Fovos, I.(2022). Developing an alternative curriculum for mathematics teaching in a detention faculty adopting an ethnomathematics perspective. *Revista Latinoamericana de Etnomatemática.* 15(Especial), 23-41, DOI: https://doi.org/10.22267/relatem.2215E.98

Artículo recibido el 30 de Septiembre 2021; Aceptado el 11 de Noviembre 2022.

Developing an alternative curriculum for mathematics teaching in a detention faculty adopting an ethnomathematics perspective

Desarrollando un plan de estudios alternativo para la enseñanza de las matemáticas en unafacultad de detención adoptando una perspectiva etnomatemática

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Abstract

In Greece, as more or less all over the world, the curriculum is a matter of central authority and teachers can only apply it in their classrooms, without any connection to the whole curriculum development process. Students' population in prison schools, and especially young prisoners, often show school denial, poor performance, academic inadequacy, and failure, leading to low self-esteem (Mallett , 2014). Common barriers to participation are lack of motivation —often because of the absence of any means for meaning-making and identity formation in prison— and previous negative education experiences (Liebling, 2011) especially in secondary school when they frequently begin to truant. Working, as teacher, for long time in the secondary school of a youth detention center in Greece, I faced the challenge to reconsider the formal curriculum. Following an ethnomathematics perspective, an alternative curriculum is developing aiming to meet young prisoners' needs and expectations as a matter of social justice, taking into consideration the need of techniques and strategies that can help to untangle and respond to above structures as part of ongoing research, policy, and practice. The young detainees following the official curriculum applied in the mainstream classes are faced with various problems, such as lack of appropriate schoolbooks, the need to motivate and successfully address educational, psychological and environmental difficulties, and the need for developing a framework for alternative teaching practices and materials based on a multicultural education with the teaching and learning of mathematics, as is the case in the field of ethnomathematics is dictated.

Key words: prison education, mathematics education, ethnomathematics, social justice, mathematics curriculum**.**

Resumen

En Grecia, como más o menos en todo el mundo, el currículo es una cuestión de las autoridades centrales y los profesores pueden solamente aplicarlo en sus clases, sin ninguna conexión con el conjunto del proceso curricular. La población estudiantil en los colegios carcelarios y sobre todo los reclusos jóvenes, demuestran frecuentemente rechazo escolar, inadecuación académica y fracaso, que conducen a autoestima baja (Mallet, 2014). Barreras comunes a la participación son la falta de motivación – a menudo a causa de la ausencia de cualquier sentido y de formación de identidad en prisión – y previas experiencias negativas (Liebling, 2011), especialmente en colegios secundarios, donde frecuentemente ellos empiezan a hacer novillos.

Trabajando como profesor por mucho tiempo en un colegio carcelario de secundaria en Volos (Grecia), enfrenté el reto de reconsiderar el curriculo formal. Siguiendo una perspectiva de etnomatemáticas, un curriculo alternativo se ha desarrollado, con el fin de satisfacer las necesidades y las expectativas de los reclusos jóvenes, como una cuestión de justicia social, teniendo en cuenta la necesidad de técnicas y estrategias que puedan ayudar a desenredar y que respondan a las estructuras anteriores como parte de una investigación, política y práctica en desarrollo. Los presos jóvenes que siguen el curriculo formal aplicado en las clases comunes, enfrentan varios problemas, como la falta de libros apropiados, la necesidad de motivar y de abordar exitosamente dificultades educativas, psicológicas y ambientales y la necesidad de desarrollar un marco de prácticas y de materiales alternativos de enseñanza, basados en una educación multicultural con la enseñanza y el aprendizaje de matemáticas, como en el caso del campo de etnomatemáticas.

Palabras clave: educación carcelaria, educación matemática, etnomatemáticas, justicia social, currículo de matemáticas.

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1. INTRODUCTION

Recent research emphasizes on the crucial role of education for both young prisoners' personal development, for distancing them from the negative values of the prison subculture (Gill & Wilson, 2017), and the reduction of recidivism (Jonck et al., 2015). However, the curricula used in prison education— no different from more typical schools—do not respond to the above objective, nor to the particularities of young detainees (Klein et al., 2004).

