Science Journal of Education
2022; 10(2): 49-57
http://www.sciencepublishinggroup.com/j/sjedu
doi: 10.11648/j.sjedu.20221002.11
ISSN: 2329-0900 (Print); ISSN: 2329-0897 (Online)

Mathematics at Work: A Study of Working Students of Higher Classes in a Greek Secondary School

Andreas Marinos

Mathematical Education and Multimedia Laboratory, University of Aegean, Rhodes, Greece

Email address:
andreasmarinos@gmail.com

To cite this article:
Andreas Marinos. Mathematics at Work: A Study of Working Students of Higher Classes in a Greek Secondary School. *Science Journal of Education*. Vol. 10, No. 2, 2022, pp. 49-57. doi: 10.11648/j.sjedu.20221002.11

Received: October 1, 2021; **Accepted**: February 4, 2022; **Published**: March 9, 2022

Abstract: The aim of this research is to find out the level of Mathematics students of an Evening Lyceum are required to use in the workplace and how this correlates to the material taught in the subject of mathematics. The research was qualitative and was conducted in Greece, specifically on the islands of the South Aegean. On these islands the majority of the population is engaged in tourism. The survey included students the majority of whom had dropped out of high school (73%) for various reasons and decided to continue their school studies in order to receive a high school diploma as required by the Greek state. These former high school dropouts work in the mornings on various tasks. The rest of the students attend classes according to their age and also work in the mornings. They also try to get a high school diploma. The questions that concerned us were the kind of Mathematics the target population of students to be surveyed use at work, and whether there are differences in the mathematics taught in the Lyceums compared to Maths students use at work. An additional question is what kind of math each task requires. The research therefore mentions the activities of their daily work and students explain the ways in which they come into contact with mathematics. We discover that most professions need only a low level of mathematical knowledge and this marks the disparity in the nature of "everyday" mathematics and the mathematics taught in the classroom setting. Mathematics taught at schools in higher classes has been forgotten and few use it. This happens to almost all students. Finally, it is suggested that there should be changes in the curricula. Mathematics curricula should be more relevant to students' daily activities in the workplace. So, the teaching of Maths needs to be put on a more realistic basis.

Keywords: Level of Mathematics, Mathematics in Professional Life, Activities and Kind of Mathematics, Evening Lyceum

1. Introduction

Many wonder what the mathematical requirements of professional life are. What mathematics, in actual fact, do professionals use in everyday routine? This concerns the students and their parents, employers, the state that draws up educational policy. Although it concerns a large number of individuals or social groups, there have been few explicit answers from researchers. The professional development of an individual depends more and more on formal criteria-qualifications, such as school diplomas Leaving Certificates from Gymnasium [Junior High] or Lyceum [Senior High]). Such a school diploma, purely and simply, entails promotion and a rise in wages, while, at the same time, it strengthens an improvement of status in the job market, especially in the public sector.

This research concerns students at Evening Lyceum in Greece, where working students study after 19:00. Night schools in Greece are Junior Secondary Schools (Gymnasiums), that is to say four-year schools of compulsory education following Primary Education and Senior Secondary Schools (Lyceums), which are also four-year schools where the students complete their Secondary Education. In the first Year of Evening Lyceum there are students who, for the most part, are quite old. These students interrupted their studies in Primary School, came late to Junior Secondary and are now continuing their studies in Senior Secondary or they stopped their studies after Junior Secondary and are now continuing at Senior Secondary level. The reasons for the resumption of their studies vary. It might be that they are interested in the acquisition of more knowledge in order to have more favourable prospects in a difficult and competitive job market, or it might be that they want to pass the School Leaving Certificate with sufficient marks in all subjects, with exam questions specified by the teaching professors without adaptation of orals, in order to get a General Lyceum Graduation Certificate, that will help them to find a better position than the one they have today. It might even be that they are taking advantage of the favourable enrolment conditions in Tertiary Education, in order to get the bonus which exists for graduates of an Evening Lyceum.

The establishment of Evening Schools in Greece is not new. For example the School of Shop Personnel was in existence at the beginning of the twentieth century and was in operation as early as 1901. The Student Educational Council established Evening School education in 1934 with the foundation and operation of a Six-Grade Junior Secondary Evening School, and in 1937 a Junior Secondary Evening School was founded in Piraeus by the "Young People's Friendly Society". The foundation of other Evening Schools soon followed. After the 2nd World War, in an effort to solve its many, varied, national, social and economic problems, the State passed legislation in a campaign against illiteracy. This legislation provided for the operation of Evening Primary and Junior Secondary Schools. Today the Evening Schools operate only within the framework of Secondary Education. The role of the Evening School today has clear orientations: it fights social exclusion and it offers the chance of more professional and social opportunities to working people.

