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THE ANALYSIS OF THE RESULTS OBTAINED BY THE CANDIDATES FOR THE 2014'S ADMISSION, SPECIALIZATION: "PRIMARY AND PRESCHOOL EDUCATION PEDAGOGY", THE MATHEMATICAL COMPONENT

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Abstract: In this article we want to point out as brief as possible the particularities of the transition from the pre-university education to the academic environment, by offering some examples from the backstage of the first evaluative meeting with future students. They were candidates for the Primary and Preschool Education Pedagogy specialization of the Faculty of Psychology and Science of Education, Babeş-Bolyai University, Cluj-Napoca. The dates offered are derived from a relatively new pedagogical micro-research: the 2014's Admission exam, with a total of 338 subjects and the content being the writing exam to verify their knowledge, the Mathematical component (arithmetic knowledge).

Key words: Primary and Preschool Education Pedagogy specialization, admission, arithmetic knowledge.

1. Introduction

In many teachers' opinion, beyond the Curriculum changes or the educational changes, school should have, further, as mission and vocation, formation of general culture of youth, but also some competences to facilitate in the future, its consolidation and enrichment. Furthermore, this thing is valid for a future teacher, who has to be a role model and a transmitter of values for the students. In the general knowledge, mathematics should have a central role, as said in *Mathematics in Education in Europe: Common Challenges and National Policies* (EACEA P9 Eurydice, 2011) "Competence in mathematics is integral to a wide range of disciplines, professions and areas of life".

In this article we want to point out as brief as possible the particularities of the transition from the pre-university education to the academic environment, by offering some examples from the backstage of the first evaluative meeting with future students. They were candidates for the Primary and Preschool Education Pedagogy specialization of the Faculty of Psychology and Science of Education, Babeş-Bolyai University, Cluj-Napoca. The dates offered are derived from a relatively new pedagogical micro-research: the 2014's Admission exam, with a total of 338 subjects and the content being the writing exam to verify their knowledge, the Mathematical component (arithmetic knowledge).

2. General knowledge and mathematical competences of the high-school graduate

General knowledge has become too much of a theorized and too less particularized concept. General knowledge, in the large acceptance of the word, speaks about gathering knowledge from various domains, which can visibly enlarge the horizon of knowledge and then allow the graduate at least the choice of a profession from a wide range of possibilities. Some assimilate this type of culture with a theoretical base of dates, more or less lacking of praxiologic foundations and guidelines. Students of today, university students and then the number one specialists of tomorrow should firstly remain with some axiological landmarks and essential abilities from all the domains studied in school.

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After, they are constantly requested the disponability to be receptive to new, to study, to learn constantly, to perfect themselves, to honorably resist changes, no matter if we are going to pursue university or not.

On one hand, some of the school's people, alongside some employers, support the idea that that package of knowledge from various domains, of which we were all so proud, should be seen in our days as a support for obtaining practical competences, asked by the labor market. That is why we often hear the question: 'For what purpose has a high-school student to learn information that he will never use in his future profession?!...' Are they right? Everything that we define as SCHOOL compulsory carries the attribute EFFICIENCY?!.. In this issue, the truth is somewhere in the middle. Sure, the student's brain doesn't have to be "filled" with useless information, but it's also not normal for them to become only the beneficiaries of ephemeral culture from the Internet, Google or Wikipedia, instead of a real culture from books. Unfortunately, the passion for reading doesn't seem to be fashionable today, even if there are big efforts made to revive it. The idea that people nowadays are not as dedicated to learning as they were before is going around. This phenomenon has, certainly, some real basis, but it shouldn't generalize. There are now, just like they were before too, students that still feel the need to read, to practice, to deepen the knowledge, just like they are students that are happy with the occasional information. Those who don't care about individual learning and who frequent vulnerable cultural environments (qualitatively speaking), show later serious gaps and a good way to measure this is by seeing the "pearls" from the baccalaureate exam or from the university admission exams.

On the other hand, from the wish to become a pragmatic adult, a lot of people don't give general knowledge enough credit and the mathematical culture is looked at with even more indifference. This is because, just as the mathematician Solomon Marcus said in an interview for the Romanian television (https://www.youtube.com/watch?v=Eo5wAcfFgMQ): "We are getting to the situation of the third age intellectuals, which most have unpleasant memories about mathematics. However, they are not embarrassed by this for the reason that math does not mean culture. Even if they do not say this explicitly… A lot of artists almost praise with the fact that they have been bad at math, because they consider that this thing adds to their gift as artists."

