COMPENSATION OF STUDENTS' HANDICAP IN MATHEMATICAL DISCIPLINES

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Abstract. *Repetitorium of mathematics*, which has been suggested as a part of the *Teacher training for elementary schools* programme in all forms of study, is aimed at levelling basic mathematical knowledge and skills of students entering university from various types of secondary schools with various positions of mathematics in the curricula.

1. Introduction

Even though we do not realise so, we get quite frequently into situations that need to be solved mathematically. The result of our solution then depends on how we are able to use our knowledge of mathematics from school. Therefore, schools pays attention to pupils' ability to solve difficult real life problems. Faculties of Education are then responsible for preparing their students to become good teachers, who are able to develop their pupils' skills in mathematics. Good teachers have to teach their pupils elementary skills and competences, but they also need to be aware of the necessity to give them enough space and time for reasoning, understanding and solving problems, together with learning how to argue. The emphasis is put on practical usage of mathematical knowledge in many different situations and contexts and in many different ways.

2. Current state

University preparation of elementary school teachers focuses on general preparation and mastering many diverse study subjects. Majority of subjects stresses memorising (as it is the nature of learning pedagogy and psychology, for instance) or they require artistic and physical talent (such as musical or

arts and crafts lessons, or physical training). Mathematical disciplines are the only subjects in which memorising is not the only way of learning. They require a different way of thinking: logical, critical and mathematical reasoning. Another important fact is that students of mathematics are usually graduates from many different types of secondary schools, including those where mathematics is just a marginal subject. As it results from Kurečková's research, during their studies many pupils and students explain their negative attitude towards mathematics mostly by incomprehension of the curriculum. And thus, incomprehension is one of the most frequent causes of the lack of interest in mathematics (cf. [2]).

These facts can be the reason of many students' difficulties. As it can be clearly deduced from students' comments and partial evaluation activities of the *Department of Mathematics*, mathematical disciplines are constantly viewed as the most difficult ones. This is, of course, negatively reflected in students' motivation and their relationship to mathematics at the beginning of their studies.

These ideas are not new, in our contribution we would like to inform about handling this situation at our department. We proposed a FRVŠ project called *Preparation of a new optional course*. The proposal was accepted – the new course was named *Repetitorium of mathematics*. Its managers are A. Stopenová, B. Novák and J. Eberová. The project is based on the *Long-Term Plan of Faculty of Education, Palacký University in Olomouc*. Its realisation is a part of completing individual recommendations of the *Czech Government Accreditation Board* in respect to accreditation of new study programmes and subjects. The new subject is a part of a new study plan at the *Department of Primary Psychology*. We expect the new subject to optimize primary teachers' preparation in respect to the outline education programme.

3. Aim

The aim of the project is to prepare a new optional subject called *Repetitorium of mathematics*. As it can be deduced from its name, the subject tries to deepen and broaden mathematical knowledge from secondary school education. We expect that the subject will help us to create supportive conditions for students who need to raise their mathematical abilities in order to deal more easily with mathematical disciplines in this field of study. We would like to balance the level of students' fundamental mathematical competences and thus to make mathematical studies more effective, which will also lead to reducing students' failures at the beginning of their studies.

The subject is expected to be included in the first semester of the first year and it is scheduled for 14 weeks of lessons.

4. Target groups of the project

The target groups are formed by 150 up to 200 students of fundamental specialisations of the faculty:

- *Teacher training for elementary school teachers* in the attended form of study,
- *Teacher training for elementary school teachers and English* or *German*,
- *Teacher training for elementary school teachers* in the combined form of study,
- *Teacher training for elementary school teachers and special education.*

5. Methods of solving the project

The following methods have been / will be / are intended to be used during the project:

- **Questionnaire**

A questionnaire was worked out to find out if students are able to name the obstacles in their studies and if the obstacles influenced their relationship to mathematics.

57 randomly chosen students of the 4th year of the *Teacher training* programme completed the questionnaire. They formed two groups. The first group were 16 students of the attended form of study (later referred to as AS) and the second group were 41 students of the combined form of study (later referred to as CS). They could choose more than one answer from multiple options and they were encouraged to think about obstacles making their mathematical studies more difficult at various levels of school education.

