THE RELEVANT FACTORS AFFECTING THE CONCEPTUAL UNDERSTANDING OF MATHEMATICS

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Abstract. ???????

1. Introduction

Nowadays there is a lot of disscussion among scientific community about problems students have with understanding and comprehending mathematics.

Sometimes, we have to consider that mathematics cannot be taught, you simply either have to have apriori talent or not. The survey we performed during project ITMS - Flexible and attractive study at ZU, for needs of labour market and knowledgeable society - aimed to analyze factors that affect students ability to understand Mathematics. During the project we surveyed 200 students of University of Zilina, studying at Faculty of Civil Engineering, Faculty of Social Engineering and Faculty of Operation and Economics of Transport and Communications their views on teaching mathematics.

We focused on analysis of attitudes and opinions of students for mathematics which they expressed in the submitted questionnaire. This questionnaire had 15 questions while scaling responses was 3th degrees. Students expressed how they like style of teaching mathematics and if they think it is important and interesting subject, how much time they spend preparing for lessons

and how they actually understand discussed curriculum, how difficult is that curriculum for them.

We got a lot of interesting materials, which we subjected to the qualitative statistical analysis.

We present to in article only few partial results and our main target was to identify the factors which have positive impact of understading of mathematics and study results of students in this subject.

2. Analysis of the qualitative characters

We used χ^2- test for contingency table $k \times m$ to verify dependence of each pair of the qualitative characters A and B. The character A was acquiring k categories and the character B was acquiring m categories.

$A \backslash B$	B_1	B_2	...	B_m	f_i^A
A_1	f_{11}	f_{12}		f_{1m}	f_1^A
A_2	f_{21}	f_{22}	...	f_{2m}	f_2^A
:			...		:
A_k	f_{k1}	f_{k2}	...	f_{km}	f_k^A
f_j^B	f_1^B	f_2^B	...	f_m^B	n

Table 1. The contingency table of the observed frequencies

We tested null hypothesis

H_0 : the characters A and B are independent

versus

H_1 : the characters A and B are dependent

The test statistics is

$$\chi^2 = \sum_{i=1}^{k} \sum_{j=1}^{m} \frac{(f_{ij} - o_{ij})^2}{o_{ij}}, \tag{1}$$

where f_{ij} are observed frequencies, $o_{ij} = \dfrac{f_i^A f_j^B}{n}$, $i = 1, 2, ..., k$; $j = 1, 2, ..., m$. The rejection region is $\chi^2 > \chi_\alpha^2((k-1)(m-1))$, where $\chi_\alpha^2((k-1)(m-1))$ is the critical value of χ^2- distribution with $(k-1)(m-1)$ degrees of freedom.

Degree of statistical dependence between the observed qualitative characters A, B we assessed by using contingency coefficient C, which is defined by

$$C = \sqrt{\frac{\chi^2}{n + \chi^2}} \tag{2}$$

and the Cramer's V coefficient, which is defined by

$$V = \sqrt{\frac{\chi^2}{n\,h}},\tag{3}$$

where n is sample size and $h = min(k,\,m)$.

3. Verification of formulated hypothesis

We formulated 3 hypotheses.

    1. The style of teaching of mathematics singificantly affects the level of understanding of mathematics.

    2. Time devoted to training for lessons significantly affects the level of understanding of mathematics.

    3. Positive relationship with subject significantly affects the level of understanding of mathematics.

Hypothesis 1. **Style of teaching of mathematics determines the level of its understanding**

To determine if the style of teaching of mathematics and the level of understanding of mathematics by students are independent we used a χ^2-test for independence. We use $\alpha = 0,05$. We observed these characters:

the character A - the style of teaching of matemathics and the character B - the level of understanding mathematics by students. The character A was acquiring $k = 3$ categories: $A_1 = A_2 = A_3 =$

The character B was acquiring $m = 3$ categories: $B_1 = B_2 = B_3 =$

We tested null hypothesis

H_0 : style of teaching of mathematics and the level of understanding of mathematics are independent

versus

H_1 : style of teaching of mathematics and the level of understanding of mathematics are dependent

The test statistics is $\chi^2 = 5,5089$. The critical value with $(k-1)(m-1) = 4$ degrees of freedom is $\chi^2_{0,05}(4) = 9,49$. The rejection region is $\chi^2 > 9,49$. Since $\chi^2 = 5,5089 \leq 9,49$, hypothesis H_0 is **not rejected**. There is evident that the style of teaching of mathematics and the level of understanding of mathematics are independent.