These views do not belong however to a healthy realism. Students demand for a flexible teacher, who proves that the same attribute does not fit at their level. That is why kindergarten teacher must encourage those preoccupations the child is inclined towards, without neglecting to transmit a minimum of general knowledge. At the same time, a solid general knowledge can help them fulfill themselves even in their own vocation and specialty.

Forming competences is an important objective in the academical training's inside and, implicitly, in the formation as a teacher. One of they key competences established at European level is the mathematical one and the basic competences in science and technology (European Commission, 2012).

The Council of the European Union' document (2008) entitled "Council conclusion on prepring young people for the 21st century: an agenda for European cooperation o schools" established that : "the acquisition of literacy and numeracy skills to be the main priority for European cooperation in education". In this context "Numeracy, mathematical and digital competences and an understanding of science are also vital for full participation in the knowledge society and for the competitiveness of modern economies".

Numeracy is the ability to reason and to apply simple numerical concepts (Brooks, M. Pui, 2010). The basic numeracy skills include understanding of the real numer line, time, measurement, estimation and computational skill - comprehending fundamental mathematics operations: addition, subtraction, multiplication and division. More sophisticated numeracy skills include understanding ratio concepts and knowing to perform multistep operations (Reyna, V.F., Nelson, W.L., Han, P.K., Dieckmann, N. F., 2009). A numerically literate person can manage and respond to the mathematical demands of life (Statistics Canada, 2003). That's why two more skills are included at the higher level of the numeracy skills: the analytical skills - the ability to understand numerical information such as required to interpret graphs and charts and statistical skills. Paulos J. A (1988) introduced the term of innumeracy

a term that is the mathematical equivalent of illiteracy: a inability to deal comfortably with the fundamental notions of numbers and chance. It is not the place here to detail the multiple aspects of the problem: the importance of numeracy skills in the daily life and in any profession, numeracy measure tests, individual differences innumeracy, innumeracy causes, innumeracy risks for society, proper ways of diminishing the innumeracy, role of teachers, schools and policy makers in this context etc.

According to EACEA (2009) "In the past years, and especially since 2007, the great majority of European countries have revised their mathematics curricula, adopting an outcome-based aproach whereby the focus lies on developing students' competences and skills rather than on theoretical content. The amount of mathematics content in the curriculum has decreased while cross-curricular links, problem-solving and the application of knowledge has incresed. This integral approach tends to be more comprehensive and flexible in responding to the needs of a diverse range of learners, as well as to their ability to understand the purpose of mathematics applications in the real world".

In Romania, the level of mathematic knowledge of the students is measured by the national test at the end of the 8th grade and for the graduates of certain high-school specialities, by the baccalaureate. Starting with the 2013-2014 school year, national testing have been introduced at the end of the 2nd, 4th and 6th grades. Beside these national tests, students achievement in mathematics is assessed through two large scale international surveys, namely PISA (http://www.oecd.org/pisa/home/) and TIMSS (http://timssandpirls.bc.edu). The Trends in International Mathematics and Science Study (TIMSS) provides data on the mathematics achievement of fourth and eighth grade students in various countries. PISA (Programme for International Student Assessment) measures the knowledge and skills of 15- year-old students in reading, mathematics and science. These two surveys focus on different aspects of student learning. In general terms, TIMSS aims to assess "what students know", while PISA seeks to find "what students can do with their knowledge".

According to the European Union's document *Europene Developing Key Competences at School in Europe* (2012) "low student achievement in literacy, mathematics and science remains a challenge" and "Efforts that increase students' motivation to learn mathematics and science by, for example, rectifying preconceived beliefs that the subjects are particularly difficult, are important steps to take". The concerns about achievement levels have led to the establishment of EU-wide benchmark in basic skills, to be achieved by 2020: "The share of 15-years olds with insufficient abilities in reading, mathematics and science should be less than 15 %" (Council of the European Union, *Strategic Framework for European Cooperation in Education and Training ('ET 2020')*, Council Conclusions May 2008).

