READINESS OF FUTURE PRIMARY-SCHOOL TEACHERS TO SOLVE NON-STANDARD MATHEMATICAL PROBLEMS

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Abstract

The paper will present partial results of a pilot research entitled "Readiness of future primary-school teachers to solve non-standard mathematical problems". For the purposes of the research, a didactic test was designed – a set of 10 non-standard mathematical problems. The problems were chosen in difficulty corresponding to the curriculum of the 5th grade of primary school. The difficulty of the individual problems was statistically verified. A questionnaire survey method was chosen for the research. 74 students of the field of Teaching at the 1st Level of Primary School from the Faculty of Education of Palacký University in Olomouc participated in the pilot research. The researchers plan to carry out the research in a national and wider international context. In the pilot research, we were particularly interested in the success of the respondents in solving individual problems and the test as a whole, and the subjectively perceived difficulty of the individual problems in the context of the achieved success rate.
It can be concluded that not all the prospective teachers were able to solve all the assigned problems. Some mistakes were caused by inattention, others by the stress factor of the time limit. The analysis of the subjectively perceived difficulty of the problem in relation to the success rate was interesting. We believe that the results of the research should be reflected in the concept of undergraduate teacher training.

Keywords: *Mathematics, solving, problem, teacher.*

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1. Introduction

Successfully solving a mathematical problem is one of the basic requirements for pupils in mathematics. Successful solving of mathematical problems is also one of the key competencies of a future teacher. In addition to solving the problem itself, the prospective teacher should have a good understanding of the mathematical nature of the problem and should be able to explain the solution to the pupil from different points of view. However, our students – future teachers – often hesitate in the case of non-standard problems and are not sure of the correctness of the solution.

By non-standard problems we mean, in accordance with the National Research Council (2001), problems whose solutions do not depend to a large extent on the usual methods used in mathematics teaching. They require a certain level of intellectual maturity in pupils as well as the ability to reason logically and think creatively. For non-standard problems there is often no single correct solution; the pupils need to think, they need insight and understanding of the meaning of the assignment, and only then are they able to solve the problem. The ability to successfully solve non-standard mathematical problems is embedded in the primary school curriculum (MEYS, 2021). It is also closely related to the issue of developing pupils' mathematical literacy.

2. Readiness of future primary-school teachers to solve non-standard mathematical problems research (RNMP Research)

The RNMP research is devoted to a deeper analysis of the issue of solving non-standard mathematical problems by students of Teaching at Primary School. The authors observe the success rate of students in solving problems, the identification of problematic mathematical topics, the degree of relevance between the student's performance and his/her self-assessment of the success of his/her own performance, the degree of professional self-confidence in solving non-standard mathematical problems, and the degree of readiness for a future profession in the field.

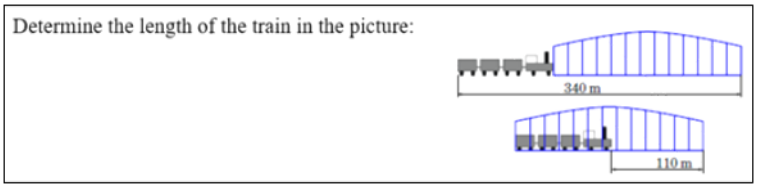
In this paper we will discuss partial results of the pilot study, which was carried out in 2020. The study involved 74 students of the field of Teaching at Primary School at Palacký University Olomouc. The students were deliberately chosen at different stages of their studies – at the beginning, in the middle and at the end. 21 students (i.e. 28.38 %) were in their 1st year, 26 students (i.e. 35.14 %) were in the 3rd year and 27 students (i.e. 36.48 %) were in the 5th year. We will focus on answering the following research questions:

- What is the success rate of students, future primary-school teachers, in solving non-standard mathematical problems intended for pupils of the 5th grade? (RQ1)
- Are the students sufficiently prepared to solve non-standard problems in their future teaching jobs? (RQ2)
- Does the success rate of solving the problem correspond to the subjectively perceived difficulty of the problem? (RQ3)

2.1. Conducting the research

For the purpose of the research, a set of 10 non-standard mathematical problems was compiled. The problems were chosen in difficulty corresponding to the curriculum of the 5th grade of primary school. Figure 1 shows an example of test problem T10. For each of the problems, the respondents were asked to rate the success of their solution on a 1-5 point scale. At the end of the test, the respondents were asked to indicate which of the problems they perceived as the most difficult and which as the easiest. The initial assumption was that the future teacher should be able to successfully solve mathematical problems of the level of difficulty of the 5th grade.

