



ACHIEVING HIGHER LEVELS OF MATHEMATICAL LITERACY WITH INNOVATIVE TEACHING APPROACHES AND A CRITICAL USE OF DIGITAL TECHNOLOGY

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Abstract

An increasing number of students in primary school dislike maths, their motivation to solve problem tasks is declining, which results in poorer mathematical literacy.

The above-mentioned issues can be solved only by applying innovative teaching approaches such as learning maths with the innovative learning environment MS Teams. Such learning is very interesting for students, knowledge testing is easier, and students get feedback immediately. Students are more motivated to learn math, which in turn means raising math literacy.

Keywords: *daily life problems, digital technology, innovative teaching approaches, mathematical literacy, MS Teams*

Introduction

Mathematics is present in most areas of people's lives and work. Due to the development of information and communication society, mathematics is increasingly less visible in other subject areas because it is hidden in technology. It is thus less important to routinely master calculation procedures for managing specific activities; understanding, cross-curricular integration, the use of mathematical knowledge and problem solving are the ones gaining in importance (Žakelj, 2011).

Mathematical literacy is the ability to detect, understand and use mathematical arguments in everyday life. The ability to modify a mathematical argument in a known situation and apply it to an unknown one, i.e., the application of mathematical arguments in new situations is especially important (Cotič & Felda, 2011).

Mathematical literacy of Slovenian students is still above average in comparison with the achievements of students from other OECD countries according to the PSA study from 2018 but the results are somewhat lower compared with 2015.

Recently, more and more researchers are dealing with the question of understanding student's emotions in the context of education and their integration with other factors of learning success and behaviour. This is also linked to motivation and positive attitude of students towards schoolwork (Šterman Ivanèè, 2019).

In the scope of life satisfaction indicators and expressing positive emotions, Slovenian students are a little under the average compared to peers from other OECD countries; the result is also a bit lower compared to the results from 2015 (Šterman Ivanèè, 2019).

A positive attitude and students' motivation for schoolwork can only be improved by different, innovative teaching methods, which bring mathematical content closer to students and encourage them to search for the solutions of mathematical problems in everyday life.

One of the possible solutions is learning mathematics in the scope of the innovative teaching environment MS Teams. This kind of learning is more interesting for the students because it has many advantages in comparison with traditional teaching methods. Within these activities, students can develop a critical relationship towards the use of digital technology, learn suitable mutual communication and communication with others. They themselves will also become responsible developers of various internet content at the same time, which means they will also develop their digital competences.

Digital literacy is a basic skill, which enables individuals to cope with the digital world. Digitally literate individuals know and use digital appliances and tools, understand the characteristics of the digital social environment, and know their way around it (Javrh, 2018).

Research Methodology

Fourteen eight-graders participated in the research group and twelve in the control group. In the research group, the lessons took place in the innovative teaching environment MS Teams. They discussed new subject matter with the use of assigned tasks in MS Teams. The subject matter and all instructions were available in digital notebooks. The students complemented and submitted their notes to the teacher in digital form. All teacher feedback to students and feedback from peers also took place inside the uniform communication channel in MS Teams. The control group had lessons in classical form with taking notes and writing findings into notebooks, feedback was given mostly in spoken form.

Motivation or positive attitude of students towards mathematics was measured with the help of a short questionnaire. Students in the research group filled in the questionnaire twice. The first time before the beginning of innovative teaching and the second time after two months of lessons in the innovative teaching environment MS Teams.

The two short questionnaires were used to check the attitude of students in the research group towards mathematics and how they liked the working method during these lessons.

Research Results

Results showed that students do not like mathematics (more than 40 %) and that they feel they cannot use the knowledge gained during mathematics lessons in everyday life (almost 30%).