In document *Mathematics in Education in Europe: Common Challenges and National Policies* (EACEA P9 Eurydice, 2011) it is specified that "Low achievement in mathematics is a common concern for all European countries. It is an issue associated not only with the effectiveness of teaching and learning, but also with providing an equitable system of education". National studies provide data on problematic subject content and mathematical skills. In Ireland, Lithuania, Romania and Slovenia, for instance, algebra, mathematical communication, and problem solving in context have been identified as common problematic areas for students (ibidem). Romania has been identified several factors that affect negatively performance in rural school. These are mainly related to the high turnover, low motivation (social and financial) and the inadequate mathematics qualifications of teachers in these schools, as well as the grouping of pupils in mixed age classes at primary level (http://didactika.files.wordpress.com/2008/05/modul-adaptare-curriculum-la-contextul-rural.pdf). For improving the situation since 2008 have been developed the Rural Education Program (http://proiecte.pmu.ro/web/guest/pir) in which 600 teachers from rural school teachers have obtained an additional university qualification in teaching mathematics. We can notice that in the majority of European countries, and Romania is among them, central education authorities prescribe or recommend support measures or assist schools and teachers in implementing measures to address students' difficulties in mathematics (EACEA P9 Eurydice, 2011, *Mathematics in Education in Europe: Common Challenges and National Policies*).

3. Analysis of the given subjects from the admission to the Primary and Preschool Education Pedagogy specialization in 2014 at mathematics

The given subject for the 2014's admission at the PPEP has a mathematics subcomponent noted with 3 out of the 10 total points. The subject targets:

- *perform basic arithmetic operations (addition, subtraction , multiplication, division);*

- *solving concrete problems involving basic arithmetic operations.*

The subject designed based on these requirements was the following:

On the exam paper, write the whole solution:

1. 1681 + 1926 – 999 =
2. 5236 : 17 =
3. 37 + 16 : 2 × 4 =
4. 380 × 53 – 53 × 342 =
5. At a social centre were brought 880 kg of sugar, 690 l of oil and 470 kg of pasta. They were wrapped in order to be given to the needy in packages containing each: 4kg of sugar, 3 l of oil and 2 kg of pasta. What is the maximum number of packages that can be made and what quantity of each product has remained afterwards?

Note: subjects from 1 to 4 are noted with 0.5 points each and subject 5 with 1 point

The scale correction was as following:

1. 1681 + 1926 – 999 = 3607 – 999 *(0,25 pt.)* = 2608 *(0,25 pt.)*
Observation. Calculation cand be also done in another order, like this for example: 1681 + 1926 – 999= 1681 + 927 = 2608
2. 308 *(0,50 pt.)*
3. 37 + 16 : 2 × 4 = 37 + 8×4 *(0,20 pt.)* = 37 + 32 *(0,20 pt.)* = 69 *(0,10 pt.)*
4. Method I:
   380 × 53 = 20140 *(0,20 pt.)*
   53 × 342 = 18126 *(0,20 pt.)*
   Finalization: 20140 – 18126 = 2014 *(0,10 pt.)*

Method II: commutativity is used and then the common factor, like this:

380 53 – 53 × 342=53× 380 – 53× 342 *(0,20 pt.)*=53×(380 – 342) *(0,20 pt.)*=53 × 38= 2014 *(0,10 pt.)*

5. Calculation will be noted, without regard to the formulation of questions, if the results are explained correctly.
   - For how many packages is there enough sugar? 880:4 = 220 (packages) *(0,20 pt.)*
   - For how many packages is there enough oil? 690 :3=230 (packages) *(0,20 pt.)*
   - For how many packages are there enough pasta? 470:2=235 (packages) *(0,20 pt.)*
   - Which is the maximum number of packages that can be made? 220 (packages) (The smallest number out of the 220, 230 and 235) *(0,10 pt.)*
   - How much out of each product remains after?
     0 kg of sugar *(0,10 pt.)*
     10 packages × 3 l of oil = 30 l of oil or 690 – 220 × 3 = 30 l of oil *(0,10 pt.)*
     15 packages × 2 kg pasta = 30 kg pasta or 470 – 220 × 2 = 30 kg pasta *(0,10 pt.)*

In the following we will detail a few aspects regarding the subject's structure and the way to mark it. In the terms of the content covered and the degree of difficulty, solving the subjects only requiered the knowledge of a mediocre 3rd or 4th grader. Therefore:

- Subject 1 has verified the knowledge and applying algorithms of addition and subtraction of the natural numbers. If on the exam paper were written only the results without specifying the intermediate calculation, 0.25 points were given. Therefore, the points for this subject were either 0, 0.25 or 0.5 points.

