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# MOTIVATION IN MATHEMATICS: THE CASE OF A GYMNASIUM IN PEJA DISTRICT OF KOSOVO

**Isa MULAJ[1*], Osman OSMANAJ[2]**

[1]*Senior Researcher, Institute for Economic Policy Research and Analyses, Pristina, Republic of Kosovo*
[2]*Teacher of Mathematics, "Haxhi Zeka" gymnasium, Istog, Republic of Kosovo*
[*]*Corresponding author e-mail: isa.mulaj@gmail.com*

**Abstract**

Using the secondary data for 250 and primary data through a survey of 25 students from a gymnasium in Peja district, Kosovo, this paper finds good or appropriate curricula and fear of failure or repeating the year not a factor in better grades but on motivation mainly coming from the teacher. Compared to the rest of the subjects and overall student performance, mathematics still remains with the poorest results on average. This is in line with earlier PISA test findings which ranked Kosovo very low, with mathematics being even lower. The average result in mathematics of 2.95 (for the grades from 1 fail to 5 excellent) in this case study is below the overall success of the students. While the causes of poorer results in mathematics versus other subjects have been observed in the rest of Kosovo's upper secondary schools and gymnasiums, the modest contribution of this paper through a small survey is in identifying the factors which work better as a driver of motivation for better results. Given that self-efficiency by the students in this case study was not found to have any significant impact on motivation, it is recommended to tighten the criteria against easier passing grades in mathematics regardless of overall success. Due to small size of the sample with primary data at a given time or year, the descriptive method is used to interpret the main findings.

*Keywords:* motivation, teaching, mathematics, performance, gymnasium.

## 1. Introduction

The critical importance and necessity of mathematics does not need to be explained differently from what Karl Friedrich Gauss has assigned it as the queen of sciences. While anyone familiar with the subject would never doubt it, the key question is how to motivate the students to achieve better results. Therefore, the objective of this paper through a case study is to identify motivation forms or their deficiency in teaching and learning mathematics as one of the most important subjects. In doing this, we present in a simple, basic and easier format the results to be understood by anyone, especially by the students of gymnasiums. Going into more detailed statistical and econometric estimates, which the sample size does not allow, would make many readers and students somehow demotivated with a feeling: "We already are averse to mathematics when complicated with formulas and estimates, thus this research is further discouraging us." But before motivating the students in mathematics, they have first to understand that mathematics in itself is a motivation, or at least it should be. Dealing with mathematics is an attractive feature in itself to human beings because of its intellect and social aspects. Of course, critics could argue that some gifted individuals may have a particular inclination toward the study of mathematics. But, can maths motivation be appealing to everyone? Maybe it can, as it has the potential to be interesting to everyone by presenting and solving the problems.

Students after graduating from high schools in Kosovo, when they undergo various tests, such as applying to enroll in university studies, rely partially on their existing overall success, especially in the subject of mathematics. Most of them choose the faculties where mathematics either does not exist at all as an exam (such as in law, political science, philosophy) or its role is less important compared to the basic subjects of the respective faculty. Aware that independent feedback on the performance of education system is needed, the

Ministry of Education, Science, and Technology (MEST) of Kosovo exposed it to compare the results with other states such as PISA (Programme for International Student Assessment). The PISA test, which is applied in OECD member states but also many other countries, measures the performance of 15-year-old students in maths, science, and reading. For the first time, this test was performed in 2000 and is repeated every three years. Kosovo is also included in the framework of this study. In 2015, the average score for Kosovo in science was 378 points or somewhere near the bottom of the PISA overall ranking, leaving behind only Algeria (376 points) and the Dominican Republic (332 points). In maths, the 362 point indicator for Kosovo was even weaker than in science and reading (OECD, 2018).