1.1. Research Statement

The type of mathematics needed in the work of students of the Greek is investigated in an attempt to understand the level of mathematics required in these students' work.

1.2. Investigative Questions

We tried to answer the following questions:

1. What kind of Mathematics do the students of the Evening Lyceum use in their work?
2. Is there difference between the mathematical knowledge required in the various day-jobs of the students of a general Evening Lyceum and that which is taught in the mathematics classes?
3. What is the role of their activities (money transactions etc.) in the kind of mathematics they use?

1.3. Hypotheses of the Research

The students of the 1st Class of Evening Lyceum use different mathematics in their work from that which is taught in their school syllabus. The mathematics that they use is of much lower level (Elementary school level) compared to that which is taught in the school Grade they are attending.

The students make use of the informal mathematical methods that they use in their work, alongside the official mathematics.

1.4. Theoretical Framework

The need for the mathematic requirements of adult life to become comprehensible, was prompted by pedagogical and cultural objectives, focused on the demonstration of the difference in the mathematic environment between the work place and the schools [1-3].

For students who are working at the same time as studying, various research shows that there is scant need for a high level of mathematic knowledge. This is true even of people employed in high technology, because the amount of mathematical knowledge which is essential for their work is very little [4]. Noss and Hoyles believe that there is a more general trend that escapes the limits of the school room and touches on society. This trend shows that a minimal knowledge of mathematics is required in daily work due to the low mathematical requirements of the various workplaces [5]. This applies even to those tasks which, by their nature of their work use complex actions, including software, the operation of which requires a lot of mathematics. To the workers however these mathematics are not visible even to those in complex workplaces and thus the mathematics that the students learn in school clearly become less applicable [5].

There have been studies carried out in the United Kingdom, referred to by Julie Gainsburg, according to which those who study mathematics at school do not do any better than those who do not. Thus the role of the mathematics taught in school cannot become visible. This is due to the fact that a very low level of knowledge is required in the students' work [6].

Thus, a large part of the syllabus, even in Junior Secondary, is considered much higher even than this level. And again differences were revealed in the way that mathematical knowledge is used at work as compared to the knowledge acquired at school.

Among other things the following points are mentioned:

A. Algebra is seldom used at work.

B. Mental calculations are important in work but are not emphasized at school.

C. The workers often use methods of calculation that are simple from mathematical point of view. Thus, even if the workers use every form of measurement, they use standardized methods of measurement and recording, where each result is found with the help of instruments, simply giving the final result of a measurement, so that the workers do the minimum of calculation, or none at all [7].

Packer [8] reports characteristically: "today's mathematics classes stress skills that few students will use while there are the other skills that employers really need."

It is worth noting that, despite the fact that there are up-to-date studies at an international level, they have had little influence on the mathematics taught at school [9].

O Pozzi et al. [10] conducted research on nurses. Nurses are described as performing calculations to transform prescription quantities in reference to particular drugs (here diathanol), taking into account the drug packaging to determine what to give to patients.

Janvier et al. (1992) [11] dealt with him transformation in professional settings, where electricity technicians using series circuits developed prototypical models different from those generally used in physics.

Various researches have also been carried out in different fields: For example in automotive industry workers [12], technicians (Magajna and Monaghan 2003) [13], engineers [14, 15].

From this corpus of work, we draw two main conclusions. First, the visible mathematics of work tends to be fragmented and associated with routine workplace activities involving measurement and recording, or simple calculations. Although these fragments are meaningful to practitioners in terms of solving particular, well understood problems, they are finely tuned to specific circumstances, and rarely interpreted as applications of more general mathematical concepts or relationships. Second, the less visible mathematics at stake is routinely tacit, rarely articulated in either written or spoken form. Tools and artifacts regulate activities and scaffold actions, so performance in authentic workplace settings generally outstrips performance on standardized written mathematical tests. Hoyles, C. Noss, R. Kent P. and Bakker A. (2013) [16].

2. Methodology

2.1. Participants

62 First Year students at an Aegean Region Evening Lyceum participated in this study. In the two Evening Lyceum classes there were students from 16 to 49 years of age. The students had various morning jobs as salespersons (in shops selling clothes, tourist shops, building materials, super markets), hairdressers, labourers, confectioners, municipal workers, in tourist professions, construction workers, electricians, plumbers, warehousemen, office employees and so on.

2.2. Research Limitations

In this research we do not examine:

A. Mathematical requirements beyond the professions of the students.

B. Whether the students can handle the mathematical requirements at the Grade level at which they study, even though from the results of the present research, mainly from the last question, some useful conclusions can be drawn, since a mathematical concept constitutes knowledge which contributes to the retrieval of other pieces of knowledge. The theorists maintain that a concept does not exist in isolation in our thinking, because a) in order for us to think we are obliged to call upon other concepts and b) when a concept appears in our thought, associations of ideas are generated that lead us to other concepts related to each other in various ways. We could say that each concept only exists through its relationship to other concepts.

