WHAT IS THE DIFFERENCE BETWEEN MOTIVATION TO LEARN MATHEMATICS IN UNIVERSITY AND IN COLLEGE?

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Abstract

Purpose—*This paper examines whether there is significant difference between Mykolas Romeris University and College of Applied Social Sciences students, their knowledge of Mathematics acquired at school, and the choice to take the final Mathematics examination or not; and their further studying results and motivation.*

Design/methodology/approach—*Test results are analysed by statistical hypothesis testing methods.*

Findings—*The motivation of University students, who have taken the Mathematics examination, to study and achieve better results, is stronger.*

Research limitations/implications—*the represented method is one of the ways to inquiry of such problems.*

Practical implications—*This study will help to identify the University and College students' weaknesses and to show ways to improve the quality of studies.*

Originality/Value—*The study should allow to measure the average time it takes University and College students of social sciences to understand a mathematical text.*

Keywords: *teaching mathematics, checking knowledge tests, quality of studies, statistical methods.*

Research type: *research paper.*

1. Introduction

The modern process of studying social sciences is hardly imaginable without information technology. It can be stated that many lecturers use computer presentations, e-books intended for self-studies, summaries of lectures, provide links to open online resources, and consult students via e-mail. Study material is supplied in the internet service web-sites or special educational service servers ("Moodle", "WebCT" et al.). Many study programs besides the traditional study methods attempt to apply distance learning-specific methods: online self-study material, continuous monitoring of study progress, teamwork (Mickus, Vydžiūnas, 2009). It is a way to cut classroom working hours in full-time studies, to promote self-studying of students and to increase students' participation in the study process as well as enhance overall performance (Rumble, 2001).

These trends are perhaps justified in teaching information technology or other social disciplines, where students can work independently at home and consult the lecturer in the classroom and report on the work carried out independently. However, in teaching Mathematics not only to social science students, one might face a problem where students, studying independently, do not understand the essence of definitions, the proof of a theorem, and are not able to work with the mathematical literature. The same problem occurs in the process of college studies. Therefore, the ongoing researches of evaluating the knowledge of Mathematics among students of social sciences try to verify the idea that it is necessary not to reduce but to increase the classroom instruction time of mathematical disciplines for social science students (Gudelytė et al., 2010). What is more, teaching in smaller groups of students, in the hope that a closer collaboration between students will provide for more effective apprehension of information, as it is still debatable whether any "smart" method can substitute direct communication of students and lecturers.

The aim of this paper is to analyse whether there is a substantial difference between Mykolas Romeris university and the college of Applied Social Sciences students' level of knowledge of Mathematics acquired in school and the choice to take the final Mathematics examination or not, and their further studying results and motivation.[1] A

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1   Motivated students are those who, upon leaving school, have taken the mathematics examination and attended lectures and practical trainings during the semester (Credé *et al*., 2010). Those who have not taken the mathematics examination are considered as little motivated.

rhetorical question arises of whether university and college students of social studies are capable of self-studying mathematical subjects, and whether so aggressively suggested new "smart" study methods really are useful for teaching basic science disciplines, which nowadays social sciences students can hardly do without. On the other hand, given the recent tendencies in the labour market, and particularly the unemployment rate of young people with higher education degree in social sciences, there is a reason to believe that it is because of the lack of fundamental knowledge, they do not acquire the necessary qualification and lose the opportunity to quickly improve necessary skills and compensate for the lack of competitiveness in the labour market against their peers, who had studied, for example, Econometrics or Financial Mathematics in other high schools, and so few of them work in the field of obtained education.

The specifics of teaching Mathematics to the population of investigated students is that students of social sciences programs are being taught only one semester, which is much less compared to specialities in exact sciences, where the Higher Mathematics is being taught for three to four semesters (Saldauskienė, Virkutis, 2005) and students are more motivated to study exact sciences. Working with students in the social sciences, a recurring question is whether it is sufficient to have two weekly lectures to fully understand the taught mathematical subject. In addition, the majority of these students are not motivated, for most of them it is not clear what Mathematics is used for in such study programs as Public Administration, International Business.

2. Theoretical Background

Mathematical disciplines are important for the social sciences, which apply many various quantitative methods. The comprehension of mathematical subject must be based on knowledge acquired in school, analytical skills and deductive reasoning (Gudelytė et al., 2011).