- Subject 2 has verified the knowledge of division. If on the exam paper were written only the results without specifying the intermediate calculation, 0.25 points were given. Therefore, the points for this subject were either 0, 0.25 or 0.5 points.
- Subject 3 has verified the knowledge of the order to perform operations, meaning: first the second order operations are done (multiplication and division) in the written order and then the first order ones (addition and subtraction). For writing only the final resuls, they were given 0.10 points.
- Subject 4 has verified the knowledge of the multiplication, the order to perform operations and taking out the common factor. For writing only the final resuls, they were given 0.10 points.
- The proposed problem for the 5th subject has verified the candidates' capacity to solve a problem from their daily life. Performing some simple multiplication and division were only the first stage of solving the problem, the essence being the ability to correlate the partial results with the problem's requirement. Finding out the total number of packages, even if market with 0.10 points, was the key without which the last 0.30 points could not be received.

From the involved reasoning's point of view, the targeted cognitive domains were: knowing, applying and reasoning. These cognitive domains are also used for the international tests called TIMSS (Trends in International Mathematics and Science Study) (Mullis. I., Martin, M. 2013). In table 1 we have made an analysis of the subjects from this point of view :

Table 1. The analysis of the cognitive domains (TIMSS) aimed by the test's items

Cognitive domain	Item's number
Knowing	1, 2, 3, 4 (method 1)
Applying	4 (method 2)
Reasoning	5

4. Analysis of the subjects solving and the results obtained by the candidates

For the admission, there were 338 candidates, all high-school graduates, having the baccalaureate promoted. Even if a part of the candidates did not have to take a math exam to the baccalaureate, they have all passed the national testing from the 8th grade and studied math in all the 12 years of school.

The histogram of the scores received for each test' item is presented in diagram 1:

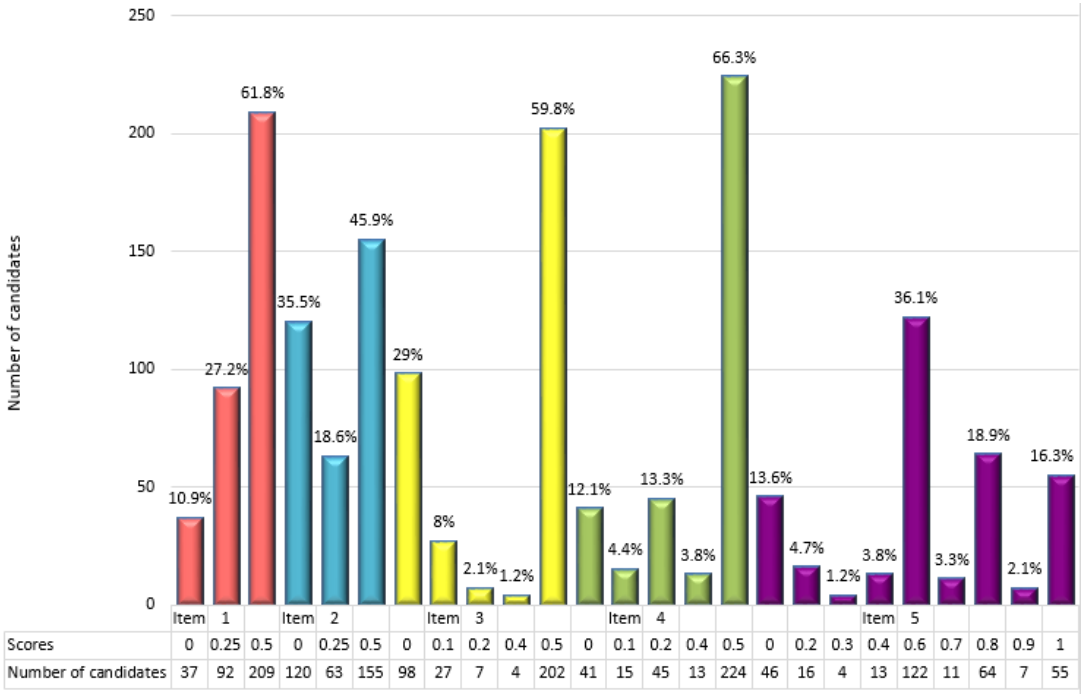

Figure 1. The histogram of the scores for each test' item

Based on this histogram and the tests solved by the candidates we can make the following observations:

- Around 60% of the candidates have managed to do correctly the first 4 subjects that involved the basic mathematical operations.
- At the first subject, around 11% of the candidates did not manage to do even a addition or a subtraction of two natural numbers, which is very worrisome. Even more worrying is the fact that for the second subject, over 35% of the candidates did not manage to do a simple division. The main mistake was the omission of the figure 0 on the tens position. Correlating this with the fact that even for the fifth subject they had to do three divisions, from which the first two were extremely simple, but still have not been solved correctly by 20% of the candidates, we can deduce that division has proven to be a big challenge for at least a fifth of the candidates. These candidates are at the innumeracy limit.
- At the third subject, 3, 29% of the candidates did not know the correct order to do the mathematical operations, the mistakes being of two types: doing the multiplication first and then the division, or doing first the addition and then the division and multiplication.
- At the fourth subject, around 12% of the candidates did not manage to do even a multiplication of two natural numbers. The main observation that we can do is that, here, the majority of them (333 out of 38, so 98,5%) have solved the exercise by direct calculation and not by taking out the common factor. This is due to the wrong school habits, thinking stereotyped instead of analyzing and identifying simpler alternative work. However, over 65% of the candidates have managed to finalize the exercise.
- At the fifth subject, over 75% of the candidates have managed to identify and solve correctly the first steps. However, only 16% of them have managed to finalize the exercise correctly. It being, however, an issue of the cognitive domain of reasoning, the results are satisfying. The main difficulty they had was the misunderstanding of the task given or the inability to represent mathematically the task. Therefore, after doing the first three divisions, they did not manage to finalize the exercise. For this subject also, we have 13% of the students that got 0 points.

The average grades for each subject is presented in Table 2:

Table 2. The average score for each item and for the test

Item no.	Average score/item	Percentage of the average score/item out of the total score/item
1	0.37 out of 0.5 points	74%
2	0.27 out of 0.5 points	54%
3	0.31 out of 0.5 points	62%
4	0.37 out of 0.5 points	74%
5	0.60 out of 1 points	60%
Average	1.94 out of 3 points	64.6%

We note the fact that the smallest average note is the one for the second item with a percentage of 54% and because it is about the division of two natural numbers, the situation is worrisome. For the third item, with a percentage of 62%, the result was predictable, knowing that the order of operations is a challenge for most students. Even if there were high percentages for the first and fourth subject (74%), the results showed that over a quarter of the high-school graduates do not know how to do a simple addition, subtraction or multiplication with natural numbers. With a 60% passing percentage for the last item, we can generally conclude that, usually, the graduates can make connections between the daily issues and the mathematical instruments used in order to solve them.

In order to be able to make more analysis of the scores obtained, we grouped the average notes in 15 intervals, each having the ”width” of 0.2 points. In Figure 2 we have the number of candidates for each score interval.