Table 1

The Results of the Questionnaire in the Research Group before the Start of Innovative Teaching N = 14

Share of students in %	I do not agree at all (%).	I do not agree (%).	I agree in part (%).	I agree (%).	I agree completely (%).
1. I like mathematics.	21.4	21.4	28.6	14.3	14.3
2. I will use the knowledge acquired in mathematics lessons in everyday life.	7.2	21.4	35.7	21.4	14.3
3. I like the working method during mathematics lessons because I learn a lot during lessons.	14.3	21.4	28.6	21.4	14.3

More than 35% of students were not satisfied with the working methods used in mathematics lessons and felt they did not learn enough. The same number of students felt the working methods during mathematics lessons were adequate and that they learned enough.

Motivation of students for learning mathematics was also measured using the share of finished homework.

Figure 1

The Results of the Questionnaire in the Research Group before the Start of Innovative Teaching N = 14

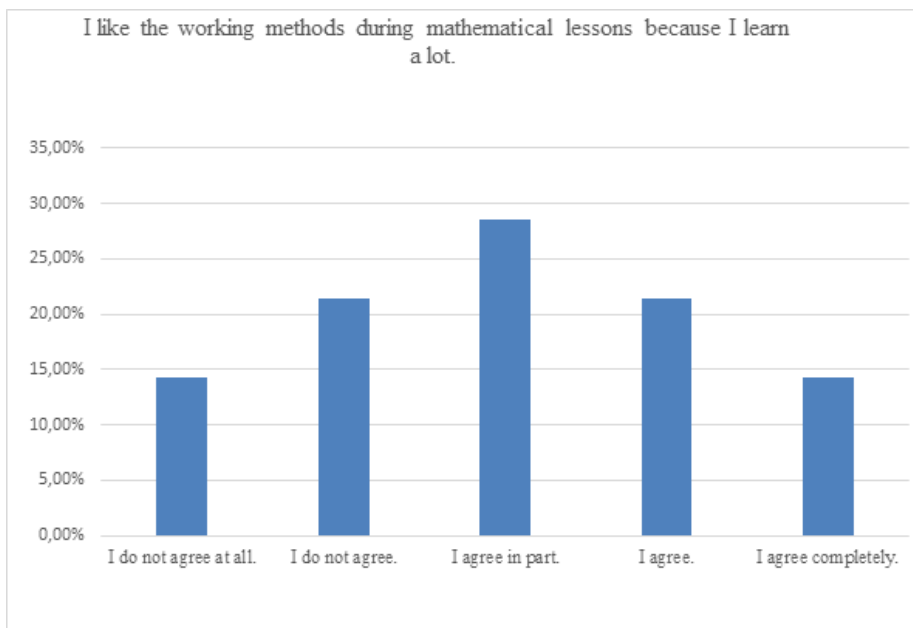


Table 2

The Results of Finished Homework in the Research Group before the Start of Innovative Teaching N = 14

Share of finished homework in %	0-20	21-49	50-69	70-89	90-100
Share of students in %	0	14.3	21.4	35.7	28.6

Less than 30 % of students finished homework regularly (above 90 %); more than 14 % of students finished less than half of their homework.

After two months of teaching mathematics using the on-line teaching environment MS Teams, a second questionnaire was performed with the students of the research group.

Results showed that the attitude of students towards mathematics somewhat improved because the number of students who do not like mathematics fell by 10 % and the number of students who feel they will not use the knowledge gained during mathematics in everyday life also fell for more than 5 %.