The school population in prison, and especially incarcerated young adults and adolescents, often experiences school denial, low performance, academic insufficiency and failure, leading to low self-esteem (Mallett, 2014; Hirschfield, 2014). Research demonstrates that literacy skills of incarcerated youngsters are considerably lower than those of their classmates in public (mainstream) schools (Gavigan, & Albright, 2015; Wexler et al., 2014), a pattern especially evident for those of different cultures and language backgrounds (Pytash, & Li, 2014); early school leaving rates are extremely high, reaching 75% (Ochoa, 2016).

In most prisons, including those in Greece, schools follow the official curriculum implemented in mainstream schools, without taking into consideration the specific needs of the incarcerated (the need for principles of adult education), or the diversity of cultural backgrounds (the need for principles of intercultural education). Inappropriate curricula, combined with the previous negative school experiences of young prisoners (mainly because of their origin from marginalized groups) within the conditions they face in prison, together make the educational process for both teachers and students difficult.

My long experience teaching mathematics in a prison school with young offenders required me to explore alternative approaches to curriculum and the corresponding pedagogical and didactical practices, in order to increase their participation and their school performance as a matter of social justice. As both a teacher of mathematics, and as a researcher, I followed an action research methodology. In addition, based on research, but also through my own personal experience, we can argue that education in this context should not become a form of treatment or behavioral control, because prisoners will reject it as another exercise in social education: their view on educational programs is essential for the programs' success (Costelloe & Warner, 2008).

This paper discusses the impact of a bottom-up approach to the development and the application of an Ethnomathematics perspective on curriculum. This project was undertaken within the

framework of my PhD thesis, aiming to improve mathematics teaching in a detention center with adult young prisoners and empowering them at the same time.

The main questions discussed here are: a) How could the implementation of this curriculum contribute to the creation of a context that will meet the learning needs of the incarcerated student population enhancing motivation for learning? b) How could an educational model, including curricula, didactical material etc., create conditions for the mitigation of disciplinary discourses and power relationships, so that young prisoners might experience conditions of acceptance, recognition, empowerment and of smooth reintegration?

2. LITERATURE REVIEW

2.1 Penitentiary's Context

The pains of imprisonment may vary by institution, jurisdiction and culture, and historical period, but some 'essential features' of imprisonment and generalized responses to those features also exist (Liebling, 2011). Individuals who are labeled as deviant tend to feel excluded from conventional society because they are considered different as a result of their behavior. The absence of any means for meaning-making and identity formation in prison, and the imposition of indeterminate and unthinkably long prison sentences to which these experiences are linked, might arguably constitute inhumane and degrading conditions (Liebling, 2011). Common barriers to participation in any educational act are lack of motivation and previous negative schooling experiences. Also, overcrowded prisons, prisoners fighting, severe self-harming, prisoners of different ethnic backgrounds, religion and culture are some serious problems (Oikonomakis, 2014), that education in prison face.

2.2. The role of education for prisoners

Recent research on the crucial role of education for young prisoners' personal development emphasizes distancing them from the negative values of the prison subculture (Gill & Wilson, 2017), rehabilitation and the reduction of recidivism (Jonck et al, 2015; Hughes, 2016) as a matter of equity and social justice. Nevertheless, it is also recognized that current educational practices in prisons are typically not as effective as one would hope (Farley & Pike 2016). Also affecting prison education in Greece is the fact that most of the teachers working in that schools have had no training specific to prison education, or to multicultural education, or even adult education.

Most of the times, the achievement of educational goals depends solely on the teachers' sensitivity and personal awareness (Hawley et al., 2013).

Grounding the notions of inclusion and equity within a prison situation, prisoners' successful (re)integration into society is linked to securing access to material resources (appropriate curriculum etc.), social connections, and the psychological foundation necessary for positive social functioning (Graybill et al., 2018). Value is created in such an environment through the idea of diversity that promotes involvement, respect, and connection (Roberson, 2006). On the other hand, social justice provides the framework and a philosophy about equitable access to resources and equitable participation in decision-making (Graybill et al., 2018). Regarding mathematics education, an Ethnomathematics perspective provides the framework. D'Ambrosio & D'Ambrosio, (2013) propose a broad agenda that includes, for example, the creative aspects of doing mathematics and the ethical implications for the design of curricula. In doing this, he also offers an antidote to the disconnection between the world in which students live and what happens in mathematics classrooms— a major reason for students' negative attitude to mathematics. He shows that this is an issue of equity—of respect for diverse backgrounds. Taking into consideration the peculiarities in that context, such as the inmates' physical exclusion from society, stigmatization, marginalization and diversity (World Health Organization, 2014), we adopt an ethnomathematical perspective, aiming at the development and implementation to support participation of young offenders.