C. The students are not separated into those who want the Lyceum Leaving Certificate and those who simply want to continue in Tertiary Education because this separation takes place in the 4th Year of Evening School, whereas we are teaching students in the 1st Year.

D. We do not relate students' performance to their age. We simply mention this in certain cases.

2.3. Framework of Questions Asked to Them

In the questions that were given to them they were asked the following:

A. Where do they use mathematics in their workplace?

B. They were asked to describe a sequence of actions included in an activity in their work environment and how this activity could be in some way related to mathematics.

C. In what School Year does the mathematics taught (according to the syllabus) have any relationship with what they use in the workplace? In essence, they were asked to evaluate what mathematics during their scholastic life is related to the mathematics used in their professional environment.

D. To report on the way an appliance they use in their workplace is manufactured using mathematical concepts.

i. As far as question A is concerned, the following was taken into consideration:

The reports and explanations concerning the use of mathematics in the workplace. These explanations could be in accordance with mathematical language irrespective of whether they were pieces of "informal knowledge" and different from formal explanations. By the concept of "informal knowledge" we mean that knowledge which is not necessarily in accordance with that of specialists [10].

ii. As far as question B is concerned, the following points were taken into consideration:

A. The nature of the explanations and the descriptions of activities that are related in some way to mathematics as they were formulated by the students.

B. The existence of causal relationships between the students' activities and their work.

C. The relationship of the possibly informal elements used by the students to formal mathematics.

i. In question C we bear in mind the students' statements as to what level of the mathematics taught in their school life they use in their workplace.

ii. In question D we attempt to evaluate the reasoning processes reported by the students as they manufacture an object in their workplace. It was requested that the constructions be accompanied by their mathematical concepts. In essence we ask the students to suggest a free mathematical condition. That is to say, they are not given a ready-made problem or mathematical condition, but are required to find mathematical conditions by themselves and to construct problems based on mathematical conditions that they might meet in their everyday routine, with the higher objective of their recalling and giving a mathematical form to their pre-existing experiences. The students suggest a method of solving a particular problem following a reasoning process. This reasoning process also determines the framework of the analysis of the interaction with the materials that are being used and which are essential to them in their daily work, and which are found in a sequential relationship. The students' actions, as they themselves describe them, should be connected with their subsequent actions in a cause-and-effect relationship in order to achieve a result.

2.4. Students' Answers

Below we describe some of the students' responses:

We begin with the most simplified logic.

As an example Alexandros L, who works as a pizza delivery boy, uses mathematics in order to give change, and to give back the day's takings to his employer. When asked to describe a sequence of actions that is included in one of his daily activities, he speaks of the 100 Euro float which is kept in the till, from which he pays the shop where he works before he begins deliveries and then he is paid the corresponding amount of money by the customers.

This student uses only addition, subtraction, multiplication and division. He cannot suggest a reasoning process to the question.

Elias B works as plumber and uses mathematics in his work in two ways:

First he measures the places where he should place the pipes and then with the help of a measure he marks the length of the pipe and where it should be cut. As far as the description of a sequence of actions included in a work activity is concerned, he chooses to describe the installation of a heating system, without, however being able to refer to anything that might be related to mathematics.

Dimitris K also works as a plumber. The mathematics he uses are subtraction, division and multiplication. More particularly, he states that he uses division to calculate how many pipes should be placed in each storey, multiplication to find how many pipes are needed for the whole building and subtraction to work out the number of centimetres of pipe he needs to cut.

Nektarios P is a worker. He cannot remember what classroom level of mathematics he uses, nor can he cannot formulate their use.

Students with professions such as confectioner, painter, or labourer gave more explicit answers.

Panagiotis K uses mathematics in the confectioners to calculate the quantities of ingredients required in the recipes, although he was not able to give further clarity or comprehensible explanations to the rest of the questions.

As far as some students' responses are concerned a more complex reasoning applies:

Maria is 34 years old and she works in an office in a construction materials warehouse. She uses mathematics in order to calculate the materials that will be needed for a particular construction, the money that she will collect from the sale of these materials, the change that she should return, the stock that is kept in the warehouse and the quantities of each order that she makes.

To the second question Maria reports as a series of actions that have some relationship with mathematics, the situations when she wants to make a calculation, to give change, to add to the card of a customer the sum that must be paid, and also to write the balance of an account that remains unpaid. Apart from that, she measures the materials from the deliveries and calculates the cost and makes quotes for the customers depending on the profit margin for the company.

To question C, namely what level of mathematics has some relationship with what she uses in her workplace, Maria answered that this was addition, subtraction, and multiplication, that is to say the mathematics taught in Primary School. She also finds useful the mathematics dealing with calculation of surfaces and volume.

