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ANALYSIS OF THE FACTORS AFFECTING STUDENT'S ATTITUDES TO MATHEMATICS

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Abstract. The problem of students' understanding and mastering mathematics is currently one of the most emphasized topics of expert public discussion. New ways of teaching mathematics more effectively and attractively are being searched for. The information society brings new alternatives nowadays; it enables us to change established and rigid forms and methods in teaching. While searching an answer to the question why the student attitudes toward mathematics are so often negative and what could influence this situation in a positive way, we conducted a survey realized under the program ITMS – Flexible and attractive study at the University of Žilina for the needs of the market and knowledge-based society.

The paper presents some of the outcomes which have ensued from the data obtained in the project realization. 200 students from three faculties of the University of Žilina were addressed in the survey (Faculty of Civil Engineering, Faculty of Operation and Economics of Transport and Communications, Faculty of Special Engineering), in which their attitudes toward mathematics were detected as well as the factors determining these attitudes.

1. Introduction

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

Sometimes, it is considered that mathematics cannot be learnt, you simply either have apriori talent or not. The aim of the survey, which we have performed during the project ITMS – Flexible and attractive study at the University of Žilina for the needs of the market and knowledge-based society, is to analyze the factors that affect students ability to understand Mathematics. During the project we surveyed 200 students of University of Žilina studying at Faculty of Civil Engineering, Faculty of Social Engineering and Faculty of Operation and Economics of Transport and Communications.

We focused on the analysis of attitudes and opinions of students of mathematics which they expressed in the submitted questionnaire. This questionnaire had 15 questions while responses scaling has 3 levels. Students expressed how they like the style of teaching mathematics and where or not mathematics is an important and interesting subject, how much time do they spend for preparing for lessons and how they actually understand the discussed curriculum, how difficult is that curriculum for them.

We got a lot of interesting material which was subjected to the qualitative statistical analysis.

In this article we present only a few partial results and our main target is to identify the factors which have positive impact on understading 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.
We tested the 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 $\chi^2 > \chi^2_\alpha((k-1)(m-1))$, where $\chi^2_\alpha((k-1)(m-1))$ is the critical value of χ^2- distribution with $(k-1)(m-1)$ degrees of freedom.

The degree of statistical dependence between the observed qualitative characters A and B is assessed using the contingency coefficient C and the Cramer

coefficient V which are defined as

$$C = \sqrt{\frac{\chi^2}{n+\chi^2}}, \qquad V = \sqrt{\frac{\chi^2}{n\,(h-1)}}, \tag{2}$$

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

$A\backslash B$	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.

3. Verification of formulated hypotheses

We formulated 3 hypotheses.

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

To determine where or not the style of teaching mathematics and the level its understanding by students are independent we used the χ^2-test of independence. We use $\alpha = 0.05$. We observed the following characters: the character A – the style of teaching matemathics and the character B – the level of understanding mathematics by students. The character A takes the categories: A_1 = very good, A_2 = sometimes convenient, sometimes inconvenient, A_3 = mostly inconvenient. The character B takes the categories: B_1 = the subject matter is understood most of the time, B_2= the subject matter is understood at 50% of lessons, B_3= the subject matter is rarely understood. We tested the null hypothesis:

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

H_1 : the style of teaching mathematics and the level of its understanding 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 $\chi^2 = 5.5089 \leq 9.49$, the hypothesis H_0 is **not rejected**. It is evident

that the style of teaching mathematics and the level of its understanding are independent (Figure 1). The value of the contingency coefficient is $C = 0.1638$ and the value of the Cramer coefficient is $V = 0.1174$. The values of these coefficients indicate that between the analyzed qualitative characters A and B there exists the small degree of connection.

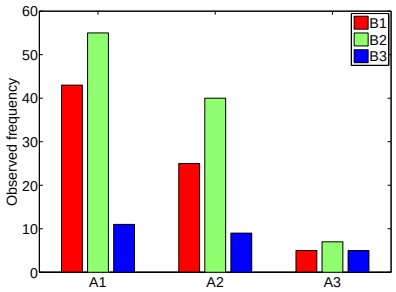

Figure 1: The bar chart of observed frequencies of characters A and B.

