* **261t** *They don't have the best stance for school. They think that if their kids don't come to school, there is no such a big problem. For example, when I came to this school 9 years ago, I had a student that she was excellent, an excellent student.*	**377t** *It happened to have their parents, some of them as my students before becoming appointed. My relationships are good. I try to influence also there the people to send their kids to school basically with my work, my example, where I don't leave the children dissatisfied from the knowledge they would take. They come every day and I want every day to feel that they learned something.* **379t** *To me, everyone!* **381t** *No, no it's the same. As I talk to other parents, the same I talk to them to. I don't feel that I should treat them differently. It's just the requirements of those children. I mean with a child of 6th grade I would do also physics, chemistry, all the subjects. Here I have restrictions.* **387t** *There are parents with high standards. For example, they want their children to come to school. They think that if they come to school all problems would be solved. They don't have the*

		She was then 1st grade, but she was 10 years old and she had come to learn reading and writing. Besides all that and because she was 10 years old and very clever, she had finished 1st grade, 2nd grade and 3rd grade in 1 year. Of course, not the whole books but as she was old enough, it was ok. The 2nd year she came again. She was very clever and it was the only one who was taking the books at home and read them with oil lamp, a lightbulb. I mean this kid loved so much the reading and writing and she finished 4th, 5th and 6th grade and she told me this time of season it was, she told me "this year I will be married Mrs". I thought that this kid would have gone to junior high school and she told me "no because my parents had me engaged". Well, I called her parents… they came here and the mother told me the following "what can we do, where should we send her, what can she finish, besides she could not have a job, can she go to junior high school and then high school with what money, we don't have any, and later she could not afford to have a job nowhere, they would say she's a gypsy who would give her a job, so leave her to be married". **267t** *Look. Many years ago they didn't feel comfortable. As the years pass, they feel more comfortable, they change too slowly. Across the street in the kindergarten, the teacher there last year had 2 kids, in this year she had 15 Roma kids. That is really good, those kids to come every day, because it means that in the next year they would definitely come to 1st grade. And as I was talking to the kindergarten teacher, she told me that they were fantastic, those Roma parents are fantastic. They send their child clean, with their food, etc. they want to learn. I mean we see this also to our children here, who will become parents in 3-4 years. They say "our kids Mrs. we will send them to school to learn writing and reading". We see that their culture slowly is changing.*	*maturity and the experience to evaluate the school's job.* **389t** *That too, but economically I don't think so because that was only when they were getting the allowance… they don't have these aspirations for them but when they come to school they feel proud, they also have ego. That people has ego and pride, they want their child to be educated but they don't have the structures to support it. That is perhaps due to the lack of experience and that is really important.* **391t** *To me I can say they feel comfortable. In general I don't know, but they come. They bring their food, they ask the principle what they have to do for some transitions, ok. It hasn't though passed into their everyday activity yet.*
Mathematical literacy citizen	**140t** *The mathematics we all do, what else? The mathematics we do here at school.*	**271t** *Let's talk about Roma kids… I think they should conquer the 4 praxis, addition, subtraction, multiplication and division and also the problems of 4 praxis. I think this is perfect!*	**393t** *Those that the school teaches, but from the start in all classes, in whole route from 1st class to 6th and then to enter to junior high school. I think that those who were in charge of the knowledge presented in books and defined the curriculum were people who knew how to operate in every child. Mathematics doesn't have anything to do with the language, where many unknown words appear and needs a different job done. Mathematics is a general terminology, with general terminology, useful everywhere. I think if the book was worked from 1st grade I believe that they would have acquired the mathematics of primary school… but the book*

			wasn't worked, we do addition, subtraction and multiplication. The book should be in every teacher's desk. I wouldn't dare imagine working without the book. It is our guidance, our buzzard. It is what we know. Of course you will add or subtract, but you would have this curriculum every year. This confuses me, creates a big problem that the kids hadn't worked the books until now… I made big efforts to make them learn what and how to write, when to read the math problem… The book for me is important to stand in the class and in the schoolbag of the kid and to work it. That's what I think.
Gender bias		**163t** *You're right, yes. Look! They are clever kids and because they are occupied from an early age with their parents, in mathematics especially the boys are doing great. Because the parent is taking along the boys for work, so the boys have a better familiarity with mathematics in contrast with girls. The girls are in a lower level due to the lack of this familiarity. What did you ask me earlier?* **185t** *Yes, yes according to book! Here we do not follow the book. We depend on the peculiarity of students. I should say that the girls are doing lower mathematics than boys according to their knowledge. The boys for example can execute a division. Now they've learned the division with two digits but the girls can't.***195t** *Yes, they assimilate them in mathematics and the boys more than girls to inform you.* **217t** *No, the girls use more their fingers and I told you it is more difficult for them. They use the written form but more their fingers.*	**308t** *Their minds are sharp, they all are merchants! They are really smart kids. The Roma girls are a little inferior in this but I think* (non-Roma) *the other girls are also inferior in mathematics, the boys are trying. I have a student who can't read but if I give him any problem he could solve it… he is very clever but has dyslexia. I have realized it… and he can't read well but he's really smart.*

Source: Excerpts of Teachers' interviews