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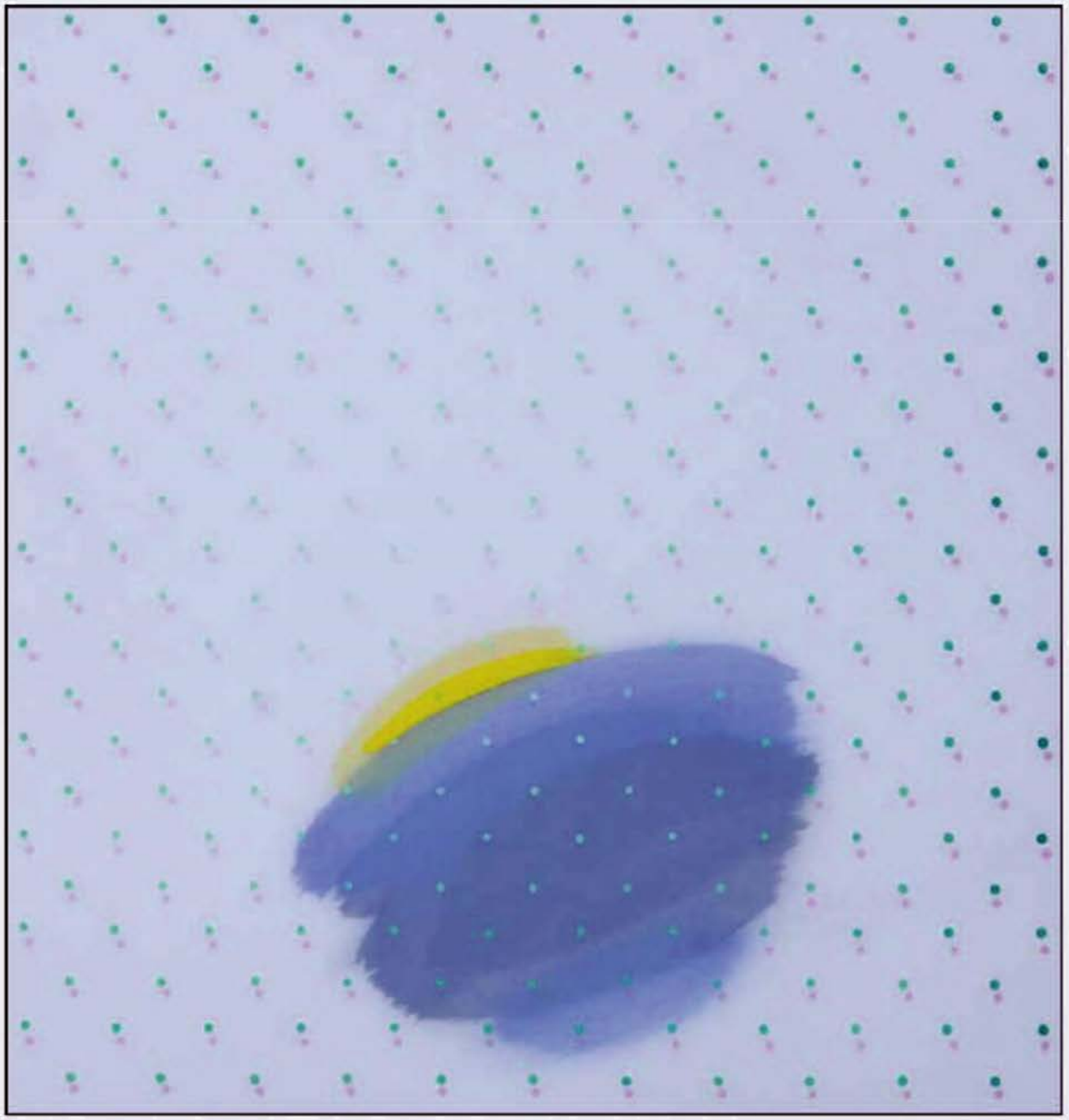

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Contents

Statistical Analysis of Student Achievement Using Different Ways of Learning

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Abstract

Education is a part of every human life. Till this year in our country we use to learn on traditional, classical way using whiteboard and presentations to present subject curriculum. But, this year the situation in education environments was dramatically changed. This situation was caused by pandemic which oculate the whole world and she led to online learning. In this paper will be analyzed and compared the results of the final exam for the subject Operating Systems for the students from different academic year: one from academic year 2018/2019 when the teaching was performed in a classical way and the second one from academic year 2019/2020 when the teaching was performed online through the platform Microsoft Teams. Both group of students are from Faculty of computer science at University "Goce Delcev"– Stip and they study the subject Operating Systems in the fourth semester. The aim of the paper is using descriptive statistics and other statistical methods (frequency distribution and correlation) to draw a conclusion which way of learning gives better results in student achievement.

