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STATISTICAL PROCESSING OF THE POSTTEST RESULTS OF 8TH GRADE OF PRIMARY SCHOOL OF KEGA 015 UKF – 4/2012 PROJECT

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ABSTRACT. *The paper deals with statistical processing of posttest results, which was written as part of project KEGA 015 UKF – 4/2012. The aim of this project was to compare knowledge level of pupils from 8th grade of primary school in the treatment and control group in this school year 2012/2013. By comparing these groups we want to verify hypotheses as are comparing the knowledge of pupils from treatment school with Hungarian and Slovak teaching language, the pupils with and without failure learning and the level of boy knowledge and the level of girl knowledge. This paper deals with the reliability of the posttest and the item analysis of the test also.*

KEY WORDS: *KEGA_015_UKF_–_4/2012, statistical processing of the posttest results, tasks of real-life context*

CLASSIFICATION: *B12*

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Introduction

This paper offers information about statistical processing of posttest results, which was written within the solution of project KEGA 015 UKF – 4/2012 named *Increasing key mathematical competencies II – Alternative learning programs in mathematics for primary schools in line with the aims of the new national education program and in line with increasing mathematical literacy under the impact of PISA*. Aim of the project in the school year 2012/2013 was creating new learning materials in teaching mathematics and verification of effectiveness of teaching using these materials in the 8th grade of primary school. This project follows project KEGA 3/7001/09 with the same name, which was dedicated to creating learning materials and verification of their effectiveness in the 5th and 6th grade of primary school. These materials are aimed at increasing key mathematical competencies by solving tasks inspired by real – life problems and so are aimed also at preparing pupils for international testing.

An experiment is being realized within the project. This experiment started with the random partition of schools involved in research into treatment and control group and then with writing the pretest. Results of pretest can be found in the paper [7]. Learning materials inspired by real – life problems are for treatment schools prepared in every year of project solution. Content of materials includes every of five education areas as they are defined in the National education program. Posttest is written in May every school year. Statistical processing of posttest results in previous school years are available in paper [8], [4] and [5].

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Main research hypothesis and research sample

Main research hypothesis is:

Prepared materials effectively contributed to increase key mathematical competencies of pupils 8th grade of primary school.

Research sample consisted of 544 pupils of 8th grade of primary schools of four Nitra region districts. Some of these schools are schools with Hungarian teaching language.

Methodology and research tools

We used experiment as a research method. Schools were grouped in the treatment and control group randomly. In the school year 2012/2013 treatment group consisted of 11 schools and control group of 12 schools. We used didactic tests as a research tools – pretest and posttest. Pretest was written only at the beginning of the experiment (it means in the 5th grade of primary school). Posttest is written in every year of experiment duration.

Posttest and additional research hypothesis

Posttest for 8th grade of primary school contained 6 tasks. Every task consisted of two subtasks. All questions in tasks were open. Content validity of the test was assessed by teachers of 8th grade of primary schools. At first the test was tested in one school and according to its results some of the tasks were modified. Pupil could get maximum of 5 points for each of subtasks, total maximum of 30 points (total). Task named "*Age of dog breeds"* (author PaedDr. K. Cafiková) was focused on logic. Task named *"Consumption of a car"* (author doc. RNDr. P. Vrábel, CSc.) was focused on area of expression. Task named *"Game Drawing of number"* (author PaedDr. Eva Uhrinová) was focus on probability. Task named *"Traffic roundabout"* (author Mgr. Zuzana Vitézová) was focused on geometry. Task named *"Candles"* (author Mgr. L. Lednický) was focused on area of functions. And task named *"Media in our school"* (author Mgr. Mária Kóšová) was focused on statistics. Due to the scope of the article we cannot provide the whole test, which was used. The test is available in www.fss.kega.ukf.sk.

The following hypothesis is verified according to posttest results:

Hypothesis 1: *Level of knowledge of pupils in the treatment group is significantly higher than the level of pupils in the control group.*

In addition to this hypothesis, we set out to verify also these hypotheses:

Hypothesis 2: *The level of knowledge of pupils in treatment schools with Slovak teaching language is not significantly different from the level of pupils in treatment schools with Hungarian teaching language.*

Hypothesis 3: *The level of knowledge of boys in the treatment schools is not significantly different from the level of knowledge of girls in the treatment schools.*

Hypothesis 4: *The level of knowledge of pupils with learning disorders from treatment schools is significantly different from the level of other pupils from treatment schools.*

The results of the posttest

Due to the hypotheses we compare the average test scores in these groups : treatment and control (E and K) , treatment schools with Slovak teaching language (ESJ) and with Hungarian teaching language (EMJ), group of girls from treatment schools (EZ) and boys from treatment schools (EM), group of pupils without learning disorders from treatment schools and a group of students with learning disorders from treatment schools (ENo and

EYes). Descriptive statistics of the compared groups are summarized in table 1.

group 1, group2	Descriptive statistics – average test score, (average), standard deviation (st. dev.), count of valid cases (count)					
	average group 1	average group 2	st. dev. group 1	st. dev. group 2	count group 1	count group 2
K, E	9,96	17,93	7,35	7,54	323	221
EMJ, ESJ	18,73	16,49	8,25	5,82	142	79
EZ, EM	18,77	17,07	7,65	7,35	111	110
ENo, EYes	18,23	6,5	7,93	6,45	13	12

Table 1: Descriptive statistics of posttest of 8th grade of primary school in the project

Since the *p*-value of normality test (Shapiro - Wilk test, Kolmogorov-Smirnov test) are for groups E, K, EMJ, EZ, EM less than 0.05, scores in these groups can not be considered to be normally distributed. Scores in groups ESJ, EYes, ENo can be considered to be normally distributed.