There is international legislation, conventions and recommendations that recognise the right of prisoners to participate in educational activities while serving their sentence. Prison education is considered a means to bring benefits both to prisoners, since they acquire skills and competences that will facilitate their reintegration into society, and to society as a whole, as it reduces the social cost of crime. Prison education is linked to improved employability among prisoners, an important factor that reduces the likelihood of relapsing and returning to prisons (Chalatsis, 2016).

The European countries as a whole make considerable efforts towards quality education in prisons, with differences depending on their local culture and educational systems. However, they face a number of common problems and difficulties and education is often not a priority. Security is the priority, and often works against education. There is a great deal of variation among European countries in the curricula available in prison education. The main trend includes the provision of educational activities, with separate courses on basic skills. This seems to meet specific learning

needs, supporting the declaration in the European Prison Rules (Council of Europe - Committee of Ministers, 2006), which states that "prisoners with literacy and numeracy needs, and those who lack basic or vocational education, should be given priority". In many cases, education programs are not offered on a permanent basis, but just funded for a specific purpose. Finally, there are lot of other challenges affecting prison education in Europe—e.g., the large number of migrants and refugees moving to Europe, and the lack of specific evidence on "what works" in prison education (Chalatsis, 2016).

These challenges need to be effectively addressed to ensure that prison education plays a key role in the rehabilitation and integration of prisoners into society. In terms of teaching practice in such environment, mathematics classes use to be heterogeneous in terms of the cognitive level and cultural background of inmate learners, and the course is considered by many students as difficult or boring. Mathematics literacy in prison schools has not received the same attention as language literacy. Maybe because, on the one hand, "mathematics is very difficult" for inmates, linguistic subjects seem easier to restart for their education (Byrne & Carr, 2015); on the other hand, the large percentage of foreign detainees creates for the state a primary concern for learning the national language.

Teaching and learning mathematics in prison is a special case of dealing with cultural differences among learners, which is fraught with obstacles: a lack of appropriate math textbooks and the need to simplify them; motivation; and confrontation with psychological and environmental difficulties, which far exceed the specific state of confinement and retardation of cognitive-social skills, and are a great challenge for the entire community of researchers and teachers in mathematics. These obstacles differ from those that arise in "mainstream" schools. For older students, researchers emphasize the importance of learning that responds to what students already know, to start in a place of emotional comfort that can then grow their knowledge through challenge. Sometimes students do not have suitable experiences to contribute to the meaning-making and the emotional hook becomes especially important (Goralnik et al., 2012, p. 415). However, there are some special values of the prison school that we perceive as a special human wealth, for both students and their teachers, as the exchange of experiences and knowledge through the prison bars is a two-way process.

It is at this point that ethnomathematics may take advantage of this interactive teacher-learner relationship and recognize the uniqueness of the learners' own cultures, highlighting aspects of

their complex knowledge systems and showing them to be alive and dynamic, valuable and valid, with their own terms and context (Shehenaz et al, 2003). Also, ethnomathematics "neither downplays, nor devalues, nor removes, any aspect of conventional mathematics, … embracing practices and methods related to a variety of cultural environments, but also a more comprehensive, contextualising perception of the process of generating, organizing, transmitting, and disseminating mathematics" (D'Ambrosio, 1994, pp.449–450). Involving Ethnomathematics makes it possible to create a dialogue that engages all students in a mathematical discussion, ensuring that learners with different cultural backgrounds will be able to contribute significant resources and ideas to this discussion. This dialogue also involves the teacher in this process, potentially opening a pathway of access to the learner's unique ways of thinking, both personal and cultural (Rowlands & Carson, 2004).