In question D, where the students are asked by using mathematics to make a construction or find a solution to a problem of their work, Maria created a square (figure 1) that represents a 5m x 5m wall that must be constructed of brick.

Maria calculates that the area to be covered is 5m x 5m = 25m^2. One brick is 0.20m x 0.20m = 0.04 m^2 in dimension and therefore covers an area of 0.04 m^2.

One m^2 will need 1:0.04 = 25 bricks

The wall we want to construct will need 25 m^2 x 25 bricks per m^2 = 625 bricks.

Therefore 625 bricks will be needed in order to construct the wall we want.

Similarly Nikos H, who is 49 years old, works in the warehouse of a multinational company selling electrical and electronic appliances. Specifically, this company trades in televisions, computers, air-conditioners and all kinds of "white appliances" (such as electric cookers, washing machines etc.)

In the first question, Nikos uses mathematics such as addition, subtraction and division in his workplace to record the merchandize in the warehouse and collect new merchandise. Also, he uses recording devices that remove the merchandize from the warehouse and debit it to the corresponding retail departments.

Nikos uses mathematics in a series of actions that are related to his daily routine, such as the unloading of products that come from Athens, deliveries by truck to customers, deleting various items such as spoiled appliances, from the system. Moreover, like Maria in the previous report, he needs to calculate the stock stored in the warehouse. Sometimes he has to make cardboard boxes. In this case he suggests a way of manufacture that appears in the following graph (figure 2).

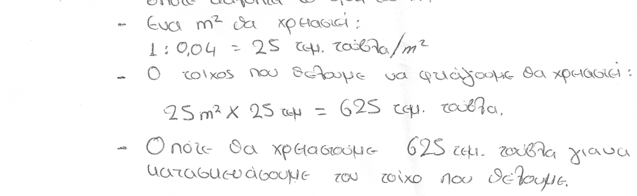

Figure 1. *Maria created a square that represents a 5m x 5m wall that must be constructed of brick.*

Nektarios K, works in tourism. He rents out sun umbrellas at a beach, and he reports that he uses mathematics in his work environment to calculate distance between umbrellas and in counting the tickets given when customers hire an umbrella. He measures distances visually. He places markers at the beginning or at the end of the distance he measured visually. There are also markers at the starting line and at the finish of his area of responsibility. He also uses numbers in the umbrellas that he sets up as 1, 2, 3 etc. His work begins in the morning when the bathers come and he collects the money from the tickets. At the end of the day he hands in the money he has received as well as the tickets that were not sold. He keeps part of the money that goes into a common fund with the other umbrella owners; he uses division to calculate what daily-wage corresponds to each one that works at this beach.

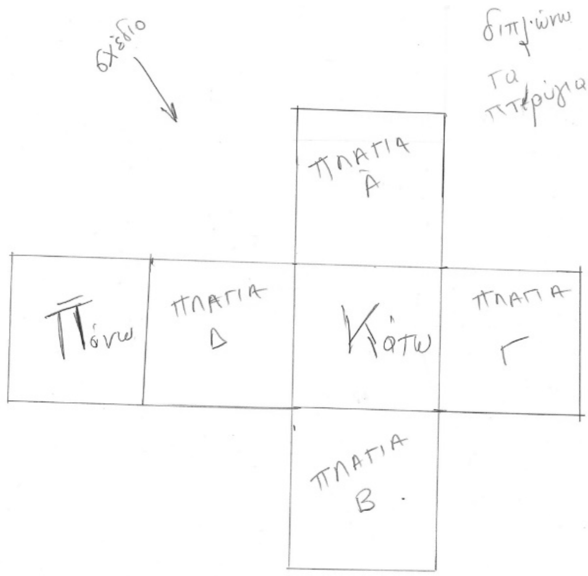

Figure 2. Suggested way of construction by the student.

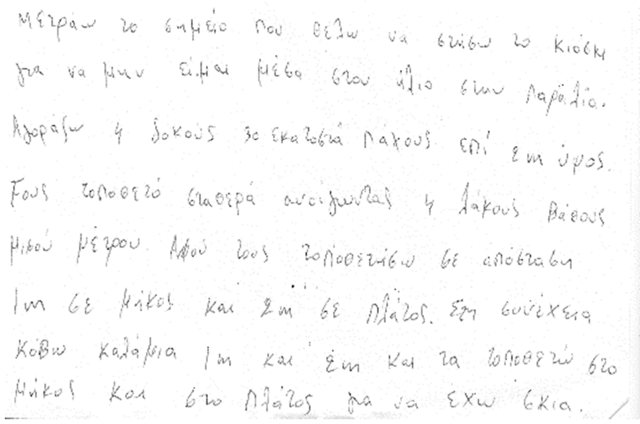

***Figure 3.** The student explains how he will build the kiosk, buying pipes and the distances he will place them.*

To the question of which level of the mathematics that he learned at school has helped him in his work, he answers that these skills are addition, subtraction and division. Moreover, he reports that the mathematics he was taught in the third class of Primary School is useful.