In table 1 and 2 we can see their answers to the following questionnaire items: "Think of your own mathematical studies and try to find factors and obstacles you have encountered. Some of them are suggested and you need to add others. Students of the combined form of study did not differentiate study obstacles according to the levels of school education, even though they were encouraged to. The reason may be seen in the time gap from their previous education. Thus they suggested the obstacles they found most troublesome and frequent.

An interesting note is that AS students with higher level of education have also higher percentage of responses fearing failure – 69%. Similar situation is with the CS students – 71%. The second most common obstacle in learning is lack of knowledge. The percentage of AS students' answers in this respect ranges from 13% to 25%, and except for the first grade, the percentage of such responses grows with higher level of school education. On the other hand, 39% of CS students consider lack of knowledge a major obstacle, which is much higher percentage than with AS students.

	AS			
	number in %			
obstacle	*low elem.*	*upper elem.*	*secondary*	*univ.*
boredom	0	31	19	0
tiredness	13	13	6	6
illness	13	6	0	0
lack of interest	19	19	25	19
lack of knowledge	25	13	19	25
fearing failure	19	25	25	69
lack of usefulness	0	0	6	0
no response	0	0	0	
other	0	0	0	0

Tab. 1: List of obstacles and percentage of AS students
who mentioned them at various levels of their school education (cf. [1]).

	CS
obstacle	*number in %*
boredom	20
tiredness	32
illness	24
lack of interest	20
lack of knowledge	39
fearing failure	71
lack of usefulness	0
small motivation	2
no response	1
other	0

Tab. 2: List of obstacles and percentage of CS students who mentioned these
obstacles regardless the level of school education (cf. [2]).

AS and CS students' answers for these two obstacles were one of the reasons
of establishing the FRVŠ project.

- **Pilot test**

By a pilot test we wanted to check if our new subject is suitable even for
students in combined form of studies. We included 3 word problems. Two
of them are formulated in such a way to be able to show the usefulness of
mathematics in solving real-life situations and problems.

[1] Two lemonades and two cakes are 44 CZK. One lemonade and three cakes are 30 CZK.
- How much is the lemonade?
- How much is the cake?
- Describe your reasoning process leading to the solution.

[2] A seal has to breathe even during sleeping. Martin watched a seal during one hour. At the beginning the seal dived and fell asleep. Eight minutes later it slowly emerged and took a breath. Three minutes later it went back under the surface and the process was repeated regularly. After one hour the seal was:

a) under the surface
b) on the way up
c) taking breath
d) on the way down (taken from [4]).

Describe your reasoning process leading to solution.

[3] A football match finished 5:4 for home team. The home team had a leading position from the beginning and they kept it until the end. How many different ways could have the score been changed? (taken from [3]).

The pilot test was given to six 5th year students of the *Teacher training for elementary school* programme in the combined form of study. The time for solution was not limited. Their results confirmed our opinion about the new subject's adequacy for teachers as well. Not a single student described his / her reasoning process. The results are shown in the following table.

	number of students			
task #	no solution	analysis made	result found	answer written
1	1	5	0	0
2	1	5	4	0
3	2	4	3	1

Tab. 3: Students' success in pilot test

- **Entrance test**

We are going to prepare an entrance test that will monitor the level of knowledge and skills of students in the *Teacher training for elementary school* programme in the attended form of study. It will include selected topics from elementary and secondary school mathematics. In the entrance test there are going to be topics included in the upcoming battery of tests and a new collection of tasks.

6. Project output

[1] Battery of tests to monitor and control continuously the study of selected topics from elementary and secondary school mathematics. These tests will monitor current state of students' knowledge and skills.

[2] Collection of selected mathematical tasks aimed at individual study, followed by interactive lessons in seminars.

7. Expected project benefits

- Helping to improve individual insufficient skills in mathematics.

- Raising students' interest in mathematical disciplines and their positive motivation.

- Building self-confidence of both prospective and working teachers in their mathematical skills.

- Making studies more effective and reducing students' failure in mathematical disciplines

8. Conclusion

The subject puts emphasis on teaching students how to master particular competences and skills and how to be able to solve textbook cases from elementary and secondary school. The usage of these skills in real life then depends on the individual's ability to apply any knowledge on practical situations and to organise and control their further education, or even to study independently and to overcome obstacles in learning.

Neither pupils nor students can be taught everything they will need in real life at school. Nevertheless, they must be able to learn how to learn.

References

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