Applied mathematics course in College as well as in University has only the most necessary and "minimal" in their content subjects: Basics Linear Algebra (operations with matrices and determinants), Linear Programming; which are based on linear methods and could be taught at school, and enable students to make estimated, accurate, although limited by the rigorous assumptions, decision. College without mentioned subjects has the Theory of Probabilities and Mathematical Statistics necessary for data analysis in Course and Final Papers, for future practical work, where students might need rather simple, but statistically-based assessments of various phenomena (such as how income from the sales of ice cream depends on the number of sunny days, air temperature, soft drink consumption and other factors). On the other hand, let us not dismiss the possibility that College graduates have the opportunity to pursue University studies and therefore the importance of mathematical skills is much more pressing than it may seem at first glance. Besides the course of Algebra, University students of social sciences usually are being taught the introductory course of Mathematical Analysis, helping to acquire basic framework of models Financial Mathematics, Economic Equilibrium, which are outlined

as abstract social phenomena (such as Economic Equilibrium models), the simplest and fundamental solutions of the resulting problems. Weak students' motivation (Kornhaber, 2004; Brookhart et al., 2003) to study mathematical subjects can be explained by laziness and erroneous belief prevailing among society that it is sufficient only being able to summarize the results correctly in the majority of Economic disciplines (Mohun, Veneziani, 2012) (especially Accounting). Unfortunately, the real need for mathematical knowledge not only has not decreased but increased significantly (for example, the implementation of the Basel III agreement on capital adequacy and strengthening supervision of financial institutions will bring additional liquidity risk indicators and developed techniques, that will have to be implemented in the future (International convergence of capital measurement and capital standards, 2004)), therefore low level of knowledge of Mathematics can become a serious problem for graduates in the labour market. It is becoming clear that the limitation of the mathematical disciplines in the process of studies of social sciences is flawed, and in the long run—even a destructive phenomenon (especially for study programs related to the traditionally very popular among the students program of Financial Management, since in the last decades there has made particularly serious progress of risk assessment in the world (Valvonis, 2006; Leipus, Valužis, 2006), and understanding of methods applied in practice the trivial knowledge of mathematics is no longer sufficient), which is partially confirmed by this research. In addition, such a limited course raises the risk that a number of economical subjects after a while will not be able to be taught to social sciences university students just because they, with these subjects of mathematical disciplines with this level of classroom work, will not be ready. However it will not be analysed in this paper.

It seems to be recognised that the content of mathematical subject taught at schools within the last decade has weakened (Cibulskaitė, 2011), it seems not engrossing to students and the system of education has formed a desire to reduce the volume of these disciplines. Naturally, the high schools are forced to react, even though the search of how to do that without undermining the quality of studies still remains a search, otherwise it is increased the demand to apply mathematical models in social researches.

On the other hand, it is possible to believe that the mathematically weak social sciences program are partly based on the belief that modern software (in particular, statistical packages, open source mathematical package, at least a part of which is also available free of charge) provides students with more opportunities for limiting themselves with only descriptive statistics and analysis of even complex social phenomena without a deeper knowledge of fundamental mathematics or statistics. In such cases, it becomes much more important that students should have acquired the basics of logical thinking (which must also be given at school) and should be able to formulate tasks correctly, define the different types of social phenomena variables and assume the stages of their solutions (Stodolsky, 1988). Unfortunately, it seems to be concluded that in this aspect the mathematical disciplines would be useful for educating students in a coherent and deductive thinking.

As the need for mathematical knowledge for social science students at a university or college due to the content similarity is basically the same, the complexity of the

mathematical discipline should be similar as well. It is therefore important to clarify whether university and college students of the social sciences should be given equal classroom work time, for whom it is more difficult to work independently with a mathematical text. Another purpose of this study is to explore the relationship between their students' motivation and their further studying results (Zerpa et al., 2011).

3. Research Methodology

Interviewed were 176 Mykolas Romeris University Public Administration degree program full-time second year students and 33 College of Applied Social Sciences Business, International Business and Banking degree programs full-time first year students in this research. It can be stated that these students' resolve to choose to study social sciences partially determined the fact that there is necessary a little knowledge of mathematics in this field of studies. The survey was conducted during one mid-semester lecture. It was attempted to determine how students understand the mathematical text and their ability to answer the questions, based on the examples and definitions in the text. The text focused on the theory of sequences and limits of functions (Gudelyte et al., 2010; Gudelyte et al., 2011). The test (Krylovas et al., 2007; Krylovas et al., 2002), which will have allowed students to get extra points, has been announced in advance. However, only 59% of University (176 of 284) and 85% of College (33 of 125) students participated in the experiment. It shows the indifferent students' motivation seeking for the highest rating. The samples are not compared bluntly because College accept much less students than University.