In question D, where the students are asked to use mathematics to make a construction, he presents a way of making a shelter at the beach. He reports that he first measures the place where he wants to set up the shelter. He then buys four beams 30 mm thick and 2 metres long. He sets them up by digging holes half a metre in depth. Then he places the beams for a length of one metre and a width of two metres. All these measurements are done visually or by pacing out the distance. Afterwards he cuts canes and places them over the one metre length and two metre width, to create shade.

Below (table 1) we attempt to list certain professions on the basis of their need for the mathematics the students were taught in the schools where they studied:

***Table 1.** Basic mathematical knowledge used in the workplace.*

[a]/[a]	Profession	Addition - subtraction	Plus multiplication & division	Plus decimal points	Plus Cross Method the three
1	Warehouseman in a Multinational Company (electric appliances)	√	√	-	-
2	Warehouseman for construction materials	√	√	√	√
3	Hairdresser	-	-	-	-
4	Design Assistant	√	√	√	-
5	Municipal employee	√	√	-	-
6	Pizza Delivery Parson	√	-	-	-
7	Airport Worker	√	√	-	-
8	Construction Worker	-	-	-	-
9	Confectioner	√	√	√	√
10	Electrician	-	-	-	-
11	Carpenter	√	√	-	-
12	Car mechanic	√	-	-	-
13	Hotel Waiter	√	√	-	-
14	Hotel employee	√	√	-	-
15	Saleswoman at a clothes shop	√	√	√	√
16	Supermarket Salesman	√	√	√	-
17	Umbrella rental at the beach	√	√	-	-
18	Plumber	-	-	-	-
19	Guard at a Money Transfer company	√	√	-	-

2.5. Commenting on the Answers

The students, especially those who work in technical jobs, do use mathematics in their work. The mathematics they use, however, are mainly what they have learned in the first classes of their Primary education at the Greek school. When these mathematics are used at work they are used almost exclusively for measurements. These measurements concern both money and materials. Generally speaking, we observe that the students are more familiar with the use of mathematical concepts in their work where there is a combination of measurements of distances and measurements of money (warehouses, trading and so on). This is seen by the skills a portion of students demonstrated in responding to questions B and D and in better determining what level of mathematics they needed, as formulated in question C.

The students who had the ability to give the best answers (these can be distinguished by responses to question D) were mainly those who used a combination of spatial measurements and money measurements in their work. There may be various reasons for this. Indicatively we refer to the situation where money is used at work, where the use of informal methods is not possible. This is because “informal methods” do not have the precision of the formal methods as taught in school. The example of individuals who work in warehouses that are also commercial enterprises is characteristic of this.

But where the students use informal mathematic knowledge, like Nektarios K. at the beach, because this knowledge is connected with actions that involve money, he approaches mathematics more satisfactorily compared to the students who use mathematics without any economic elements (money), such as the plumber, the hairdresser, the construction worker or the worker at the airport, the electrician, the craftsman, the confectioner or the design assistant.

Approximately 82% of the students who participated in the research cannot manufacture by themselves a mathematical situation as requested in question D. Thus, we observe that, either they do not answer this question at all, or they answer in such a way that y proves their ignorance of or weakness in any mathematical approach (their difficulty in the development of mathematical reasoning is evident) to the formulation of a mathematical situation in their everyday routine.

Moreover, we can distinguish from the generally poor showing, that the students have more difficulties in the formulation of problems based on situations of their everyday routine, compared to when they are given ready-made mathematic situations.

Generally speaking from the students’ responses we can maintain that it is possible to divide them into three categories depending on the way they use mathematics.

A. Those that use the “formal mathematics” and algorithms in general that they were taught at school, irrespective of their school grade.
B. Those who make use of informal methods of solution that are not taught in the school environment.
C. An intermediate category of students who combine informal methods in their work with the formal mathematics that have been taught at school.

