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STUDENT'S AUTOEVALUATION IN THE FIRST YEAR OF STUDY, ESPECIALLY CONCERNING MATHEMATICAL ABILITIES

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Abstract. Significant differences are observed in secondary education of mathematics in the Czech Republic. It makes significant obstacles during tertiary education studies, because many of students do not finish its first study year. Therefore there is a need to continuously evaluate their mathematic abilities and perform appropriate changes in study courses.

1. Introduction

In the frame of the curricular reform in the Czech Republic there are developing and implementing frame curricula (RVP) preceded by more strict standard curricula. In the scope of particular schools they are called school curricula (SVP) which are derived from RVP. The first RVP for secondary schools was accepted in 2007, and from 2009 first groups of schools started to teach according to school curricula[1]. In comparison with old curricula, although they describe compulsory and optional topics, they are more flexible than the old ones. This leads to high imbalance of students' mathematical knowledge from school to school. In the Table 1 we can observe continuity of old curricula and new RVP. Particular types of schools are the following: G – Gymnasium (preparation for university studies), SPS – industrial school (preparation for practice in several technical branches), SOS – integrated school (specialized branches for practice), OA – secondary business school (economically oriented for practice), SOU – secondary education for practice in a trade.

[1] Introduction of RVP and SVP is dividend into 4 phases that should be finished by 2012.

Topics by RVP		SOS, SPS, SOU (2000)	Gymnasium (1999)
SPS, SOS, OA, SUS	Gymnasium		
	Basic notions (definition, proposition, theorem, proof), sets, propositional logic..		Basic notions, numeric fields.
Numbers and expressions transformations.	Numeric fields, power functions, variable expressions, equations, inequations.	Algebraic expressions. Powers, roots.	Algebra.
Function and its behaviour. Equations and inequations solving.		Linear, quadratic function, in/equations. Functions and their properties. Logarithmic and exponencial functions.	Functions.
	Functions and series.	Goniometry, trigonometry.	Goniometry, trigonometry.
Progressions and their usage.		Progressions.	Progressions.
Problem solving using application of functions, progressions and trigonometry. [1]			
Planimetry.	Geometry in plane, space, trigonometry, analytic geometry in plane, space, conic sections.	Planimetry.	Planimetry.
Stereometry.		Stereometry.	Stereometry.
Analytic geometry in plane.		Analytic geometry in plane.	Analytic geometry in plane.
Analytic geometry conic sections [1]		Analytic geometry conic sections[1]	
Combinatorics, probability and statistics.	Combinatorics, probability and data processing.	Combinatorics and statistics.	Combinatorics, probability and statistics.
Complex number's operations and quadratic equations in the field of complex numbers. [1]		Complex numbers.[1]	Complex numbers.[1]
			Analytic geometry in space. [1]
		Differential and integral calculus. [1]	Differential and integral calculus. [1]

[1]Optional recommended topics..

Table 1: Comparison beetween topics of RVP on gymnasium and specialized schools and old curricula from 1999/2000.

In Table 2 there is the number of hours for the whole period of education on the type of school.

	gymnasium	SPS	OA	SOS	SUS
Number of hrs	10	10 - 12	8	8 - 10	8

Table 2: Minimal hours of mathematics according to the school type by RVP.

According to the mentioned above we can predict these results:

1. Differences between gymnasium and other types of schools should be find especially in the topic "propositional logic".

2. Further differences should be not only in topics but particularly in deep of the knowledge.
3. All school leavers should have worse knowledge in topics "analytic geometry, complex numbers and differential and integral calculus". In the contrary, they should have strong knowledge of "number operations, equations, functions, series, statistics and geometry".

We performed research among students of first year university study through questionnaire.

2. Research and hypotheses

Do correspond differences between types of secondary schools with the distribution of topics in RVP? Which topics are taught well in secondary education and which we have to improve in the first year of university studies? Does knowledge of students depend on the type of secondary education (several types of secondary schools)? Does knowledge of students depend on the type of study field attended?

We performed the abovementioned research by the form of questionnaire given to students of first year at Faculty of Science, University of Ostrava. The sample includes 787 students, we generalized results also for minor subset, where we are only observing mainstream fields for Faculty of Science. Questions were grouped according to mathematical topics into the following ones: sets, numerical fields (SET), propositional logic, proofs (LOGIC), functions (FUNCTION), equations, inequations (EQUATION), fundamentals of the differential and integral calculus (MA), combinatorics (COMB), probability, statistics (STAT), analytical geometry (GEOM).

We have devised questions in these topics and we performed analysis upon the scale. Every student can evaluate knowledge in the scale $1-5$ (subtopics of above), where 1 is the minimal knowledge and 5 is the maximal knowledge. The method Analysis of variance (ANOVA) has been used. We analyzed results upon the secondary school attended and study fields [2].