Ccs concepts

- *Probability and statistics • Education • Mathematical analysis*

Keywords: *Education, learning, statistical analysis.*

1 Introduction

Education is one of the most important processes for the development of a society. That is why the education process is researched, described in many papers and is most often a motivation for writing. This paper is also derived from the idea to research education, i.e. to investigate the results achieved by students after the changes in the educational process imposed by the pandemic that occurred with the virus COVID 19 and the introduction of online teaching. The purpose of this paper is to compare the results of students in the final exam after classical teaching and after online teaching in the same subject. The students are from the Faculty of computer science at University Goce Delchev - Stip and an analysis was made for the subject operating systems. The results of the students' achievements will be listed first and then a statistical analysis of the results will be given. In the end a conclusion will be drawn.

University Goce Delcev Stip had policy fully implement ICT in all segments of management, administration and teaching a long time ago [2]. The purpose of [2] is understanding teaching staff acceptance and use e-Learning system. In accordance with this to state that after 2010 year the teaching process at the University "Goce Delcev" Stip has been changing by usage of the e-learning methods. [10] compares the achievements of students in Math 1 who use Moodle as a teaching tool with those who does not. Authors conclude how e-learning impacts on the success of the students based on the results obtained.

The main aim of [5] is to analyze the situation about such educational e-platforms for studying mathematics in Macedonia and neighbored region. [4] is about the habits and competences of IT students in the use of information technology resources. The goal of authors is to assess what the opportunities provided by the Internet have been used for in terms of learning and development. The obtained results can help them to develop and improve virtual learning environments, as well as create an improved form and content of online courses in the future.

Authors in [1] analyse the impact of the knowledge acquired from the previous mathematical education in correlation with knowledge gained from lectures and exercises in Mathematics in technical faculties at University Goce Delchev - Stip so that one part of these students are tested with electronic tests, and the other part are tested on classical way. The authors conclude that both ways i.e. classical and electronic diverge each other and we cannot precisely define what results are less reliable.

The challenge of the modern educational process is to include the multimedia and interactive materials. The educational e-platforms for studying mathematics are helping teachers and students at the same time. The teachers can analyze the students' success after every lesson and can adapt the materials for their needs, students can communicate with the other students and teacher. However, there is a lack of such materials especially in our and the neighbor countries. The main aim of [5] is to analyze the situation about such educational e-platforms for studying mathematics in Macedonia and neighbored region.

Sometimes because students have more partial exams in one session they are not sufficiently

prepared for the exams. So, goal of authors in [6] is to discover whether students achieve better results if we allow them to make corrective partial exam or not? For that purpose, authors chose the subject Digital logic and they analyzed the results of partial exam and corrective partial exam in the academic year 2016/2017.

[3] is focused on processes of modernization of teaching mathematics in primary schools by using ICT. The empirical results from the realized research shows that the Macedonian educational system should introduced and practiced ICT for math teaching. The subject of [8] is determination the students' attitude towards mathematics in the higher classes in the secondary schools, in Stip, Republic of Macedonia. In research [9] authors investigate the factors that affect the motivation of teachers to use ICT in their teaching and maintain the same.

In [7] authors say that demonstration and visualization play an important role in the teaching process of the subject mathematics in primary, secondary schools and universities. They make the teaching content interesting and accessible, especially when technical devices are used. They process mathematical content (algebra, geometry, analysis) in two different ways (some with GeoGebra and on a computer, and others without visualization and GeoGebra) then they done testing, compared the results and a conclusion drawn.

The realizations, with a special review to the educational area in mathematics, have been presented in [11].

2 Statistical data analysis

The aim of this paper is to analyse students' achievements for the subject Operating Systems (OS). This subject is mandatory for Computer Science students in second year of studies. Students are learning some fundamentals for OS, the architecture of OS, types, algorithms for process distribution, they also solve tasks, write shell scripts, terminal commands (in Linux OS) and make some projects. There are two partial exams and final exam for the subject. For data analysing, the results from the final exam from two group of students are used and respectively the grade obtained after the final exam. Two group of students were tested: 43 students in the first group on traditional way and 60 in the second group - online. First group of students studied on classical way using whiteboard and presentations to present subject curriculum. Also, the exams were performed on classical way - in a classroom. Students were physical present in universities, until Marth when disease (CORONA virus) appear. According to the situation the second group of students used to learn from home. They had presentation of subject curriculum online and they used to take exams online. Microsoft Teams platform was used for online studying at all. Students were forbidden to have physical contact with academic staff everywhere in the world, so in our country was the same situation. As academics we respected the situation and we adapted to the new situation.

Table 1: Groups of students

Gender / group	2018/2019	2019/2020
male	26	30
female	17	30
summary	43	60

For each subject student can gain maximum 100 points, 70 from exams – partially and final exam, 10 from paperwork and 20 from presents. To pass the subject they should have minimum 51% or 51 points. According to points students have grade from five to ten. Grade five means that students didn't pass the exam and they must take the exam again. From table 2 for classical students we can see that only six students have grade above eight, 27 under eight and 14 students didn't pass the exam. The table shows that we are talking about weak generation of students, because 32.56% from 100% didn't pass the exam and 53.49% had grade six and seven.