When the results fall short of the desired expectations, then it is worth noting that the general political, economic and social situation is not only subject for criticism, but after all, for not improving the quality in education and bring about positive changes. Therefore, the response as a warning out of desperation has often been that only in the new generation is it hoped to achieve any significant improvement. While this belief exists largely for the younger generation and can be viewed as a positive psychological factor, expectations should not be dealt with emotions but determination and commitment to reform. This is an alert that the situation cannot be significantly improved or in line with expected trends, because the new generation not only does not have accumulated knowledge, but is stagnating compared to the generations of other countries. Of course, the young population presents a potential and perspective for economic and social development, though before being forced to learn, it must be motivated to learn and become more creative, in this case, in the subject of mathematics. The performance of teaching, learning and scores in secondary schools and gymnasiums is an evolutionary process requiring new forms of motivation. Gymnasiums are a generation "in transition" or between primary and higher education. It has been proven that this is where Kosovo stands worse compared to most countries in the world, as indicated by PISA test. On average, the relative poor performance in mathematics is not a born habit but rather a product of the relations between the teacher and the student where the motivation factors are a key. This research through a case study of a gymnasium will first analyze the students' success or their overall score, and recommend the needed measures to motivation in mathematics.

## 2. Theories on motivation in mathematics

If we understand the importance and necessity of mathematics in a wide range of human activities, then we certainly should be aware of the diversified motivation approaches in learning and teaching it. Commenting on the consequences of the late 19$^{th}$ and early 20$^{th}$ century controversy over the foundations of this subject, the influential mathematician John von Neumann wrote in *The Mathematical Essay (1947)* that "the clear concept of absolute rigorous mathematics it is not immutable. The variability of the concept of rigor shows that something other than mathematical abstraction must enter into the composition of mathematics." Although the reason that mathematics is authoritative because of its supposed rigor and certainty, what we mean by rigor has changed throughout history, over new ideas and realizations. Understanding of mathematics, as pointed out by Wedege and Evans (2006), focuses on the dynamics of the relationship between people, mathematics or the subject taught in school, and society. For this they recommended the theory of socialization and learning in the workplace. However, Ward and Bodner (1999) had remarked that teaching and learning classes have fundamental differences as the students may not have the kind of motivation we wish they should have.
Is motivation an inherited phenomenon, or is it a result of compulsory tasks and consequences empowering some behaviors and weakening others? In other words, as Pintrich (2003) raised the question, is motivation something distinctive that we are born with, can be strengthened by external factors, or is it something intertwined with the learning process? This is similar to the common perception used, that someone "is born" with a certain skill, e.g. someone finds mathematics easier to learn, while the rest of the students are more expected to learn things in the form of text or language. When it comes to motivation, scholars like Ricks

(2003) came to the opposite conclusion by maintaining that only mathematics is motivation. According to Scheinerman (2017) what attracts the students, is that the graph theories are 'happy, beautiful' theorems and proofs, which arrive through the sweat of the intellectual game. Similar to the best poems, they contain perfectly expressed truths about the world. Perhaps the most passionate boast against our dual view of mathematics is "A Mathematicant's Lament" pamphlet by American private school teacher Paul Lockhart (2009). Written in 2002 and circulated for years among mathematicians and teachers, Lockhart harshly criticized the simple nature of learning mathematics more compulsorily. Mathematics, Lockhart wrote, is almost always taught in a way that obscures current knowledge and reasoning, the greatness and intuition, the excitement and frustration that the mathematicians foster.