At first, we divided answers only into two classes: "I've never hear about it" and "other answers". We got the reply to the first question. According to partition of topics in RVP/old curricula, differences between secondary schools providing preparation for practice (SPS, SOS, OA, SOU) and secondary schools providing preparation for university studies (G) would be especially in the topic LOGIC and next differences would be rather at an intensity of knowledge. But results of the research does not correspond with the assumptions (see Table 3). Likewise strong consciousness in the topic MA does not correspond to the fact that this topic is not obligatory at secondary schools

[2] They are marked as field's codes in the following text.

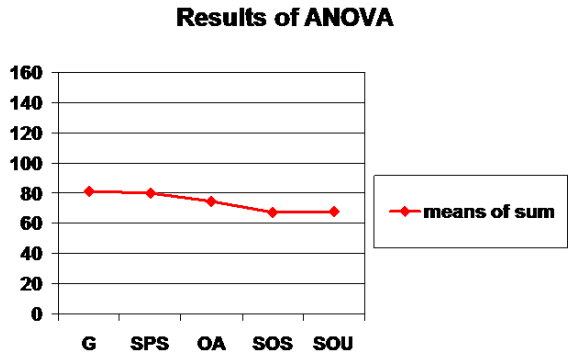
already since year 1999. On the contrary, in the long term fixed subjects at all secondary schools, probability and statistics have weak position in the consciousness of respondents.

%	SET	LOGIC	FUNCTION	EQUATION	MA	COMB	STAT	GEOM
G	81	91	98	100	92	91	79	91
SPŠ	82	75	99	100	98	93	78	95
OA	62	80	92	100	88	90	65	83
SOŠ	54	45	89	97	76	73	58	81
SOU	54	42	90	96	76	80	52	90
sum	71	73	95	99	88	86	71	89

Table 3: Percentage of students' knowledge.

3. Data analysis and results

Results of ANOVA showed statistically significant differences between schools in overall results - F-ratio = 24.96, i.e. Prob. level < 0.000001.

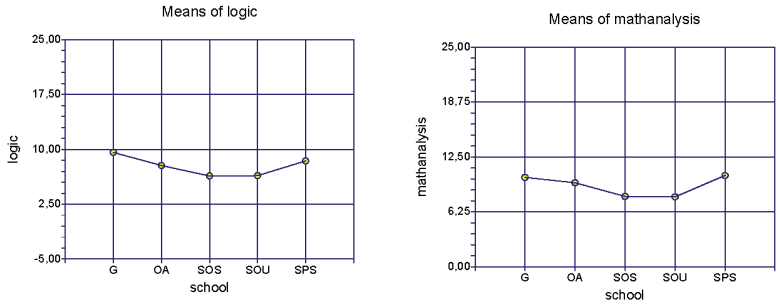


Another interesting result is showed by the Tukey-Kramer Multiple Comparison Test:

Group	Count	Mean	from Groups
SOS	197	67, 11675	OA, SPS, G
SOU	49	68, 10204	SPS, G
OA	60	74, 76667	SOS
SPS	130	80, 03846	SOS, SOU
G	346	80, 93642	SOS, SOU

From the base test we can conclude that hypothesis about difference between schools has been accepted (zero-hypothesis rejected). From additional tests given above, we can see that the level of math knowledge is similar at G, OA and SPS schools. Contrary, SOS and SOU schools have statistically significant differences from the first mentioned school.

If we analyse precisely the topics mentioned, we get these results against factor of school. We used the MANOVA Test. We can also reject zero hypotheses for every particular topic. From following graphs we can observe that differences (not statistically proved) are especially in MA and LOGIC, where practice schools attendants have slightly worse results against other schools.



In the end we verified whether knowledge of students depends upon the study field. We used the Bonferroni (All-Pairwise) Multiple Comparison Test and obtain the following results:

Group	Count	Mean	Different From Groups
AI-KS	1	46	
AE-KS	7	57,14286	AM, IS-KS
GRR-KS	2	67	
AE-PS	28	67,5	AM
KGI	10	69,7	
CHEM	42	71,35714	AM
GRR	74	72,24324	AM
OTK	26	72,69231	
SBE	27	73,18519	
AI-dist	7	73,42857	
FGG	30	73,73333	
PKG	36	75,30556	
BIOF	8	76,25	
AI	177	76,36723	
INF	21	76,42857	
EXB	23	81,04348	
AME	9	81,77778	
IP	25	82,36	
AM	18	90,61111	AE-KS, AE-PS, CHEM, GRR
FJ2	1	92	
KIP	2	104	
IS-KS	3	105	AE-KS

So we cannot reject the zero hypothesis that all students of different programmes have the same results.

4. Conclusions

The analysis of the results shows significant differences between the type of secondary schools. Practically oriented schools have low level of mathematical preparation, so we can establish special courses for these students. Also topics are not balanced (but not statistically). This means that we have to focus to logic and mathematical analysis.

References

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