In my attempt to create an ethno-mathematical framework in which I can open such a pathway of access to my students' ways of thinking, I identified through a sociocultural approach, and based on the view (Wittmann, 1995) that mathematics in general is a "design science", the existence of various strands of heterogeneity. All these years of teaching in collaboration with experienced teachers, as well as through both in-person interviews and focus groups during the research process, but also later confirmed in the international research literature (e.g., Sauerwein, 2020), I discovered that some of these strands serve as a basic framework that emphasizes the differences between teaching in enclosed school environments and mainstream school classes:

• *Communicative*: Not everyone can use a common everyday communication language. Especially in the first months of each new school year, young students in the first grade of secondary school find it difficult to adapt and acclimatize to the classroom. An important role is played here by their compatriot classmates, who know the Greek language and are the bridge of communication and the connecting link, as well as literacy teachers, so that these children can learn the basic vocabulary faster, so that they can attend, initially, and manage to communicate later. The learning of the Greek language is not limited only to the prison classroom, as prison students will have to communicate with the various agencies of the correctional institution.

• *Emotional*: Language problems are inseparable from everyday life. This can contribute to frustration, due to the feeling of inadequacy in almost every aspect of learners' daily lives. All these years I have noticed that, although most people find mathematics difficult to learn, they can be more easily supported, as there is a universal common mathematical language, which covers,

especially in the first period, their language insufficiency. Of course, the bilingual presentation of the worksheets activities at the beginning of the course helps in their faster adaptation.

• *Mathematical*: prior mathematical knowledge is very individual and for prison students this can range from elementary mathematical operations, in rare cases, twelve years of mathematical education. In addition, the primary focus on students' prior mathematics education, appears to be in the symbolic languages of arithmetic and algebra.

• *Cultural*: Regular schooling is not obligatory in every culture or every family. In some countries, students are expected to contribute to their family income instead of attending school. However, students, especially those from Asian and African countries, have a positive attitude towards school and teachers, and are grateful for any help and they express this gratitude at every opportunity.

3. METHODOLOGY

An ethnomathematics research project demands a qualitative orientation that focuses on the meanings attributed to events as well as on the ways that people make sense of their world. The main aim is to understand ‘what it is like’ to experience particular conditions, and how people manage certain situations, and mainly to study these things within naturally occurring settings (Willig, 2013, p.51).

For the research discussed in this article, an Action Research Methodology was exploited, together with principals of Critical Ethnography. The ethnographic research provided an insider view of some aspects of young prisoners’ everyday life in the mathematics classroom, and in prison, sometime overtly, sometimes covertly, for a period of seven months. At the same time, action research provided the opportunity for teacher-researcher reflection and the redesign of curricular activities aiming at positive changes regarding participation and improvement of performance in mathematics learning.

In the context of educational research-action, the teacher has a dual role, in addition to the teacher of the practice, being the researcher who studies and investigates aspects and parameters of his teaching (Katsarou & Tsafos, 2003). The researcher-teacher critically and dialectically explores their theory and practice in an effort to understand, interpret, and generally enlighten specific aspects of each case (Elliott, 1991; Carr & Kemmis, 2004). Through the dialectical connection of theory to practice, a researcher-teacher is in an ongoing process of searching for ways to change practices that are formed in specific socio-cultural conditions.

A significant practice I used as a researcher-teacher is to incorporate culturally relevant practices into mathematics instruction, finding ways to connect learning to culture and not simply teaching strictly dependent on mathematics curriculum. Critical Ethnographic Action Research gives me the opportunity to reflect on whole process after each mathematics classroom experience. Encouraging students to incorporate their own culture—stories, experiences, symbols, and language into problem-solving opportunities, and developing those together, promotes engagement and a sense of classroom community. They enthusiastically participate in mathematical topics containing references to their home country, reinforcing foundational mathematics skills or for solving higher order mathematics problems.

3.1. Data collection techniques

The pragmatological material mostly emerged through ethnographic techniques, and more specifically: the research diary, participative observation, field notes, individual semi-structured interviews, focus group interviews and worksheets. The collected data were analyzed, and the resulting categories were coded in: Gender-Age, Place of origin, Professional experience, Educational level, Educational needs, Educational desires, Relationship with mathematics, Importance of mathematics in their lives, Attitude towards school - teacher, Attitude-participation in school and educational process.