Table 1. Types of final Mathematics examinations, which students have taken at school

	University students		College students	
Have not taken examination	45	25%	7	21%
Have taken national examination	74	42%	22	67%
Have taken scholastic examination	54	30%	4	12%
Have not pointed	5	3%	0	0%

Table 2. Attendance of students at practical training

	College students' attendance	University students' attendance
Number of students	33	178
Mean	16	18
Median	18	19
Mode	22	22
Standard Deviation	5	5

4. Results and Findings

Analysis of the obtained data reveals the following results: the mean of University students for the pilot test on the theory of sequences and limits of functions is 9.12 (out of possible 18 points), and 5 among College students, showing that student motivation to independently study for the test was low. The University students have been passed this pilot test better than College students (Figure 1).
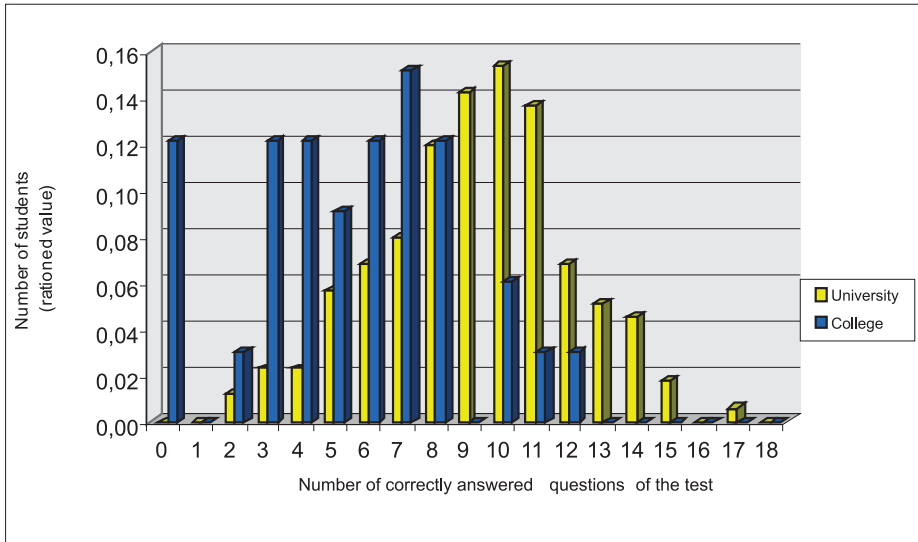

Figure 1. Distribution (normal value) of University and College students' correctly answered questions

The dependence of University and College students' attendance and final evaluation of mathematical subject is checked by calculating Person correlation coefficient. It is got that University and College students' statistically significance p of relation (Asymp. Sig (2-sided) is statistically very significant, i.e. $p < \alpha = 0.01$ for University students and $p < \alpha = 0.05$ for College students.

Value of the Person correlation coefficient for University students is 0.659; it shows an average strong relation. Value of the Person correlation coefficient for College students is 0.352; it shows the weak relation between attendance and the final results (Table 3).

Table 3. The dependence of the students' practical training attendance and the final results

Correlations				
Type of organization			score of the examination	attendance
University	score of the examination	Pearson Correlation	1	0,659**
		Sig. (2-tailed)		0,000
		N	178	178
	attendance	Pearson Correlation	0,659**	1
		Sig. (2-tailed)	,000	
		N	178	178
College	score of the examination	Pearson Correlation	1	0,352*
		Sig. (2-tailed)		0,044
		N	33	33
	attendance	Pearson Correlation	0,352*	1
		Sig. (2-tailed)	0,044	
		N	33	33
**. Correlation is significant at the 0.01 level (2-tailed).				
*. Correlation is significant at the 0.05 level (2-tailed).				