Hypothesis 2. **Time devoted to training for lessons of mathematics significantly affects level of understanding of mathematics**
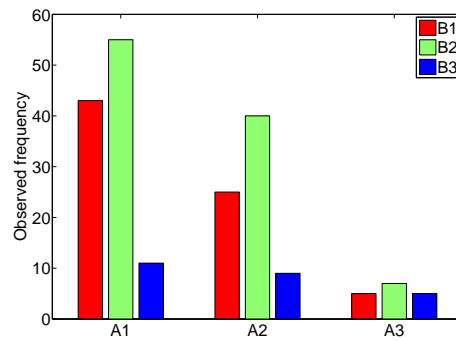
Figure 1: The barchart for A by B ????? POPIS OBRAZKU

To determine if the quantity of time spent for training for the lessons of mathematics and the level of understanding of mathematics by students are independent we used a χ^2-test for independence. We use $\alpha = 0,05$. We observed these characters:

the character A - the quantity of time spent for training for the lessons of mathematics the character B - the level of understanding of mathematics The character A was acquiring $k = 3$ categories: $A_1 = A_2 = A_3 =$

The character B was acquiring $m = 3$ categories: $B_1 = B_2 = B_3 =$

We tested null hypothesis

H_0 : the quantity of time spent for training for the lessons of mathematics and the level of understanding of mathematics are independent

versus

H_1 : the quantity of time spent for training for the lessons of mathematics and the level of understanding of mathematics are dependent

The test statistics is $\chi^2 = 9,6552$. The critical value is $\chi^2_{0,05}(4) = 9,49$. The rejection region is $\chi^2 > 9,49$. Since $\chi^2 = 9,6552 > 9,49$, hypothesis H_0 is **rejected**. There is evident that the quantity of time spent for training for the lessons of mathematics and the level of understanding of mathematics are dependent.

The value of the contingency coefficient is $C = 0,2146$ and the value of the Cramer's V is $V = 0,1554$. The values of these coefficients indicate, that between the analyzed qualitative characters A and B exists small degree of the connection.

Hypothesis 3. **The positive relationship for mathematics significantly affects the level of the understanding of mathematics**

Figure 2: ????? POPIS OBRAZKU

To determine if the positive relationship for mathematics and the level of understanding of mathematics by students are independent we used a χ^2-test for independence. We use $\alpha = 0,05$. We observed these characters:

the character A - the positive relationship for mathematics the character B - the level of understanding of mathematics The character A was acquiring $k = 3$ categories: $A_1 = A_2 = A_3 =$

The character B was acquiring $m = 3$ categories: $B_1 = B_2 = B_3 =$

We tested null hypothesis

H_0 : the positive relationship for mathematics and the level of understanding of mathematics are independent

versus

H_1 : the positive relationship for mathematics and the level of understanding of mathematics are dependent

The test statistics is $\chi^2 = 16,89$. The critical value is $\chi^2_{0,05}(4) = 9,49$. The rejection region is $\chi^2 > 9,49$. Since $\chi^2 = 16,89 > 9,49$, hypothesis H_0 is **rejected**. There is evident that the positive relationship for mathematics and the level of understanding of mathematics are dependent.

The value of the contingency coefficient is $C = 0,2791$ and the value of the Cramer's V is $V = 0,2055$. The values of these coefficients indicate, that between the analyzed qualitative characters A and B exists small degree of the connection. ???

4. Conclusion

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The results of the statistical analysis confirmed, that the strongest factor affecting conceptual understanding of the mathematics is the positive rela-
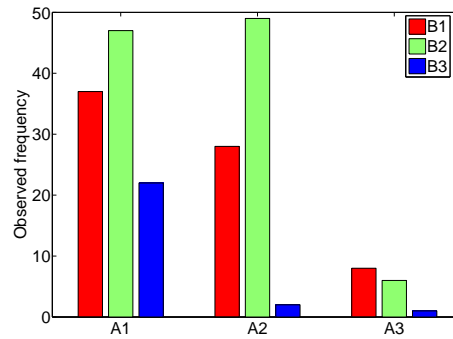
Figure 3: ????? POPIS OBRAZKU

tionship with this subject. In the second place is the time spent by preparing for the lessons. The style of teaching mathematics is ??? It is not about how much time a student spend by learning mathematics, but it is mostly about the positive student´s attitude, interest and volition to learn the mathematics.

In this research we confirmed a generally known fact: the intrinsic motivation of student in the carrying out any activity is necessary. For the teachers of mathematics it means to focus his effort on creating and application of appropriately chosen methods and procedures so the students can understand importance of mathematics for everyday practice and was also more intrinsically motivated.

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