1) As regards “formal mathematics” and general algorithms, it is ascertained that only a very small number of students (only 4 out of 62) uses the “formal mathematics” and general algorithms that they are taught at school, irrespective the school grade (they also refer to Primary School mathematics). These few have developed the ability to conceive precisely the concepts, dimensions, attributes and relationships between them, particularly those that are essential for the comprehension and solution of real problems of modern life and for keeping in contact with modern technological, economic and social realities. By now introducing an equivalence between mathematical concepts and real situations we have, as a result, a mathematical theory for describing real situations or, as it is predominantly called, an “application” of a concept to real situations. We observe that every such correspondence of mathematical concepts to real situations must be through a set of non-mathematical concepts and a series of linguistic or even symbolic expressions. These non-mathematical concepts and linguistic or symbolic expressions in turn determine and attribute a particular meaning to the mathematical concepts in the context of each particular real situation and, at the same time, they define a frame of reference for the mathematical concepts in the each particular situation in terms of each particular correspondence. That is to say, this correspondence of mathematical concepts to real situations attributes additional (non-mathematical) meaning to the mathematical concepts and, at the same time, determines their frame of reference in reality. Thus, each mathematical concept has a general mathematical meaning but, by corresponding to a real situation, it acquires a special meaning in the context of this correspondence. Consequently, we observe that for these students a mathematical concept acquires different meanings with the attribution of different frames of reference to different forms of correspondence with different real situations [17]. The students use formal mathematical concepts for transactions in the marketplace and for situations where there is production and where services are offered. Thus Nikos X. uses primary-school mathematics very well since this is the only level of mathematics he uses. He reports that he does not use more than the four basic operations, in order to check the products that come in or go out or are returned damaged, while, at the same time, he can use “formal mathematics” to find solutions for the manufacturing of a box made of cardboard, which he will have to make in order to send a damaged appliance to the central warehouse in Athens.
2) As far as the second group is concerned, that is to say those who make use of informal methods of solving

that are not taught at the school environment, we observe that:

i. The students' mathematical behaviour is as if they had not studied mathematics at all at school, a fact that is shown by the answers they select or from their inability to choose an answer.
ii. They select a completely different way of solving the exercises, so that there is no indication that their learning behaviour has been influenced by the school grade they are now attending.

Take, for example Sofia, who works as a hairdresser. We observe that she uses her fingers to estimate the desirable length of hair for a customer and then she cuts off the hair that exceeds this length.

Elias, who works as a plumber, uses a tape-measure, but not in the conventional way to read the measurement of distance (e.g. between the point that the tap will be placed and the end of the pipe), but he marks this distance on the tape-measure and then transfers this mark to the pipe that he is going to cut.

3) In the last group, that is to say those students who combine in their work informal methods with the formal mathematics that they have been taught in school, they use informal processes of solving exercises combined with the formal school mathematics. These students select this mixed use of school mathematics in combination with informal methods, because using only the methods and algorithms as they taught at school has proved ineffective for them. This finding agrees with the reports of Bosniadou in various studies, as for example those of Carrahel and Schliemann, that the students end up with absurd results when they try to reach any conclusions using the calculation processes that they have learned at school [18].

The mathematics taught at school function as an amplifier of "thinking activities" as it is reported by Bruner [19] both in mathematics and in logic.

Finally, with regard to the mathematical complexity of the problems constructed, it was observed that most of the problems the students constructed were problems involving a lot of actions. The students probably believe that difficult problems are those which involve many actions and a lot of stages are needed to solve them, even though simple mathematical operations are used.

3. Discussion

Mathematics has developed through our human need to deal effectively with daily situations or to explain particular phenomena. However, mathematics teaching in schools, by aiming mainly at the formation of more generalized knowledge and by focusing more on the final outcome and less on the process of mathematical creation, tends to present mathematical knowledge outside the context from which it emerged, or included in situations that are connected only very loosely with the personal experiences of the students. Such a teaching practice overlooks the socio-cultural character of the process of the construction of mathematical knowledge on the one hand, and, on the other hand, it downgrades the importance of the various mathematical experiences that students have outside the classroom that are connected with a particular process [20]. Thus, we observe a very low level of mathematical knowledge at school. We consider that the instructive model that prevailed in the old days (and which continues, unfortunately, to be used even today in Greece) which considered teaching as a process of transferring knowledge from the schoolteacher to the student has been overtaken by better methods [21]. It is shown, therefore, that the Mathematics that are taught in school as well as the school activities do not offer anything substantial to the students' learning. Thus, poor levels of mathematical knowledge are observed in students, so that there is no correspondence between the students' mathematical knowledge and the mathematics they have been taught at school. And so the question emerges: what kind of mathematics do the students learn after all, as, based on what we see, it is not possible to maintain that any of the approaches to mathematics were of any value. We include all the school classes, since the students studied at school in different school years, and they are all different ages.

Therefore, in our case, i.e. students of 1st Year in Senior Secondary, the teachers who teach in this school year, compelled by the syllabus to cover certain topics, teach the students what is supposed to be taught. It is observed, however, that this does not have any results on our students' knowledge. The students cannot build any new knowledge on past knowledge (that was taught at school), simply because this past knowledge does not exist or exists only to a small degree. What does exist is a set of informal elements with very little or no knowledge originating from school mathematics taught in much lower classes, and which have no connection with the mathematics of 1st Year Senior Secondary. This is due to the fact that the syllabus of 1st Year Senior Secondary is different and no process of genuine communication can be developed through which the teacher tries to take into consideration his students' interpretations.