In view of the above, we verify Hypothesis 1, Hypothesis 2 and Hypothesis 3 using the non-parametric Mann-Whitney U test and Hypothesis 4 using the t-test.

gr.1, gr.2	Sum of rank group 1	Sum of rank group 2	U	Z	p	Z adj	p	Count group 1	Count group. 2
K, E	68534	79706	16208	10,82	0,00	10,82	0,00	323	221
EMJ, ESJ	17085	7446	4286	-2,90	0,004	-2,908	0,004	142	79
EZ, EM	13212,5	11318,5	5213,5	1,88	0,06	1,88	0,06	111	110

Table 2: Results of Mann – Whitney U test

gr.1, gr.2	average group1	average group 2	t	df	p	F	p	st. dev. group 1	st. dev. group 2
EYes, ENo	6,5	18,23	4,04	23	0,0005	1,51	0,5	6,45	7,93

Table 3: Results of t-test

A graphical representation of the average test score together with 95% confidence intervals for each group can be seen in Figures 1a - 1d. For comparison, Figure 1b, 1c and 1d we present and illustrate also test scores of the control schools.

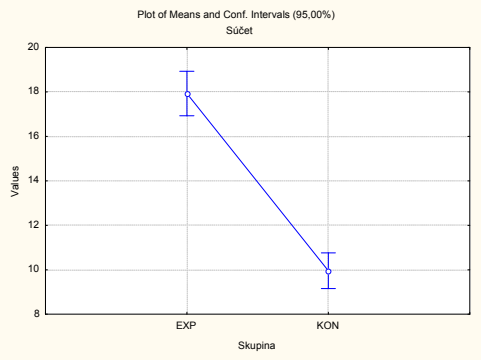

Figure 1a: Graph of average for E and K

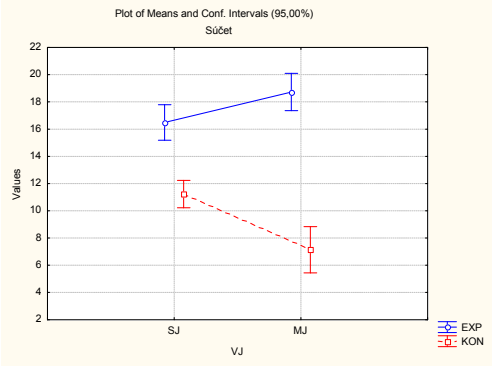

Figure 1b: Graph of average for SJ and MJ

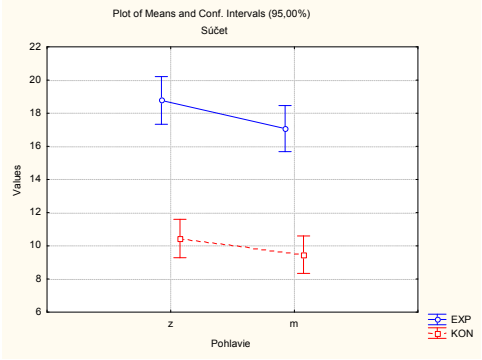

Figure 1c: Graph of average for Z and M

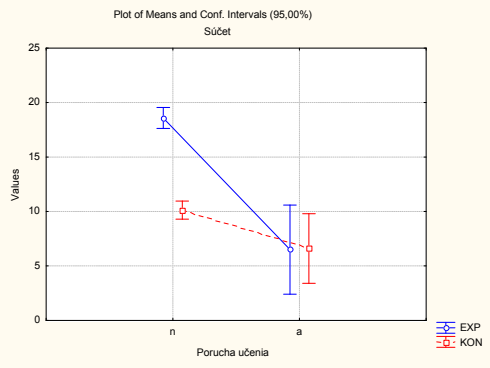

Figure 1d: Graph of average for No (n) and Yes (a)

According to results of M-W U test (Z adj. = 10.83, p = 0.000) we reject statistical hypothesis Mean value of test score is the same in the group E and K, and also according to graphical representation of average posttest scores (Figure 1a) it is clear that the average posttest score of the treatment group (17,93) is statistically higher than of the control group (9.96). Therefore the Hypothesis 1 is valid.