The mainstream theory has evolved regarding motivation in mathematics. The *theory of self-determination* as defined by Ryan and Deci (2000, 2002), is related to the student's choice s/he thinks it works best, or autonomy that refers to the perceived origin or source of one's behavior. *Intrinsic* or internal motivation describes an activity that is undertaken or realized only for the student's pleasure without any external influence (Cai *et al*, 2016), while *extrinsic* motivation relies on external influences such as reward, coercion, and punishment. Intrinsic motivation leads to self-motivation for learning, while external motivation gives the goal to pursue learning (Li and Lynch, 2016). The impact of affective variables is often underestimated because they tend to have indirect rather than direct effects on achievement. For example, Reynolds and Walberg (1991) found that motivation influenced achievement in science only indirectly, through some out-of-school reading and engagement in school work. Some findings suggest that problem-solving, creativity, and a deep understanding of teaching material require high levels of positive emotions and intrinsic motivation (McLeod, 1990; Schiefele, 1992). The concept of intellectual autonomy is characteristic of the student's way of participating in the practices of a classroom community, which relates to awareness and will to acquire their intellectual abilities when making mathematical decisions, and judgments when participating in the activities of mathematics (Hannula, 2002). Although the *self-efficiency* theory is understood as a commitment to do something, it does not mean that it will lead to success or being efficient in that determination. The theory of *social recognition* first proposed by Bandura (1989), refers to the direct acquisition of knowledge through observation, interaction, experiences, and external media influence. Compared to those that are superficial learners, motivated students gravitate toward selfishly oriented learning and rely on how they perceive others as a source of motivation (Nguyen, 2008). In broad terms, the *theory of expectations* or achievements was developed based on the working environment to motivate employees, which was later expanded and revised to other areas, including education. In this respect, Edge Research (2016) recommended incorporating emotional skills, positive attitudes, self-management, practices, and procedures into the policies for school assessments.

Students oriented to a profession or task, learn the subject for their interest or ego. Concerning motivation and ego or self-efficiency as a forecast of math outcomes, an earlier study by Sartawi *et al* (1995) of 287 students with an average age of 10.3 years in the United Arab Emirates, found that motivation in mathematics measured through four factors (non-motivation, external rules, specific tasks, and intrinsic motivation), had a 30% variance in the results t for males and 21% for females. However, the regression model had not found the appropriate statistical significance, so only 5% of the results were properly explained through the above motivating factors.

As it appears, motivation in mathematics involves combined and diverse methods and techniques of working with the students that should be in the function of achieving better results. All these require different teaching strategies, which are tailored to the needs of students such as: understanding the main competencies of learning through mathematics, linking mathematics to maintaining its vertical and horizontal coherence, practical application, inside and outside the classroom practical implementation with real-life situations, formation, and

strengthening of mathematical skills based on investigation, problem-solving and a variety of strategies for solving them, and so on.

## 3. Methodology and data

This paper uses two types of data: i) secondary or those obtained from the gymnasium; and ii) primary data collected by the autors with a number of students. The first dataset is a sample of 250 students divided by a gender ratio of 50:50 out of a total 417 that the gymnasium had, or 60% of them, whose grades were taken from their classroom diary records. Only final grades are taken for analysis. The second sample consists of a limited number of 25 students as respondents, of which 13 were males and 12 females, who were asked questions regarding motivation forms in mathematics. In addition, the iterviews were conducted with three teachers of mathematics to learn of their motivation forms used. The main focus was on the grade or success shown in the subject of mathematics at the end of the second semester of 2019. Before doing this, it was necessary, to begin with, and obtain the overall score or success, then the grades were collected for the Albanian language or the category of "reading", biology, physics, and chemistry, or all three together included in the "science" category. These two categories of grades were taken into account to compare their average success to mathematics, then the focus was placed on mathematics only, including the answer to three main hypotheses, as follows:

> H1: Motivation as a pushing factor for better results comes from the teacher and teaching methods (tests, tasks, homework, assignments, competition events in mathematics);
> H2: Fear is a mandatory factor of temporary motivation (fail, loss of the year, lowering of overall success);
> H3: Motivation stems from the student (self-determination) due to future ambitions (faculty enrollment, etc.).

These hypotheses are made by the overall purpose, objectives, and expected results. Their testing is based on indicators generated from basic data analysis, which may be sufficient for the nature of this paper with a small database and number of observations. It is a kind of testing like in the hypothesis: "The Sun rises in the East and sets in the West." Among many other observations and techniques to test this hypothesis, an observer takes a compass in open air field when the Sun rises and notices the direction from the compass as "E" (East), then in the evening in the direction indicating "W" (West) when the Sun sets.
The limitation of this research is in small samples of cross-section data at a given time, thus the results cannot be generalized. A short period along with the limited number of observations, especially in the primary data, does not enable to obtain robust estimates, therefore the paper is restricted to interpreting and explaining the main Fig ures as findings through the descriptive method.