What can be done in this case? How can we help the students? The social interaction and the discussion of mathematic interpretations and solutions are essential for learning. The students learn that mathematics is related with activities they meet in their work and in their social environment. This also agrees with Voigt, who maintains that students learn through processes that are related to the social context in which the concepts are discussed, as well as through interactions with the individuals that the students collaborate with [22]. The students' daily experiences connected with mathematics outside the classroom, offer an environment in which informal mathematical knowledge is shaped, the kind of knowledge that is a product of the effort by the individual to deal with real situations and can be characterized as applied mathematics, depending on the circumstances within which it arises and rich in mathematical relationships (correct or wrong). According to the relevant research, this informal knowledge constitutes a precious frame of reference at least for the students' initial attribution of meaning to mathematical concepts, representations and processes by the students, particularly when they are required to be involved in activities related to real situations, in which the use of particular knowledge is required. The encouragement of this practice contributes to the continuous exploitation of informal knowledge for the deeper comprehension of mathematical ideas, as it activates the processes of reflection that condition mathematical thought [20]. Only this has any meaning for the students, because they understand the reason they them, and what their aim and their usefulness is.

What is the teacher's role? Taking into consideration the age of the majority of the students, we believe that the teachers should follow certain principles that are described by Vosniadou, even if they are intended for younger ages groups, since we believe that these principles have a direct application for Senior Secondary classes too.

This emphasises what we have stated above, that the accumulation of new and unknown knowledge cannot lead anywhere, because in the end the students adopt only the knowledge that they use in their everyday routine. On the other hand, any pre-existing knowledge these students might have is usually insufficient or contains misleading ideas and important misapprehensions.

Unfortunately, modern technology has affected everyday use of maths negatively. It has actually led to maths non-use because a worker does not need to do any mathematical operation since the result is registered automatically on a computer screen which can be shared with other people who are in different distant places.

It is maintained, therefore, that teachers should discuss the content of the subject before they begin teaching, to ensure that the students have the essential pre-existing knowledge that they can then activate. Therefore, the detection of mistaken ideas and misapprehensions sometimes forces the teacher to review the past syllabus in order to correct these. The teacher can also ask the students to do certain preliminary work by themselves, so that, judging from the results, he can fill the gaps in order to teach the new units. Since teachers can discover enormous gaps of knowledge in comparison with the level that the students are at now, they will have to proceed to the necessary corrections. They can achieve this by introducing a model or context that will also contain elements of informal mathematics drawn from the everyday routine of students so that many of the students will use this model as a ladder in their effort to improve their performance. Our conclusion here is that the use of suitable strategies by the teacher can play an important role in the students' learning process. On the other hand, the students themselves have developed strategies that help them resolve the daily mathematical problems that they meet at work. Some of these strategies have been reported in the main part of this work. These are the continuation of methods of solving daily mathematical problems that children create from a very early age. Thus, when preschool age children are sent to buy certain items, they repeat on the way what their parents asked them to buy, in order to remember them. This is because they have discovered repetition as a strategy for improving their memory although no one taught them. Nektarios K did precisely the same, when measuring the distances to place the umbrellas, by using repetition of the distance he estimated visually.

Important benefits derive in teaching from the utilization of strategies and methods that the students use in their daily mathematical needs but also from seeing how these strategies can be extended to other types of problems in mathematics, such as those that are taught at school. This will happen only if the teachers make systematic efforts to teach learning strategies to the children. These strategies help learning and make it more rapid.

A possible intervention at these ages on the other hand, to disconnect the informal strategies used in mathematics from the formal mathematics taught in school, will have no result or can "prohibit" the students' efforts to construct problems based on formal mathematic situations. All the above theoretical perspectives recognize the value of mathematical knowledge produced outside school. The strategies can differ as to precision, difficulty of implementation, and requirements, and they can also differ in the spectrum of problems in which they have an application. The wider the range of strategies the students can use the more effectively can they solve mathematical problems. Educators should be able to set a problem situation, and indicate the process of investigation or pose basic questions. Moreover, they will have to transfer to these problems the confidence the students have when using informal strategies of problem solving, where the students' work will be supported by their known strategies [21].

4. Conclusions

A low level of mathematical knowledge is observed in students' performance (ή a poor students' achievement in maths is observed) which shows that there is no correspondence between students' practical mathematical knowledge in everyday life and knowledge of mathematics acquired through formal instruction. To illustrate, some students, especially hairdressers and plumbers, choose a completely different way of solving exercises, so that there is no indication that their learning behaviour has been influenced by formal instruction in the classroom.

Thus, the processes of school mathematics can indisputably offer richer and more powerful alternative solutions to mathematical processes than those which arise from the workplace of the students.