3.2. The setting of the research: place, time, participants

My role in this process was as researcher-teacher of mathematics. The school in which I have been teaching for many years and within which the research was carried out is a high school, inside the Special Youth Detention Center in the region of Thessaly in Greece. A part of the research was extended to a similar school in another Detention Center in the wider area. Both schools follow the official curricula of the respective schools in the outside community. This research lasted twelve months, until the time these lines are written, and completed in the context of my doctoral thesis.

The students are adolescents and young adults, most of whom are foreigners from North African and S.W. Asian countries, and some from Balkan countries, while few are Roma of Greek, Albanian and Bulgarian origin. There is a high gradation of their cognitive level. The average level of education is low, with many detainees lacking basic social and soft skills and knowledge. Also, many students have learning difficulties and concentration problems. Because most of them are foreigners, there is a wide range of fluency in the Greek language. Thus, their participation in this

research process provides an authentic representation of their educational reality, their particular potentials, and their specific abilities and skills. The way each student approaches, explores and internalizes knowledge is very unique. There are students who understand a school environment and its expectations, and students who never have no experience with it, so they were expelled for delinquent behavior, while others have had little or no educational experience. Some prefer to work alone, while others act better within the team. Thus, the learning profile of everyone differs and is greatly influenced by their environment, but also by their previous socio-economic status. Finally, we should mention the beneficial reduction of their sentence for each day of school attendance and their participation in educational programs. Thus, learning the Greek language, beneficial reduction of punishment and the meaningful use of their time are the main reasons why they come to school.

4. FINDINGS - RESULTS

4.1. Conduction fieldwork

In our case, we describe a school in a detention center that, despite the peculiarities of students—age, background etc., follows a standard curriculum designed to address the needs of mainstream students. So, in order to design an appropriate curriculum for these students we started with investigating and analyzing learning needs, exploring the learning needs regarding mathematics and subsequent standard tests. All of these had to be combined, and formed the basis of a profile of the learners and their learning needs, drawn from sources such as personal interviews/discussions, focus groups (intentionally or spontaneously emerged in mathematics classroom) and written tests.

In the beginning, extensive fieldwork was conducted, providing pragmatological material through personal interviews and focus groups. That pragmatological material provided information about the curricula in their countries, their everyday experiences through storytelling use while it was explored their knowledge regarding particular mathematics concepts and procedures: number and operations, measures, shape and space, and handling data.

The pragmatological material was completed by a written test protocol (Department for education and skills, 2003). Tests were graded, in terms of their level of difficulty—to cover as wide a range of knowledge as possible and through real life problems—while young prisoners' age, interests, past experiences, and the fact they are attending a typical secondary school were taken into

consideration. It should be noted that the school in the prison has the responsibility for certifying the formal education of young prisoners (students).

The analysis of the data from these tests showed a differentiation of the cognitive level of the students. They had great difficulty moving on from first questions to the more complex and those that requiring more advanced knowledge. Students from North African countries have attended school in their country for 8-10 years, and have a higher level of knowledge than those of S.W. Asian countries, who have been to school for 0-8 years. The level of students from Balkan countries (Albania, Serbia, and Romania) as well as Greek-Albanian students is from moderate to high; while at a very low level are Greek Roma.

More specifically, students from North Africa have a very good knowledge of basic mathematical concepts, while in the group of students from N.W. Asia, as well as in most of the other students, there is a lack of knowledge of basic mathematical terminology. There are students who do not even know the words and symbols for division, nor their meaning; however, they can find the sharing of an amount, especially using amounts of money.

In “Handling Data” they can read and interpret diagrams satisfactorily. However, they did not do well in terms of range and probability, while the average was known to almost everyone. In Measure, Shapes and Space showed their weakness in the names of geometric shapes, in some units of capacity and volume, in calculation of duration in hours and minutes, in the distinction between perimeter and area, in finding area of complex shapes and volume, the lack of knowledge negative indications on the thermometer, on the reading of vehicle speedometer indications, on the reading of ruler grades, on the perception of spatial coverage and on currency conversion. However, they managed to read gradations of weight, positive temperature and capacity ratings, time, while there is a sense of length, volume and time. In all phases of the tests, there was a hasty and careless reading of some exercises, but also the lack of understanding of questions due to lack of knowledge of the respective concepts in their mother tongue. These findings in combination with the discussions in the focus groups are attributed to the poor relationship they had with the school mainly after the early years of school education, due to delinquent behavior or mandatory work for livelihood.