After the statistical calculations it is possible to confirm the conclusion that the motivation, which is understood as students' practical trainings attendance (Table 2), to study mathematical subjects and taking final Mathematics examination at school (Table 1), determines better results of the pilot test and final evaluation of mathematical subject (Table 3).

University students, who have taken the Mathematics examination more attended practical trainings (mean is 18.48 out of 22) and got higher average scores from final evaluation of the subject (mean is 7 out of 10). The mean of the students who have not taken the Mathematics examination, are following: attendance is 13.96; final evaluation of the subject is 4.09.

The mean of College students who have taken the Mathematics examination, attendance is 15.6 and 2.9 from final evaluation of the subject. The means of students who have not taken the Mathematics examination are as follows: attendance is 15.74; final evaluation of the subject is 3.08.

It could not be said that the attendance of the College students has influence on the final results of the mathematical subject. We can reason that there are more weakly in mathematics students in College and they have to have more hours of Mathematics to complete vacancy in knowledge of school mathematics.

In order to be sure that the means of University and College students who have taken and have not taken the Mathematics examination, attendance statistically significantly varies. Student criteria is checked for the hypothesis:

H_0: the means of University students who have taken and have not taken the Mathematics examination at school, practical trainings attendance are equal.

H_1: the means of University students who have taken and have not taken the Mathematics examination at school, practical trainings attendance are different.

Since p = 0.000 < α = 0.05, hypothesis H_0 is refuted and a conclusion is drawn that the means of University students', who have taken and have not taken the Mathematics examination at school, are different, i. e. statistically significantly varies.

Here is hypothesis for College students:

H_0: the means of College students who have taken and have not taken the Mathematics examination at school, practical trainings attendance are equal.

H_1: the means of College students who have taken and have not taken the Mathematics examination at school, practical trainings attendance are different.

Since p = 0.000 < α = 0.05, hypothesis H_0 is refuted and a conclusion is drawn that the means of College students who have taken and have not taken the Mathematics examination at school, are different, i. e. statistically significantly varies.

There are also checked another two hypothesises:

H_0: the means of University and College students pilot test results are equal.

H_1: the means of University and College students pilot test results are different.

Since p = 0.000 < α = 0.05, hypothesis H_0 is refuted and a conclusion is drawn that the means of University and College students' the pilot test results are different, i.e. statistically significantly varies.

Based on this data, it becomes clear that both the weaker students' of University and College motivation to study, as well as their attendance is declining, which in turn affects the final results, and vice versa: the motivation of the best students is increasing, because their attendance is by far the highest, and the results—statistically best.

It is obvious that the knowledge acquired in school and the choice to take the Mathematics examination at school motivated the University and College students more to prepare for the pilot test than those who have not taken the Mathematics examination.

On the other hand, descriptive statistics showed that in order to guarantee 50% possibility of positive results of the final evaluation of this mathematical subject, University students had to attend 14 out of the 22 practical trainings, College students—20 out of 22. However, due to the little number of College students, it requires exhaustive inquiry of their motivation (see Table 4).

Table 4. The influence of the students' practical training attendance on the final evaluation of student knowledge

University students' attendance	Pass-rate	College students' attendance	Pass-rate
Less than 22	100	Less than 22	100
Less than 21	78.13	Less than 21	100
Less than 20	75.00	Less than 20	50
Less than 19	80.00	Less than 19	100
Less than 18	62.50	Less than 18	33,3
Less than 17	83.33	Less than 17	100
Less than 16	55.56	Less than 16	100
Less than 15	50.00	Less than 15	0
Less than 14	50.50	Less than 14	100

5. Conclusions

It can be statistically ascertained that the practical training attendance directly influences student study results. There is a strong correlation between University student attendance and final evaluation of mathematical subject in the end of the semester and weak dependence of College students. There is drawn a conclusion that even if there is a student's casual attitude towards mathematical subject, it is possible to achieve their better results, if there would be increased hours of lecturing on mathematical disciplines and student attendance would be obligatory. It can be reasonably stated that the students' attendance and the choice to take Mathematics examination at school determines better the University and College students' results. Obviously it is hard to independently study the mathematical subjects for University and College students of social sciences. On the other hand, students' motivation problem remains a challenge for educators: as the mathematical disciplines are not engrossing for most of those studying social sciences, there is the goal to engage students with relevant examples and engrossing form of mathematical subject, and it would increase student's attendance, motivation and activity during practical trainings, thereby it would raise the students' competence level.