Students appear to use visual methods for measurements, as in the case of the student who places umbrellas for bathers on the beach. In this case, what the student initially does is to visually estimate a constant length and then he adds up in his mind how many umbrellas are needed to cover the part of the beach that is in his responsibility. The same student also uses division in order to share the profits of the day with his co-workers after subtracting the fixed expenses.

The conclusion drawn therefore is that a teacher can give more meaning to students' out-of-school activities by relating them to the material taught at school. Thus, school mathematics can function in a more authentic context. This conclusion inevitably leads to the recognition of the effect of students' socio-cultural experiences on the configuration of mathematical meaning. This leads to a new way of approaching mathematics teaching so that students' experiences are connected with mathematics taught both inside and outside school and have a central role in the planning and implementation of educational practice. Thus, there will be positive results if school takes into consideration the informal methods students use as well as students' pre-existing knowledge and connect this previous knowledge with what is taught at school to the extent possible.

References

[1] Reed, H. J and Lave, J. (1981) "Arithmetic as a tool for investigating between culture and cognition", in R. Casson (ed.), Language, Culture and Cognition: Anthropological perspectives, Macmillan, New York, pp. 437-455.

[2] Carraher, N. Carraher, W. and Schliemann, S. (1985). "Mathematics in streets and schools", British Journal of Developmental Psychology 3, 21-30.

[3] Jurdak, M. and Shahin I. (1999). "An ethnographic study of the computational strategies of a group of young street vendors in Beirut", Educational Studies in Mathematics Education 40, 155-172.

[4] Kent P, Noss R. (2002). The mathematic components of engineering expertise: the relationship between doing and understanding mathematics. Paper delivered at the conference Engineering Education 2002, Institution of Electrical Engineers, London,

[5] Noss, R. Hoyles C. (1996). The visibility of meaning: modeling the Mathematics of banking. Int J Comput Math Learn? 1 (1): 3-31.

[6] Cockcroft, H. (1982). Mathematics counts: report of the Committee of Inquiry into the teaching of Mathematics in schools. London: The Stationary Office (HMSO).

[7] Gainsburg, J. (2005). School Mathematics in work and life: what we know and how we can learn more, Technology in Society 27 1-22.

[8] Packer, A. (1997) Mathematic competencies that employers expect. In: Steen LA, editor. Why numbers count: quantitative literacy for tomorrow's America. New York: College Entrance Examination Board? p. 137-54.

[9] National Research Council (1989). Everybody counts: a report to the nation on the future of Mathematics education. Washington, DC: National Academy Press.

[10] Chazan, D. (2000). Beyond formulas in mathematics and teaching: Dynamics of the high school algebra classroom. New York: Teachers College Press.

[11] Janvier, C., Baril, M., & Mary, C. (1992). Contextual reasoning of electrical technicians. Les Cahiers du CIRADE, 1, 155–169.

[12] Smith, J. P. (1999). Tracking the mathematics of automobile production: Are schools failing to prepare students for work? American Education Research Journal, 36 (4), 835–878

[13] Magajna, Z., & Monaghan, J. (2003). Advanced mathematical thinking in a technological workplace. Educational Studies in Mathematics, 52, 101–122. Masingila, J. O. (1994). Mathematics practice in carpet laying. Anthropology & Education Quarterly, 25 (4), 430–462.

[14] Gainsburg, J. (2007). The mathematical disposition of structural engineers. Journal for Research in Mathematics Education, 38 (5), 477–506.

[15] Kent, P., Noss, R., Guile, D., Hoyles, C., & Bakker, A. (2007). Characterizing the use of mathematical knowledge in boundary-crossing situations at work. Mind, Culture, and Activity, 14 (1&2), 64–82.

[16] Hoyles, C. Noss, R. Kent P. and Bakker A. (2013) Mathematics in the Workplace: Issues and Challenges Educational Interfaces between Mathematics and Industry.

[17] Hasapis, D. (1996). the frames of report of mathematic significances at their teaching in the first degree education and their ideological orientations. The Mathematics in the education and the society. Practically 1st Pan-Hellenic Congress of Mathematic Education, Athens, 1996 p. in 117.

[18] Bosniadou, St (1995). The Psychology of Mathematics Publications: Gutenberg Athens 110-148.

[19] Bruner, J. (1972). Relevance of Education. London: Penguin.

[20] Carme (2007). http://carme2007.edu.duth.gr/images/them_sin.htm.

[21] Spirtou A., Koumaras, P. and Psyllos D. (1995). A constructive strategy for the education of future teachers. Modern Education, 84, 50-59.

[22] Voigt, J. (1996). Negotiation of Mathematical Meaning in Classroom Processes: Social Interaction and Learning Mathematics. In L. P. Steffe, & P. Nesher (Eds.), Theories of Mathematical Learning (pp. 21-50). Mahwah, NJ: Lawrence Erlbaum Associates.