Table 2: Classical students

grades	number of students	cumulative number	valid percent	cumulative percent
5	14	14	32.56	32.56
6	13	27	30.23	62.79
7	10	37	23.26	86.05
8	1	38	2.32	88.37
9	3	41	6.98	95.35
10	2	43	4.65	100
summary	0	43	0	

From table 3 for online students we can see that there are also a few students - only 16 with grade above eight. That is 26.68% from 100%. The number of students who didn't pass the exam is three. The rest of 68.32% had grade six and seven. If we compare two tables table 2 and table 3, we can conclude that according to grades frequencies the group of online students have better results than classical students. There are 12.73% online students more than classical students with grade above eight and 27.56% online students more than classical with grade five. The number of students with grades six and seven is almost the same in both groups.

Table 3: Online students

grades	number of students	cumulative number	valid percent	cumulative percent
5	3	3	5	5
6	28	31	46.66	51.66
7	13	44	21.66	73.32
8	4	48	6.67	79.99
9	4	52	6.67	86.66
10	8	60	13.34	100
summary	0	60	0	

Descriptive statistics give us information about mean, standard error, median, mode, standard deviation. From table 4 we can conclude the following. First the mean grade for online students is bigger than classical students. Median have the same value for both groups of students. From mode we can see that the number of passed students with grade 6 is most represent at online students, but in the group of classical students the number of students who didn't pass the exam is most represent. That means that online students have better results than classical students. Standard deviation is a measure of how far each observed value is from the mean. In our paper the standard deviation is also bigger for online students instead classical students. The range between a maximum and a minimum grade is 5 and is same for both groups of students. The minimum grade is 5, the maximum is 10 for both groups.

Table 4: Descriptive statistics for generation 2018/2019 (classical students) and generation 2019/2020 (online students)

Classical students		*Online students*	
Mean	6.348837209	Mean	7.033333333
Standard Error	0.212780259	Standard Error	0.193052592
Median	6	Median	6
Mode	5	Mode	6
Standard Deviation	1.395293465	Standard Deviation	1.495378946
Sample Variance	1.946843854	Sample Variance	2.236158192
Kurtosis	0.82722196	Kurtosis	-0.283584323
Skewness	1.154629049	Skewness	0.979500506
Range	5	Range	5
Minimum	5	Minimum	5
Maximum	10	Maximum	10
Sum	273	Sum	422
Count	43	Count	60

Correlation is a statistic that measures the degree to which two variables move in relation to each other. We are going to present correlation between two generation of students, one from academic 2018/2019 when the learning process was classical and on the other side the second generation from academic 2019/2020 when the learning process was online via internet. A correlation coefficient that is greater than zero indicates a positive relationship between two variables. From figure 1 we can see that there is a positive correlation with R= 0.759126. This means the two variables moved in the same direction together.

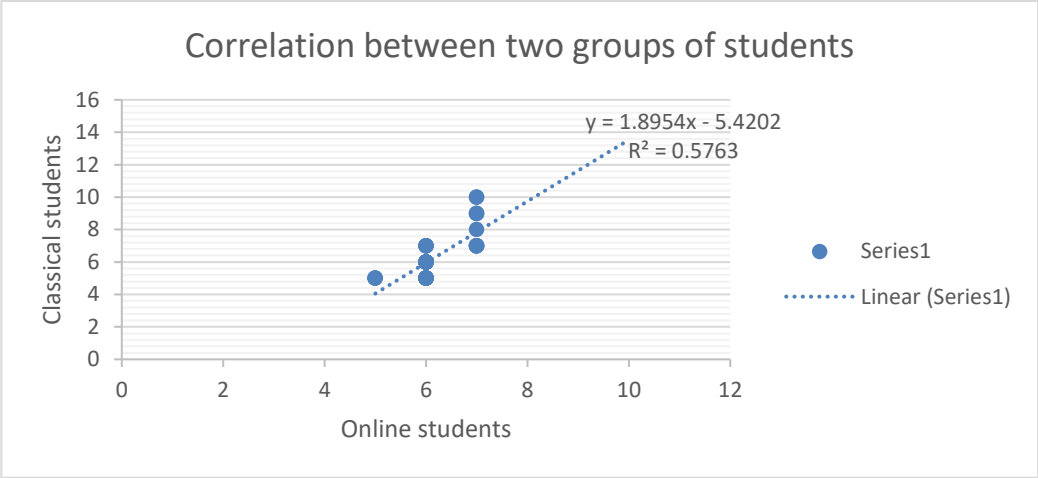

Figure 1: Correlation between two groups of students

3 Conclusion

All over the world teaching is online and students learn from home, without travel expenses and without wasting time. They listen lectures and exercises at fixed time, but also can watch them offline in time they want to. In our university because of CORONA virus, lectures and exercises was conducted from home at fixed time, but also students could record us and listen to our exercises and lectures later.

From statistical analysis we can draw a conclusion that online group of students have better results than classical group of students. According to this we can conclude that online learning is not a bad approach to working with students at all.

We also conducted some questionnaires in the paper [12] to see students' opinion on online teaching. We conclude that students prefer classical teaching vs online teaching. They accepted this style of learning only in this condition (during the pandemic).

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