Through the discussion in both facilitated focus groups outside of the mathematics classroom and in informal focus groups during mathematics teaching, information about their culture and school experience in their country and inside prison emerged, which also directed adjustments within the

development of teaching. Each time a new mathematical concept was introduced, there was a discussion about whether and how it was taught in their country, as well as other related concepts. Also, because most of them were working from an early age, we discussed the mathematics that may have been "hidden" in their work, and in general, in their activities or their journey to Greece. Through these the focus group discussions, I realized that some of the students were of high competences in mathematics in their home countries, competencies they lost during their incarceration; they needed time and appropriate conditions to 'find themselves'. A comment by a student from Algeria is characteristic: "for 14 months I've been here my mind has stopped to work, we will become stupid; now being involved in problem solving of mathematics I feel that my mind has started to work again".

Another issue that emerged was the different posture that teachers have held in the majority of students' countries. The teacher in many students' home countries was considered to be someone of absolute authority, occupying absolute thought. Even though a lot of time has passed from when they were students in their home countries, they still expect the teacher to perform this same posture; instead of being active, they just wait for the teacher to transfer the mathematics knowledge.

The school systems of Greece and of Europe generally obviously differ from those of the countries of origin of the students, and therefore also their school experiences. According to what most students convey, the teaching here is less authoritarian and contains different ways of working. Memorized learning is less prevalent, and especially challenging is that it is not even required very often, which means that lessons are often experienced as more demanding for them, since they require creativity, self- initiative or mathematical discourse, things they were not used to in their own countries' schools.

This research reveals difficulties in mathematics teaching and learning arising from the use language—different from their own. For example, students could not understand the mathematics content in word problems, and thus they were unable to recall the potentially relevant mathematics knowledge they had acquired in the past. A practice that was selected to resolve this problem was the use of a fellow student as an interpreter; this student had a strong understanding of the Greek language, and was able to enhance the bilingual presentation of mathematical concepts and exercises. A student interpreter needs to also understand the mathematics content in order to

transfer the crucial information to the other students; in general, our student interpreter worked as a mediator between me as the teacher and the other students.

Some limitation due to the Pandemic. Some of the research took place during the recent pandemic, a condition that was accompanied by corresponding restrictions: on the one hand a strong limitation in undertaking my role as a teacher and researcher was the use of a mask, which did not allow adequate communication with the students. They very often asked me to remove it from my face in order to understand better what I was saying. Furthermore, for a three-month period, face-to-face teaching was forbidden, and synchronous communication via the internet was impossible. The only possibility was the physical delivery of educational material to and from students, which could subsequently be re-delivered after assessment. Consequently, students took steps backwards regarding language use as well as regarding the norms of school, something similar with the first time they started to attend school.

4.2. The development of the educational material

For the development of the educational material the topic-based teaching (Kawarti, 2020) together with Task-Based Learning (Al Kandari & Al Qattan, 2020) were exploited. Both provided the opportunity for developing connections among mathematics ideas, and for developing communication skills; that are crucial for their survival inside prison as well as after release back into the community, mostly in terms of increasing employability.

In the development of materials, I tried to maintain a balance between students that pursue mathematics as a subject they consider easy to learn, and those students with contrasting, previous negative school experience that have led to negative attitudes toward mathematics. In order to address the mathematics fear/anxiety of the second group of students, I developed appropriate educational material where Mathematics were ‘hidden’ and less "painful", through word problems and real-life stories. Additionally, I took into account previous researchers and didactical proposals that have been successfully implemented in other prisons, and modified them for the specific learners using the information obtained through the fieldwork (focus group, ethnographical notes etc.). The material was developed in a way not only to be attractive and effective for mathematics classroom needs, but also to be useful outside of the classroom.