## 4. Results

The overall performance is calculated for a number of key subjects, where mathematics is included in the first place (more details on this later in the section), Albanian language, biology, physics, and chemistry. These represent the basis of student performance or achievement. Grouping of these subjects into three categories are also used in the PISA test as: i) mathematics, ii) reading (Albanian language), and iii) science (biology, physics, chemistry), having a higher variance in different subjects and being related in score among those having similar features. For example, the students with a grade of 3 in the mathematics category, on average were likely to have the same grades in physics and chemistry, or the subjects using numbers, formulas, charts, etc. First, let us look at distribution of the results between mathematics and the Albanian language by grades.

**Table 1.** Student grades in mathematics and native (Albanian) language

| Grades | Albanian language | % | Mathematics | % |
|---|---|---|---|---|
| **5** | 38 | 15.2 | 34 | 13.6 |
| **4** | 40 | 16.0 | 28 | **11.2** |
| **3** | 42 | 16.8 | 42 | 16.8 |
| **2** | 101 | **40.4** | 107 | **42.8** |
| **1** | 29 | **11.6** | 39 | 15.6 |
| **Total** | **250** | **100.0** | **250** | **100.0** |

*Source: Secondary data from the gymnasium, 2019, and Authors' own calculation*

Although the indicators from Table 1 are simple, they reveal a situation that needs to be clarified for the success by the students. Majority of them have almost an average success with a passing grade 2 which is presented by the highest frequency and participation, followed by 3, in Albanian language as well as in mathematics. A simple comparison at the first glance witnesses the difference between the success in grades between the subject of Albanian language and mathematics, where the students are on average better or more successful in the first. They have less maximum grades in mathematics (13.6%) than in Albanian (15.2%), and at the same time, more poor grades (1) in mathematics, respectively 39 versus 29. In the general overview, it appears as if mathematics is the most difficult subject, but it is too early to draw such a conclusion without entering into further analysis. When the grades of other subjects such as biology, physics and chemistry were included, then the result came out as in Table 2.

**Table 2**. Results by subjects and gender

| | Albanian language | | | Mathematics | | | Biology | | | Physics | | | Chemistry | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Grades** | **Σ** | **M** | **F** | **Σ** | **M** | **F** | **Σ** | **M** | **F** | **Σ** | **M** | **F** | **Σ** | **M** | **F** |
| **5** | 38 | 17 | 21 | 34 | 17 | 17 | 36 | 19 | 17 | 32 | 17 | 15 | 35 | 17 | 18 |
| **4** | 40 | 19 | 21 | 28 | 15 | 13 | 42 | 20 | 22 | 31 | 13 | 18 | 41 | 21 | 20 |
| **3** | 42 | 20 | 22 | 42 | 22 | 20 | 45 | 25 | 20 | 44 | 21 | 23 | 46 | 20 | 26 |
| **2** | 101 | 55 | 46 | **107** | **52** | **55** | 96 | 47 | 49 | **105** | **54** | **51** | 95 | 49 | 46 |
| **1** | 29 | 15 | 14 | 39 | 20 | 19 | 31 | 16 | 15 | 38 | 19 | 19 | 33 | 15 | 18 |
| **Total** | **250** | **126** | **124** | **250** | **126** | **124** | **250** | **127** | **123** | **250** | **124** | **126** | **250** | **122** | **128** |

*M – Male, F – Female*

*Source: Secondary data from the gymnasium, 2019, and Authors' own calculation*

First, female students recorded better success in the subject of the Albanian language. Although the causes have not been researched in more detail, we can assume that the nature of the subject may be the motive why women on average score better. Among other things, the content of the subject with stories, works, writers, love poems, etc., may have been more inspiring for women, who dominate the range from grade 3 to 5 with greater frequency or appearance. In mathematics, the grade 5 for "excellent" is equally distributed in each gender, by 17 cases respectively, and almost with equal proportions but the larger numbers (20 males versus 19 females) for 1 or "failing." In the other three subjects (biology, physics, and chemistry) the distribution varies according to grades, but in general, the achievements of both genders appear similar without any notable difference, especially in the highest and lowest grade. A greater variation is observed in the distribution for grade 3 in chemistry having 26 females versus 20 males, then in biology with 25 versus 20, and for grade 4 in physics where there are 18 females and 15 males.