Results of *M-W U test* show that there is significant higher posttest score in the treatment group of school with Hungarian teaching language (18,73) than in the treatment group of school with Slovak teaching language (16,49) as well. If we look at Figure 1b, we can realize that there is probably significant higher posttest score in the control group of schools with Slovak teaching language than in the control group of schools with the Hungarian teaching language. In light of this, we divided data file into the four groups (ESJ, KSJ, EMJ, KMJ). We compared posttest scores in these groups using the multiple comparisons. We used Kruskal–Wallis one-way analysis of variance (H=123,8139 a p-value=0,000) and post-hoc test to Kruskal–Wallis test. We found that differences between almost all of groups are significant except difference between groups EMJ and ESJ. The p-values are in the Table 4. This conclusion is a little bit different from previous one. But, we are focused on comparison groups EMJ and ESJ especially, so we accept previous results.

Therefore, we can say that Hypothesis 2 is valid. It means that level of knowledge of pupils from treatment group of schools with Hungarian teaching language is significantly higher than level of pupils form treatment group of schools with Slovak teaching language. Very interesting is also that level of knowledge of pupils from control schools with Slovak

teaching language is significantly higher than level of knowledge of pupils from control schools with Hungarian teaching language (*p*-value = 0,000944). Therefore we can say that in schools with Hungarian teaching language became to higher improvement.

	KMJ (7,14)	EMJ (18,73)	KSJ (11,23)	ESJ (16,49)
KMJ (7,14)		0,000000	0,000944	0,000000
EMJ (18,73)	0,000000		0,000000	0,621231
KSJ (11,23)	0,000944	0,000000		0,000009
ESJ (16,49)	0,000000	0,621231	0,000009	

Table 4: Nonparametric multiple comparisons

The results of the *M- W U test* (Z adj. = 1.88, p = 0.06) also shows that difference between average posttest scores in the group of boys from the treatment schools (17,07) and group of girls from treatment schools (18,77) is not significant. Hypothesis 3 is valid.

We made a random selection of 13 students from group ENo in order not to compare data files (EYes and ENo) with very different range. The result of *t-test* for comparison of these two groups shows that there is a significant difference in the level of knowledge among groups EYes and ENo. Hypothesis 4 is valid.

We placed descriptive statistics of posttest score in the table 5 and item analysis (average, modus, median, standard deviation, % of pupils, which obtained maximum score from task, % of pupils, which obtained score 0 from task) in the table 6. We can see that in every task the rate of pupils with maximum score from task was lower than 80%; it means that none of the tasks is "suspect". Modus is equal to maximal score (score 5) in the task named "*Age of dog breeds"* and *"Traffic roundabout"*.

Variable	N	average	median	modus	count of modus	min	max	st. dev.
Sum	544	13,19	13	5	32	0	30	8,39

Table 5: Descriptive statistics

	Descriptive statistics								
	average	med	mod	count mod.	min	max	st. dev.	% pupils min	% pupils max
Age of dog breeds	2,69	2	5	185	0	5	1,96	22,61%	34,01%
Consumption of a car	1,64	1	1	231	0	5	1,40	17,46%	7,72%
Game Drawing of number	1,53	1	0	269	0	5	1,87	49,45%	13,42%
Traffic roundabout	2,64	3	5	151	0	5	1,95	25,18%	27,76%
Candles	2,17	2	0	228	0	5	2,14	41,91%	28,68%
Media in our school	2,52	2	2	222	0	5	1,68	15,81%	23,35%

Table 6: Item analysis of posttest

Pupils achieved the highest average success rate of right solutions on solving the task *"Age of dog breeds"*. Conversely, the task named *"Game Drawing of number"* was the most difficult for pupils.

We computed reliability coefficient (Cronbach's alpha = 0,85) in order to check the degree of reliability of posttest. We should also compute value of Cronbach's alpha after deleting one of tasks. If value of Cronbach's alpha becomes higher, this task makes reliability of test lower. Values of Cronbach's alpha after deleting one of task are shown in table 7. We can say that posttest was reliable enough.

	Age of dog breeds	Consumption of a car	Game Drawing of number	Traffic roundabout	Candles	Media in our school
alpha after deleting	0,82341	0,83542	0,82421	0,81956	0,81826	0,83085

Table 7: Value of reliability coefficient after deleting one of tasks

Conclusion

We have shown that posttest which was made by us for pupils of 8th grade of primary school was reliable adequately.

According to its results it can be concluded that materials prepared for teachers and their pupils of 8th grade of primary school helped to increase their key mathematical competences effectively. It turned out pupils from the treatment schools with Hungarian teaching language achieved significantly better results than pupils from the treatment schools with Slovak teaching language. In contrast, pupils from the control schools with Slovak teaching language achieved better results than pupils from control schools with Hungarian teaching language. It can be assumed that this may be due to the fact that in schools with Hungarian teaching language teachers worked with prepared materials more than in schools with Slovak teaching language. Difference between levels of knowledge was not significant with regard to the gender of pupils in the treatment schools. The expected result about significant higher level of knowledge of pupils from treatment school without learning disorders occurred.

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