After my seventeen years of experience with teaching mathematics, I am adept at identifying topics that may be of interest to my students. However, young detainees are a dynamic student population for whom I must always update my materials, based on the data derived from them and their life

experiences. Sometimes it can be difficult to start a conversation about a student's hobbies, work and past life outside prison. However, there is a wealth of material that can be drawn simply from talking about prison mathematics. Indeed, it has been demonstrated that the use of informal knowledge in mathematics classroom enriches the educational experience (Stathopoulou, 2005, 2007).

Through an ethnomathematics perspective that values any kind of knowledge that 'works' in its context, I tried to identify and exploit their relevant previous experiences, their interests, desires and expectations. This investigation and the findings of personal interviews and focus groups resulted in the development of word problems, short stories and mathematical tasks that were included in the produced educational material. Some examples that illustrate the nature of these materials include:

- Cooking-catering-nutrition on the occasion of prisoners who work in the kitchen, but also their own eating habits that they have now and those that they have brought from their countries.
- Fitness. Planning to be in good physical shape, (it is a normal prisoner occupation) and healthy is a great way to use maths.
- Calculations and estimates concerning daily life and health.
- Estimation of the work's cost done by pupils prior to their imprisonment and due to their approaching release.
- Discover interesting mathematical patterns and data in any arithmetic, geometric or statistical context.
- Drugs and addictive substances. Drug segregation, cost, dosage, detoxification process, methadone use scale, weight gained as health improves, are all very relevant discussions from which mathematical concepts such as addition, subtraction, multiplication, division, ratio and proportion, percentages, statistics, etc. emerge.
- The building and the environment of the prison: The questions raised may include the shape of the building, the corridors, cells, windows, corners that appear in the building, the number of floor tiles in the classroom, the cell, the number of rectangular desks to form a square etc.
- Sentences policy: the differences between parallel and sequential ones can help to describe abstract mathematical concepts, such as number line, fractions, percentages, etc.
- Gambling: Card Deck Design, Winnings, Debts, Odds.

- The temperature and the thermometer, highlighting environmental, geographical issues with references to occasions from their countries of origin.
- The human body: Symmetrical or not, use of fingers to measure, 3 physical dimensions as applied to the area and volume, the size of the shadow at different times of the year, the volume of water displaced in a bath.
- "An investigation for prisons around the world." Data on incarceration rates, broken down by country as well as demographics, provide a wide range of dialogues and discussions where students can apply the mathematical concepts of ratio, proportion and percentage.

During the solution process of the mathematical problems, I was led through questions to discussions that raised social issues concerning their own communities and social structures, and to aspects of the social reality of their countries, as well as the differences they encountered when coming to Greece. This all created useful feedback for the creation of new topics that emerged through mathematics. This method contributed substantially to the participation of the students themselves in the production of educational material. Besides, mathematics is everywhere. It is simply a matter of raising awareness, looking at our direct surroundings through a different perspective and using mathematical words that can "mathematize" the experiences and interests of each student.

4.3. Reflecting on my experience

Since, this experience has affected me in both roles, I would like to share some thoughts here, based on the dual role of teacher and researcher, completing all of the research. These simultaneous roles required that I move in and out of context, having different perspectives depending on whether I was teaching or researching. A common feature of all approaches within the framework is the focus on issues of teaching practice, seeking to explore under the surface of the obvious and what is taken for granted. Such research approaches have been framed with various methodologies, such as action research, student interviews, focus groups, etc., whose common goal is to produce knowledge that can contribute to improve teaching and learning.

Due to the restrictions related to prison framework--e.g., recording, videorecording, photo shooting--it was difficult for the two roles to be accomplished the same time. On the one hand, in the role of the teacher, I had to be focused on the teaching practice and the attitude of all students, on the activities, and on everything involved in the teaching process. As the researcher, I needed

to observe everything, and to record everything in my memory so that I could keep records after each class session. This whole process is difficult and arduous, and requires complete concentration and strong observation skills, so as not to miss something potentially important. After the lesson, I kept notes on the key and important points of the whole process. At home, isolated in my office, I would close my eyes and bring everything from my memory that had taken place in my class, and in combination with the students' worksheets, I recorded details and critical emblematic events on paper.

