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## ANALYSIS OF STUDENTS' OUTCOMES FOR THE SUBJECT MATHEMATICS AT UNIVERSITY LEVEL

Lindita Loku, Mirjana Kocaleva, Biljana Zlatanovska,  
Natasha Stojkovicj and Aleksandar Krstev

**Abstract.** Education plays a significant role in each community because education is a process of gaining knowledge. We live in a world where mathematics is all around us, and it is the basis of all natural and technical science. Without mathematical knowledge, we cannot explain certain complex physical and natural phenomena, and cannot solve certain more complex problems of everyday life. For that purpose, students have to learn at least mathematics at university level (low-level mathematics aimed for all university students, no matter at which faculty they study). In this paper, research is aimed at data analysis of student's outcomes for the subject mathematics at university level. The results obtained from the overall testing will be processed with statistical data analysis (demographic characteristics, descriptive statistics, frequency distribution).

**Keywords.** *Education, testing, statistical analysis, teaching.*

### 1. Introduction

Education is the most important discovery of humankind and it is the process of acquiring knowledge, learning things, experiencing ideas. Otherwise, education is not only the process of receiving knowledge, but it also teaches humanity and persons to respect each other. Education includes different educational techniques and methods such as lecture method, storytelling, learning by doing etc. Generally, there is preschool, primary, secondary and higher (university) level of education [1], [3] and [4]. Education can be formal, informal and non-formal as is shown in Figure 1.

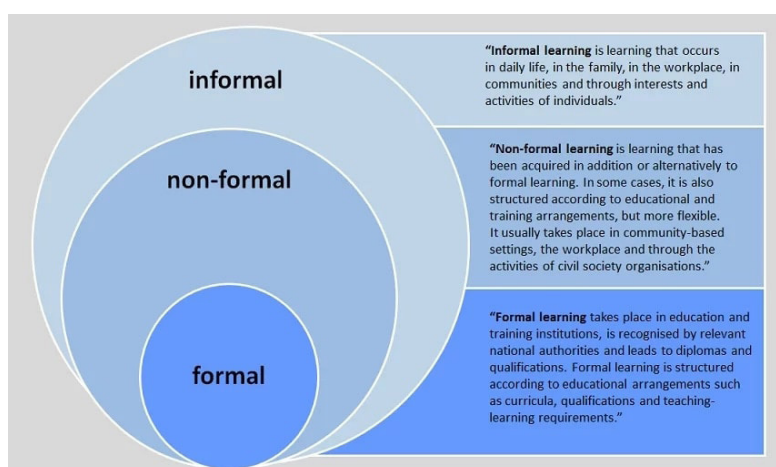


Figure 1. *Types of education [5]*

Formal education takes place in school (classroom), with a teacher; it is hierarchical, full time, subject oriented, with predefined curriculum content and with a certificate. Informal education is some somewhat self-learning, practical learning and learning examples from real life, without a predefined curriculum content and has no timetable. Non-formal education is a very long process and it includes learning from home, from experience, from work and environment and has no age limit [5], [6]. We will focus on formal education and a university level mathematics e-test. The curriculum is on low-level, because this mathematics is intended for all university students.

Research into mathematics education is a growing discipline and an interesting field of research, especially research about learning problems at university level [13], [14], [15]. Holton, D., & Artigue, M. (Eds.) [13] talk about teaching and learning of mathematics at university level. One part of their research is the issue of why the number of university student increased but not the number of



mathematical student as well. Nardi E. in his book offers a unique perspective on the ways in which mathematicians perceive their students' learning, teach and reflect on their teaching practice and on how they perceive the often fragile relationship between the communities of mathematics and mathematics education. Crawford, K. et al. in their paper present the different experiences of learning mathematics at university. The paper [15] reports research of university students in the first year into the conceptions of mathematics. A survey based on students' conceptions of mathematics was developed and issued to students two times (at the beginning of the year and after one semester). The results recommend two different experiences of learning mathematics.

Students' attitude towards learning mathematics is also a good topic for research. This topic is discussed in the papers [10], [11], [12]. "Students' success in mathematics depends upon attitude towards mathematics" [10]. Farooq, M. S., and Shah, S. Z. U. [10] made a survey about students' attitudes towards mathematics. The survey was conducted on 685 students (male = 379 and female = 306). The students were 10<sup>th</sup> grade and selected from 10 schools. With descriptive statistics and t-test was concluded that males and females have the same type of attitude towards learning. Hannula, M. S. [11] in his article suggests a new framework for analysing learning attitude towards mathematics. He identified four evaluative processes as aspects of attitude: emotions aroused in the situation, emotions associated with the stimuli, expected consequences, and relating the situation to personal values. A case study of a lower secondary school student will be analysed in the paper. The case study will describe the negative attitude towards mathematics, and then will examine how negative emotions were developed during problem solving situations. The purpose of Zakaria E. et al. study was to determine the effect of cooperative learning on mathematics achievement and attitude towards mathematics. Their study was carried out on two form one classes in Miri, Sarawak (one class, experimental group with 44 respondents and the other, control group with 38 respondents). The two groups were pre-tested and post-tested after implementation. The results of this study showed that cooperative learning methods improve students' achievement in mathematics and their attitude towards mathematics.

## 2. Research methodology and statistical data analysis

The aim of this research is considering the student knowledge in the subject mathematics at university level. The course content teaches the basics of mathematics such as elements of mathematical logic (statements, statement operations, statement formulas, locking rules, tautology, contradiction), scales and proportions, basic concepts of number theory (divisibility, congruence's), matrices (matrix operations, determinants), equations and inequalities (systems of equations and inequalities and methods of solving them), combinatory (principles of counting), real numbers arrays, functions, elements of probability theory, elements of statistics.