Hypothesis 2. **The time devoted to training for lessons of mathematics significantly affects the level of understanding mathematics.**

To determine where or not the time spent for training for the mathematics lessons and the level of understanding mathematics by students are independent we used the χ^2-test of independence. We observed the following characters: the character A – the time spent for training for the mathematics lessons and the character B – the level of understanding mathematics. The character A takes the categories: A_1 = more of time spent in comparison with others subjects, A_2 = the same time as for other lessons, A_3 = less time in comparison with other subjects. The character B takes the categories: B_1 = the subject matter is understood most of the time, B_2 = the subject matter is understood at 50% of lessons, B_3 = the subject matter is rarely understood. We tested the null hypothesis:

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

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

The test statistics is $\chi^2 = 9.6552$. Since $\chi^2 = 9.6552 > \chi^2_{0,05}(4) = 9.49$, the hypothesis H_0 is **rejected**. It is evident that the time spent for training for the mathematics lessons and the level of understanding mathematics are dependent (Figure 2). The value of the contingency coefficient is $C = 0.2146$ and the value of the Cramer coefficient is $V = 0.1554$. The values of these

coefficients indicate that between the analyzed qualitative characters A and B there exists the small degree of the connection.

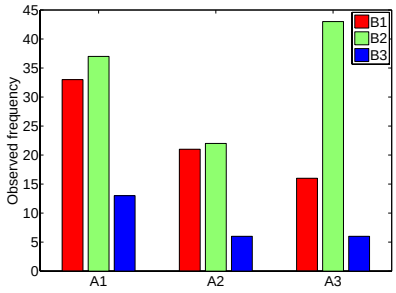

Figure 2: The bar chart of observed frequencies of characters A and B.

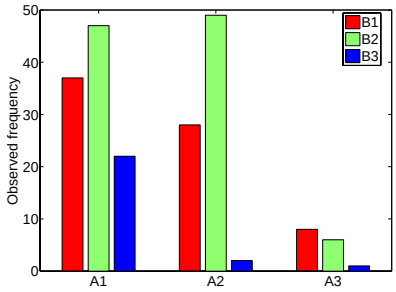

Figure 3: The bar chart of observed frequencies of characters A and B.

Hypothesis 3. **Positive attitude to mathematics significantly affects the level of understanding mathematics.**

To determine where or not the positive attitude to mathematics and the level of understanding mathematics by students are independent we used the χ^2-test of independence. We observed the following characters: the character A – the positive attitude to mathematics and the character B - the level of understanding mathematics. The character A takes the categories: A_1 = I like mathematics only if I understand the curriculum, A_2 = my attitude to mathematics depends on a topic which we learn, A_3 = I do not like mathematics. The character B takes the categories: B_1 = the subject matter is understood most of the time, B_2 = the subject matter is understood at 50% of lessons, B_3 = the subject matter is rarely understood. We tested the null hypothesis:

H_0 : the positive attitude to mathematics and the level of understanding mathematics are independent, versus

H_1 : the positive attitude to mathematics and the level of understanding mathematics are dependent.

The test statistics is $\chi^2 = 16.89$. Since $\chi^2 = 16.89 > \chi^2_{0.05}(4) = 9.49$, the hypothesis H_0 is **rejected**. It is evident that the positive attitude to mathematics and the level of understanding mathematics are dependent (Figure 3). The value of the contingency coefficient is $C = 0.2791$ and the value of the Cramer coefficient is $V = 0.2055$. The values of these coefficients indicate that between the analyzed qualitative characters A and B there exists the small degree of connection.

4. Conclusion

Our research brings two interesting results. Especially, we have verified the generally-known fact: the intrinsic motivation of students to carry out any activity is necessary. For mathematics teachers this means to focus their efforts on creating and applying the chosen teaching methods in such a way that students can understand the importance of mathematics for everyday practice and they will be more motivated intrinsically. The time spent for preparing for mathematics lessons is an important factor for understanding mathematics. It was proved that not only the time spent by students for preparing for lessons, but also their accessibility are important.

The second result proved that in mathematics education the motivation is more important than the teaching method itself. The replies of the respondents also confirmed that the attitude to mathematics is already formed in high school. Students' success in learning mathematics at the university depends mainly on the knowledge which they acquired in high school. Verification of the hypothesis number 1 confirmed this fact. The methods used in teaching mathematics at the university are not so important as the motivation of students and the time of preparing for mathematics.

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