Figure 1. Assignment of problem T10.

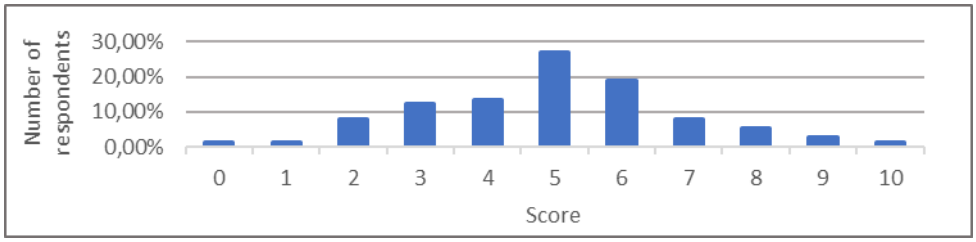


Based on the answers of the respondents, the difficulty of each problem was statistically determined according to Chráska (Chráska, 2007). The difficulty value Q is given by the relation of $Q = 100\frac{b}{n}$, where b is the number of respondents who solved the problem incorrectly or not at all, and n is the number of all respondents. Value of $Q \in < 0, 100 >$. A problem can be considered difficult if Q > 80. If Q < 20, the problem is easy. The results are summarised in Table 1. Easy problems include T_2 and T_4; on the contrary, problems T_1 and T_9 can be considered difficult.

3. Discussion

The scores achieved by the respondents in the didactic test are shown in Graph 1. Scores included a range from 0 points (minimum) to 10 points (maximum). We assumed that prospective teachers should correctly solve all the problems presented. The results were surprising to us.

Graph 1. Respondents' scores in the didactic test.



Only one student of the 5th year solved all the problems correctly. Most of the students (i.e. 27.03 %) achieved a score of 5 points. Only 36.49 % (i.e. 27) of the respondents scored higher than 5. The results of 10 respondents (i.e. 10.81 %), who scored 0, 1 and 2 points in the test, are quite striking. The results achieved by the students did not depend on the year of study. Students of the 5th year did produce slightly better results than students in the other participating years, but the differences were not statistically significant. We believe that the students involved generally do not have sufficient skills in

solving non-standard problems. The evaluation of the difficulty of each problem is summarised in Table 1. According to the results obtained, problems T2 and T4 can be classified as easy problems and problems T1 and T9 as difficult ones.

Table 1. Difficulty of test problems.

Test problem	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
n_s	12	64	42	67	29	54	28	42	10	18
Q	83.78	13.51	43.24	9.46	60.81	27.03	62.16	43.24	86.49	75.68

Key: n_s – number of successful solvers, Q – difficulty coefficient.

The respondents' subjective evaluation of the difficulty of problems T1, T2, T4 corresponds to the results obtained in the test. Significant differences can be observed in problems T8 and T9. Although the respondents perceived T8 as the second most difficult problem, 56.76 % of the respondents successfully completed it. In contrast, problem T9, which has the highest difficulty coefficient Q, was perceived by the respondents as only moderately difficult. However, only 18.51 % of the respondents successfully solved it. A self-reflection of one's own performance in the case of this problem did not correspond to the objective outcome.

As part of the analysis of the results, we examined whether the respondents adequately perceived their success in solving the individual problems in the didactic test. A detailed analysis is beyond the scope of this text. Let us just give summary results that can lead us to deeper reflection. For most of the problems, the respondents overestimated their performance. Specifically, for problem T10 (Figure 1), there were 18 correct solutions, although 26 respondents thought they had solved the problem correctly. Only 10 successful solvers were sure of the correctness of their answer. These findings point to the possibility of a deeper interpretation of the results in the area of prospective teachers' self-confidence and adequate self-assessment.

4. Conclusions

The development of pupils' mathematical literacy is closely linked to solving application word problems, which are often non-standard. This means those problems for which it is not possible to use a pre-learned solution algorithm. It is striking that the research respondents, prospective teachers, were unable to successfully solve such problems at the level of difficulty of the 5th grade. The results of the research indicated the need to revise the concept of undergraduate mathematics training of primary-school teachers. So far, these are partial results that should be verified in a broader international research.

Acknowledgements

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