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UNIVERSITETO IR KOLEGIJOS STUDENTŲ GEBĖJIMO STUDIJUOTI SAVARANKIŠKAI PALYGINIMAS

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Santrauka. *Šio straipsnio tikslas yra išanalizuoti, ar yra reikšmingas skirtumas tarp universiteto ir kolegijos studentų mokykloje įgytų matematikos žinių lygio bei pasirinkimo laikyti baigiamąjį egzaminą ir tolesnių jų mokymosi rezultatų, motyvacijos. Kyla retorinis klausimas, ar socialinių studijų krypties studentai universitete ir kolegijoje yra pajėgūs sa-varankiškai studijuoti matematikos dalykus, ir ar taip agresyviai siūlomi nauji „išmanūs" studijų metodai išties būtų naudingi dėstant fundamentaliųjų mokslų disciplinas, be kurių šiais laikais sunkiai išsiverčia socialinių mokslų studentai. Kita vertus, atsižvelgiant į pas-kutiniąsias tendencijas darbo rinkoje, ir ypač į jaunų žmonių, įgijusių aukštąjį socialinių mokslų išsilavinimą, nedarbo lygį, atsiranda pagrindas manyti, kad būtent dėl fundamen-taliųjų mokslų žinių stokos jie neįgyja reikiamos kvalifikacijos ir praranda galimybę spar-čiai tobulinti reikiamus įgūdžius bei kompensuoti konkurencingumo trūkumą darbo rinkoje prieš savo bendraamžius, studijavusius, pvz., ekonometriją ar finansų matematiką kitose aukštosiose mokyklose, ir todėl retas jų dirba darbą pagal įgytą išsilavinimą.*

Kadangi matematinių žinių poreikis socialinių mokslų studentams universitete ar ko-legijoje dėl sprendžiamų problemų turinio panašumo yra iš esmės vienodas, tai ir matema-tinės disciplinos sudėtingumas panašus. Svarbu išsiaiškinti, ar socialinių mokslų studentams universitete ir kolegijoje reikia skirti vienodą auditorinio darbo trukmę, kuriems iš jų sekasi sunkiau dirbti savarankiškai su matematiniu tekstu.

Tyrime dalyvavo 178 Mykolo Romerio universiteto Viešojo administravimo studijų programos nuolatinių bakalauro studijų antro kurso studentai bei 33 Socialinių mokslų kolegijos Verslo, Tarptautinio verslo bei Bankininkystės studijų programų pirmo kurso studentai. Paskaitos metu studentams buvo pateiktas matematinis tekstas su 18 testo uždarojo tipo klausimais iš sekų ir funkcijų ribų teorijos. Testuojant buvo siekiama nustatyti, kaip studentai supranta matematinį tekstą ir sugeba, remdamiesi tekste esančiais pavyzdžiais ir apibrėžimais, atsakyti į testo klausimus. Taip pat buvo pateikta anketa, kurios tikslas buvo sužinoti, ar studentas laikė matematikos egzaminą, jei taip, tai kurį: mokyklinį ar valstybinį.

Atlikus tyrimą gautos šios išvados: motyvacija studijuoti matematines disciplinas, kuri suprantama kaip dalyko pratybų lankomumas ir matematikos egzamino laikymas dar mokykloje, lemia geresnius studijų rezultatus; stipri koreliacija tarp universiteto studentų lankomumo ir gauto galutinio įvertinimo semestro metu bei silpna priklausomybė kolegijos studentų; laikiusių ir nelaikiusių mokykloje matematikos egzaminą tiek kolegijos, tiek universiteto studentų pratybų lankomumo vidurkiai statistiškai reikšmingai skiriasi; universiteto ir kolegijos studentų funkcijų ribų teorijos žinių testo vidurkiai reikšmingai skiriasi; universiteto ir kolegijos silpnesnių studentų motyvacija mokytis smunka kaip ir jų lankomumas, o tai savo ruožtu atsiliepia jų galutiniams dalyko rezultatams; mokykloje įgytos žinios ir pasirinkimas laikyti egzaminą labiau motyvavo universiteto ir kolegijos studentus pasiruošti testui nei nelaikiusius mokykloje egzamino.

Raktažodžiai: *matematikos dėstymas, žinių tikrinimo testai, studijų kokybė, statistikos metodai.*