Another finding that is not included in the analysis because as stated earlier, we relied only on the final grades, is that the overall student success in most subjects has also influenced the improvement of the grade in

mathematics. For example, if s/he had half of the grades 5, then in mathematics it was noticed that 3 was later increased to 4, and in some cases, it was even closed as 5. This might have happened, among others, for not disrupting the overall average success of the teacher to the student, and motivating the student for greater efforts in mathematics in the future. Similar cases have occurred when in mathematics the students had a higher score than in others such as the Albanian language were, there has been a tendency to increase the grades in this subject as well. Although these are very small details but important to be researched further, for which we have no space to go on, it is worth noting that higher grades or better success in some or many subjects, is likely to be followed by the trend of increasing the lower grades in other subjects by the teacher without proper merit of the student. Given that mathematics on average has lower scores compared to the rest of the subjects, then such a move, apart from a kind of motivation for overall sucess, may weaken true knowledge and skills in mathematics.

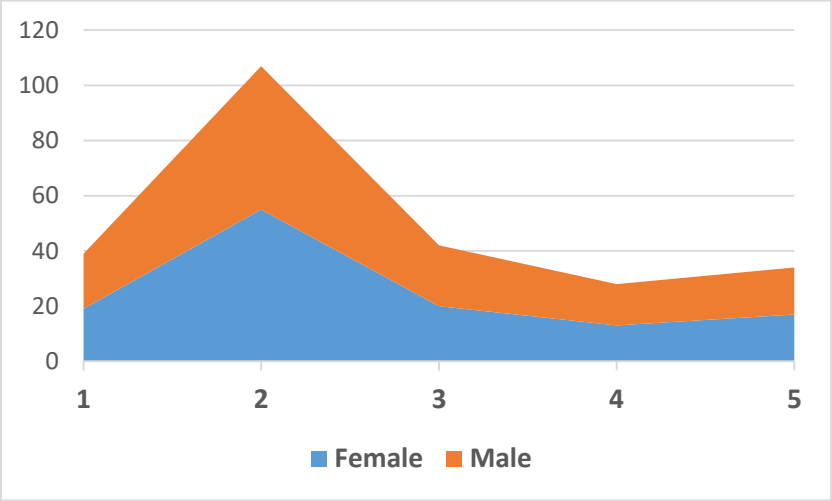


**Fig 1.** Depiction of grades by gender – overall score/success
*Source: Secondary data from the gymnasium, 2019, and Authors' own calculation*

From the overall results, it was noticed that the average success is slightly weaker in mathematics than in other subjects. The average grade in mathematics for the selected sample of students from the gymnasium is below the overall average, which is an unsatisfactory indicator. A similar situation, if not worse, maybe in other high schools in Kosovo until it is confirmed by studies. For the respective case study in question, the results for mathematics look like in Fig ure 2. The highest frequency in general, but also by gender, appears to be grade 2.