I agree with (Wilson 1995) and (Ahl, 2020) that the teacher as a researcher, instead of being two different roles, are two roles representing two sides of the same coin. I have always reflected on the course of teaching and the learning outcomes of my students, from the first days of my presence in prison school. However, when I decided to research the whole process in a formal and scientific way in the context of my thesis, when I entered the classroom, I did not feel like half a teacher and half a researcher. I felt like a teacher continuing my work to help my students learn, but more focused and more observant. Teaching is a process that takes you to another world for as long as it lasts, during which you forget everything and devote yourself to it with a passion that fascinates you and fills you with all kinds of emotions, especially when you have such a special population of students. The selection of the subjects of the studies to meet the objectives set was made from a realistic and ethnomathematical perspective, guided by the problems themselves. I identified the specific problems in the role of the teacher, who teaches in this school context. My role as a researcher is required to conduct studies and gain new scientific knowledge. However, in order to use this knowledge to improve teaching, the results need to be adapted to practice. The adaptation process requires access to the educational framework again. Access requires information within the field. Therefore, one possible way to make this adaptation, which is based on both access to research and access to teaching, was to take on the dual role of researcher-teacher. That was, after all, my approach to this research project.

5. DISCUSSION- CONCLUSION

In this paper, I shared the experience of exploring alternative curriculum development for young prisoners, secondary school students in a youth detention center in Greece. The curriculum was designed to bridge their experience and expectations with the demands of a formal curriculum. The development and implementation of this alternative curriculum took into consideration the previous and current peculiarities of the daily life of the learners as well as the educational and

socio-political reality of their community. Teaching was organized in ways in which discussion, dialogue and examination of contradictions were key components of educational actions and activities. Specifically, my focus was on developing new tools, promoting new roles and activities, and developing a socio-critical literacy, while preparing students for their social reintegration. The school-in-prison framework constitutes an institution within another, and it is expected to combine different discourses and practices: that of disciplinary system and of school education (Blazich, 2007, p. 54).

The development of the new curriculum and teaching practices helped to reframe their education, their understanding of themselves, and created opportunities for the collective creation of new forms of joint action to solve the problems they encounter throughout their lives, as members of marginalized groups. This whole process and the educational model that was enacted contributed to the creation of a different, collective space within the prison, with mitigated disciplinary discourses and power relationships. The students had the opportunity to experience conditions of acceptance, recognition, empowerment. They tried out new ways to use their own skills that led them not only to school achievements, unprecedented for some of them, but also to dream of a smooth social integration back into the space in which they had lived before their incarceration, but now with different perceptions and social attitudes.

Mortari (2016, p. 455) stresses the need for caring about students/young prisoners, and that the educator has the responsibility ‘for ensuring that care permeates the relationship, then a core task of pedagogical reflection is identifying the relational postures which shape good and right care—that is, care which facilitates the flourishing of the human being’.

My long experience as a teacher in prison schools, which could be considered as a “large database”, has led me to similar findings that together with an ethnomathematics perspective values any kind of knowledge that ‘works’ in its framework, and that has as a central aim social justice. This orientation has long guided my work as teacher and researcher. The above were encapsulated in the design and the application of a particular alternative curriculum to meet the needs of young prisoners—a population of different cultural origins—that went beyond mathematics learning and supported them to survive in prison and to be prepared for life out of prison. In addition, their different previous school experiences, the different mindset of their home countries' school systems and beliefs about mathematics and its teaching, were expressed in the following observations of misunderstandings in practice:

- In mathematics, there is only one correct solution, which can be given either by the teacher or by the computer.
- Mathematics is a final product and consists mainly of imitation of the teacher's solutions in a formal way without deeper knowledge or discussions (in the classroom).

These experiences certainly cannot be generalized to non-European school systems. These attitudes towards school in general and their views on mathematics make it difficult for them to adapt to the new learning environment and develop sustainable mathematical concepts (Sauerwein, 2020).

In summary, returning to my research questions, it seemed that the development of a such curriculum provoked students to be actively engaged in their mathematics learning in a framework in which disciplinary discourses and power relationships were mitigated, generating an empowerment environment. The whole experience, also for me as a researcher and teacher, at the same time provided me the opportunity, as it is presented above, to develop better communication between these complementary roles, roles in which each provides feedback for the other.

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