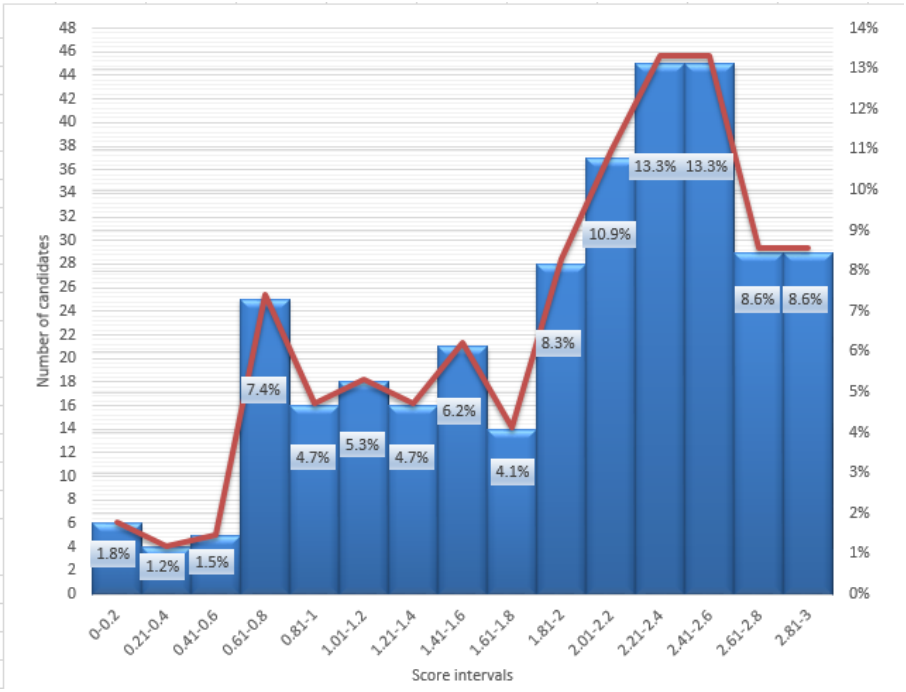

Figure 2. The histogram of number of candidates for scores intervals

The modal classes are 2.21-2.4 and 2.41-2.6, each having 45 candidates. The median class is 2.01-2.20, which is bigger than the value 1.5 corresponding to the middle score, fact that shows that the data values fall into the upper half of the distribution. There are 10 candidates (3%) that have obtained a score under 0.5 points, so they did not manage to solve any subject. Meanwhile, on the opposite side, 26 candidates (7.69%) have obtained the maximum score of 3 points. Around 30% of the candidates managed to get a score near 1.5 (see figure 3).

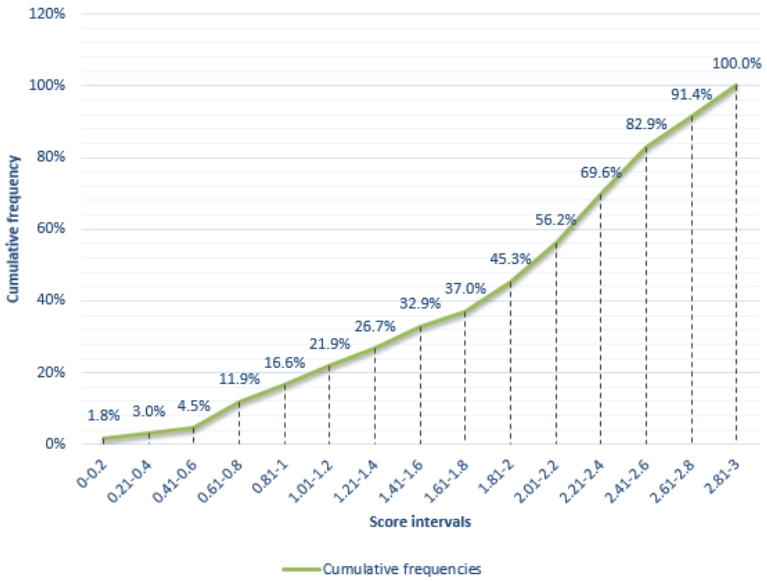

Figure 3. The cumulative frequency of the scores

5. Conclusions

Along with the reintroduction of the admission exams in the colleges from Romania, we have the possibility to check the level of mathematical knowledge of the high-school graduates in other way than by the baccalaureate. The admission to the PEPP specialization gave us the possibility to check

the basic arithmetical knowledge of the students, which in most cases have studied math in school on a second plan. Even if the taken lot is not necessarily representative, we believe that it can show the level of mathematical general knowledge of the high-school graduates. This testing has involved simple exercises with natural numbers. The scores obtained for each item shows that over 10% of the high-school graduates cannot do an addition or subtraction right and around 17% have the same problem with multiplication, while 20% have troubles with the division. After the assessment of the results obtained, the results present in the official documents of the EU (see references) were confirmed. It says that the students have low performances at math. Besides these numbers, we must ask ourselves how did these students graduated high-school, knowing that math was studied throughout school. Normally, this category of students should not have gotten into high-school in the first place. However, even if an 8th grade graduate has received a very low score at math, he will be admitted to high-school, because the mandatory education system is 10 grades. They also studied math at a higher level in high-school though. How could such a student promote math throughout high-school remains a mystery for us. For this category of students, the Ministry of Education and Research should propose programs and remedial classes at math.

Considering the results obtained by this study, we believe that we do not fit yet in the EU's request (*Strategic Framework for European Cooperation in Education and Training ('ET 2020')*, Council Conclusions May 2008) that, by the end of 2020, less than 15% of the kids under 15 years old to have insufficient skills at math. And this is especially because there still are children which abandon school, or who do not wish to pursue a college and which have not been included at all in this study.

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