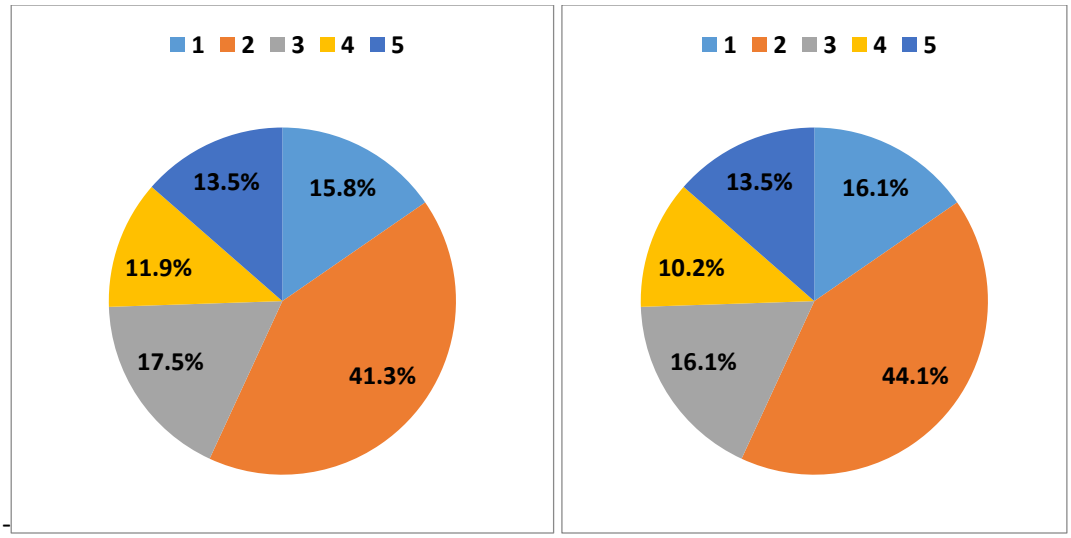


**Fig 2.** Grades by gender – overall score/success

*Source: Secondary data from the gymnasium, 2019, and Authors' own calculation.*

The share of grade 2 is higher among female students (44.3%) than for males (41.3%). The Fig ure of 13.5% in both genders is greater only in the cases with grade 4, and smaller than the rest of the grades. Taken in general the grades 4 and 5 in mathematics for the sample in the gymnasium, it turns out that only 1/4 of students have their scores inscribed as "very good" and "excellent." This can be considered a moderate achievement.

In addition to student grades, the source of primary data was the survey of 25 students, or 10% of them from the total sample of secondary data. As noted in the methodology section, the research with this group of students focused mainly on questions about motivation factors and/or their lack of achievement in mathematics. Although all the data collected can be presented and interpreted, we have selected the results from the ones that are more informative and meaningful. Out of a total of 25 students surveyed, only four of them reported having the highest grade (5), with another four having the next best grade (4). More of them or nine students reported having a grade 3, five with 2, and two with the poorest or failed grade 1. Only in two cases the result in mathematics was greater than or at least equal to, the grade of any other subject. The largest number of this group of students surveyed or 17 of them, had the lowest grade in mathematics than in other subjects. The mathematics curriculum was generally considered appropriate, with few students proposing that the textbooks should contain more exercises, tasks, tests, and clearer procedures for solving them. Over half of them find mathematics to be more difficult than other subjects. For this reason, the questionnaire also asked questions about motivation, the answers of which are summarized in the table below.

**Table 3.** Responses by students on motivation factors

| Motivation forms | Male | Female | Total |
|---|---|---|---|
| Teacher/methods | **3** | 1 | 4 |
| Self-determination | 2 | 1 | 3 |
| Overal success (environment) | **4** | **3** | **7** |
| Ambitions/future studies (expectations) | 2 | 2 | 4 |
| Participating in competitions | 1 | 1 | 2 |
| Fear and mandatory motivation | 1 | **3** | 4 |
| Other | 0 | 1 | 1 |
| **Total** | **13** | **12** | **25** |

*Source: Primary data of 25 students, 2019, and Authors' own calculation*

The most frequent motivation from this small survey about maths, is reported to the overall success, which suggests that the students are pushed to learn more this subject to not receive a grade below the average of other subjects. Some of them learn it out of the fear for ending up with the poorest result or failing. This applies to both men and women, with the exception of the response to compulsory motivation which is more common among the females. Ambitions for further studies are the motivating factor for two cases of men, and two others of women. In this regard, these respondents emphasize that maths is almost the key subject in tests when competing to enroll in college or university, so they are more committed to it at this stage. On the other hand, those who cite fear and compulsory motivation as a factor, give the reasoning that they do not intend to study in any faculty where mathematics enters as a key exam, but in some others where this subject is lacking. They see the learning of maths through compulsory motivation just as a procedure enough to get a passing grade, or not to fail or lose the schooling year because of one subject. Based on the answers received, *self-determination* as motivation is not so much found to be important (only in three cases), and a little more (in four cases) is given to the teacher as a source or factor of motivation, especially by male respondents. Participation in math competitions that is found in two occasions, is about one student who has taken part, and another who thinks he will pursue such events in the future.