The sample of tested students consists of 47 students from different faculties (Table 1). The test was not a traditional one, it was an e-test performed on a computer. The e-test had 60 questions divided into 4 groups: true/ false, multiple choice, matching and one choice question. The questions covered short assignments, recognition and application of formulas as well as definitions that define basic mathematical terms necessary for their knowledge and are crucial for successful passing of the course exam. The time planned for testing was 45 minutes and the maximum score was 90 points. For a student to pass the exam 46 points were needed, or 51% of the total points [2], [7], [9].

Table 1. *Demographic characteristics of respondents*

Demographic characteristics		Number	Percentage
Gender	Male	28	59.57 %
	Female	19	40.43 %

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Faculty	Faculty of Law	2	4.25 %
	Faculty of Agriculture	10	21.28 %
	Faculty of Mechanical Engineering	1	2.13 %
	Faculty of Tourism and Business Logistics	13	27.66 %
	Faculty of Philology	20	42.55 %
	Undeclared	1	2.13 %

The results obtained for students' learning outcomes are presented in Table 2 with descriptive statistics and in Table 3 and Figure 3 with frequency distribution. The total number of students is 25. From the maximum number of points 90 that can be gained, we can see that the obtained mean is 43.53489 or the mean value is low. The maximum number of gained points is 77.25 and the minimum is zero. Standard deviation is 12, 55846.

Table 2. Descriptive statistics

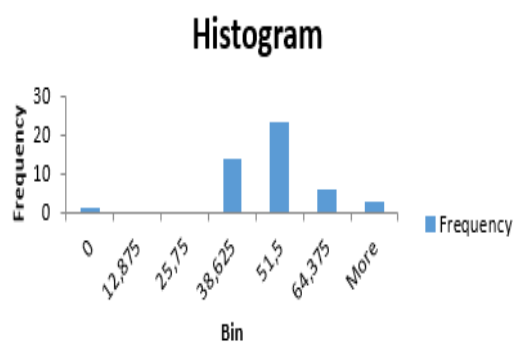
Mean	43,53489
Standard Error	1,83184
Median	41,25
Mode	35,25
Standard Deviation	12,55846
Sample Variance	157,715
Kurtosis	3,198134
Skewness	-0,0146
Range	77,25
Minimum	0
Maximum	77,25
Sum	2046,14
Count	47

Frequency distributions organize and present the frequency visually in order to interpret the results more easily. A frequency distribution of data can be shown in a table or graph (histogram). One student has 0 points. There is no student who has points in the interval from 0 to 25.75. Fourteen students have achieved from 25,75 to 38,625 points. Most of the students, or 48.94% of them, have gained from 38,625 to 51,5 points. The rest 9 students have more than 51.5 points.

Table 3. Frequency table

group	score	Absolute frequency	Relative frequency
1	0	1	2.13%
2	from 0 to 12	0	0%
3	from 12,875 to 25,75	0	0%
4	from 25,75 to 38,625	14	29.78%
5	from 38,625 to 51,5	23	48.95%
6	From 51,5 to 64,375	6	12.76%
7	>64,375	3	6.38%
total		47	100 %

Figure 2. Frequency histogram



The results from Figure 2 show that we have the smallest percentage for the students who obtained more than 64.375 points. Students have not obtained a score lower than 25.75. The high percentage, or over 48.95% of students, have between 38.625 and 51.5 points. These results are not good because we have a maximum score of 90, and we do not have many students with more than 46 points [8]. This description is given in Table 3 using quartiles.

Table 3 *Quartiles*

Q1	36,5
Q2	41,25
Q3	48,38

### 3. Discussion and conclusion

Maybe learning mathematics is harder when students have to learn the entire course' content alone, without instructions from a teacher. Maybe in addition to the teaching materials we should introduce classes and exercises for students in order to gain at least the fundamentals of the subject.

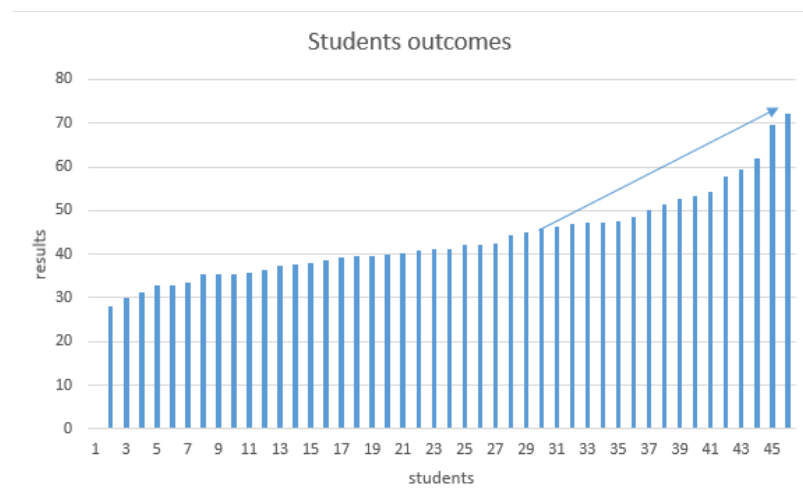


Figure 3. Student's outcomes

Figure 3 presents students' outcomes and we can see that only 18 out of 47 or 38.3 % passed the exam. According to our student assessment system, the greatest grade will be nine (above 74 points). More precisely, there will be twelve students with grade 6, three with grade 7, two with grade 8 and only one with grade 9. The average grade of this group of 18 passed student is 6.56. From the results obtained with e – testing it can be concluded that the results are not so good and we recommend a formal way of learning against informal or non-formal.

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