## 5. Discussion of results and hypotheses

Testing the hypotheses set out is based on the Fig ures and results from the previous section, then from the descriptive assessments. Regardless of the smaller share of the greatest score with a grade 5, motivation as the driving factor of the best result is addressed as the merit of the teacher, which comes from teaching methods (tests, questions, homework, tasks, competitions), thus accepting the first hypothesis H1. The teacher with his/her approach and methods, such as the first one in the gymnasium who made the selection for math competitions and encouraged other students to feel enthusiastic about whether they will be chosen, is the driving factor of motivation. Hypothesis 2 “Fear is a mandatory factor of temporary motivation (lagging behind, loss of the year, disruption of overall success), is rejected. In support of this rejection, we refer to the finding that, when the general success in most subjects is higher, then there is a tendency even in maths to get a higher grade. This score does not come from merit or any motivation. We can rely a little on the assessment of two other teachers, who admit that they “freed their hand a little” in certain cases when gradin in maths based on the overall success of the student. So it is not about the student’s fear, but about preventing further demotivation on the part of the teacher. Hypothesis 3: “Motivation stems from the student (self-determination) due to higher ambitions (enrollment in the faculty, etc.)”, has not found enough base from the survey with 25 students, therefore it is rejected. The main motivation factor appears to be the teacher, even in cases where few students achieve self-determination such as participating in competitions and winning a prize, because, up to that point, the teacher paves the way with his/her approach and methods.

## 6. Conclusion and future research

As in other areas, many theories have been developed about mathematics and studies have been conducted about the motivation to teach and learn it. In this way, the intellectual and social aspects of mathematics become more sophisticated and advanced. Based on the factors, methods, and techniques of teaching mathematics, MEST has also prepared the core curriculum for high schools and gymnasiums, where from its review, we conclude that it does include the necessary instructions that should provide motivation and achievement in maths. However, the findings from our case study, apart from confirming the situation that is constantly emerging from the PISA test for Kosovo, show a discrepancy between good plans and poor results. Out of three categories of science, the results for maths remain weaker than in reading and science. Material, human, and motivational resources are being spent, and the result is an average poor performance in maths.

There is something wrong here between the plan and the results, with which we rejected two hypotheses and accepted the first or the one when the motivation for achievement comes from the teacher and his/her approach. As a teacher, having a little "free hand" when it comes to grading the student not only in maths but also in other subjects due to overall success, is not motivation but preventing demotivation. True, the student loses the entire schooling year because of failing in one subject – mathematics. Does the teacher have the right for giving the student a passing or higher grade? The teacher should not allow this situation to come or work to prevent it, therefore it is recommended that the teacher identifies the lack of motivation by the student earlier, and tightens the criteria for grading. When the criterion is set a little stricter that if you have a failing grade (1) only in mathematics and with it you will miss the school year, then this will serve as a warning and lesson for the next students. In this way, compulsory motivation should apply at an early stage to the students, sometimes even by punitive measures as a lesson to forthcoming students who may be more likely to choose the motivation by themselves as self-determination.

The main findings from descriptive statistics in this paper have a shortcoming due to small size samples with cross-section data. To validate these results or find them otherwise, it is recommended that future research on the same topic extends to include a larger sample across several gymnasiums for an extended period, for at least five years in a row with secondary data (grades in mathematics) to make a panel model. This would then be supplemented by cross-section primary data from a sample survey with students to estimate the significance of motivation factors in mathematics, from the first to the last year of schooling in the gymnasiums.

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