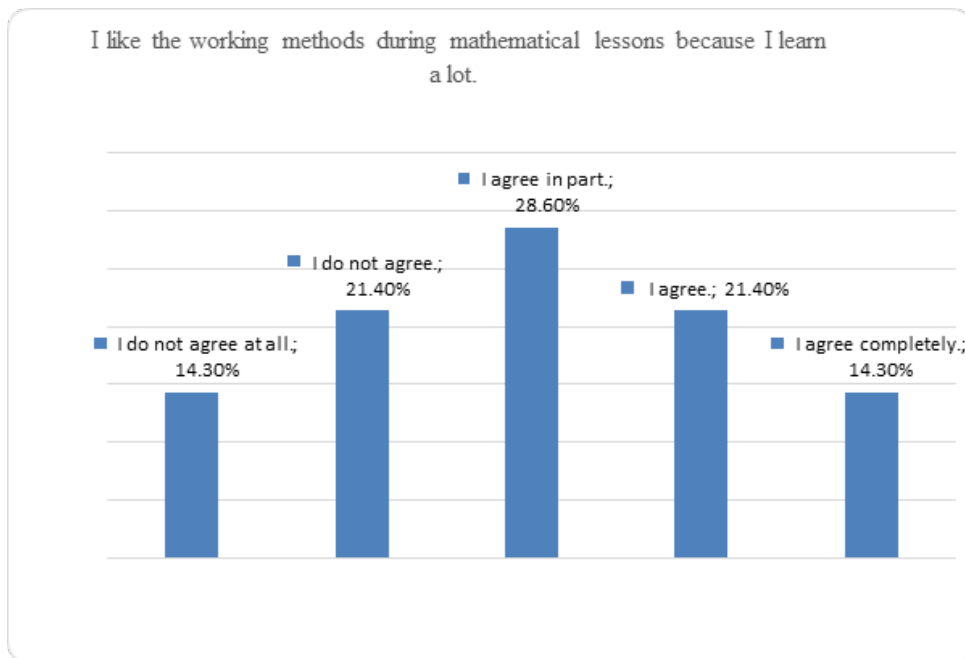
Table 3

The Results of the Questionnaire in the Research Group after two Months of Innovative Teaching N = 14

Share of students in %	I do not agree at all (%).	I do not agree (%).	I agree in part (%).	I agree (%).	I agree completely (%).
1. I like mathematics.	7.2	21.4	28.6	28.6	14.3
2. I will use the knowledge gained in mathematics lessons in everyday life.	7.2	14.3	35.7	28.6	14.3
3. I like the working method during mathematics lessons because I learn a lot during lessons.	0	14.3	21.4	35.7	28.6

Figure 2

Student Satisfaction in the Research Group after Two Months of Innovative Teaching N = 14



Only as much as 14 % of students felt that they did not like the working methods during mathematics lessons or that they do not learn enough. As much as 64.3 % of students were satisfied with the new working methods during mathematics and felt they learned enough.

The essential difference was also seen regarding homework; students finished homework using various digital technology such as smart phones and solved exercises in digital notebooks in MS Teams.

Table 4

The Share of Finished Homework in the Research Group in the Two Months Period of Innovative Teaching N = 14

Share of finished homework in %	0-20	21-49	50-69	70-89	90-100
Share of students in %	0	7.2	14.3	50	28.6

More than 7 % of students still finished less than half of their homework but there was a substantial increase of the number of students who finished more than 70 % of their homework; their share was 80% of all students.

The students of the control group finished the questionnaire only once, after the research group finished the two months of innovative teaching. Students from the control group discussed the same subject matter and learned to use mathematics in everyday life with the use of the textbook. The homework in both groups also covered the same content but in the research group they were made using digital technology.

Table 5
Results of the Questionnaire in the Control Group N = 12

QUESTION/ Share of students in %	I do not agree at all (%).	I do not agree (%).	I agree in part (%).	I agree (%).	I agree completely (%).
1. I like mathematics.	16.7	8.3	33.3	25	16.7
2. I will use the knowledge acquired in mathematics lessons in everyday life.	16.7	16.7	16.7	33.3	16.7
3. I like the working method during mathematics lessons because I learn a lot during lessons.	16.7	16.7	25	25	16.7

Results showed that students in the control group like mathematics more - less than 25 % of the students answered they did not like mathematics. Similarly to the research group before the start of innovative teaching, the students of the control group felt that they will not need the knowledge gained in mathematics class in everyday life (almost 30 %).

Similar to the research group, the control group had 30 % of students who were not satisfied with the working methods used in mathematics lessons and felt they did not learn enough. A slightly higher share, 40 % of students, felt the working methods during mathematics lessons were adequate and that they learned enough.

Motivation of students for learning mathematics was also measured using the share of finished homework.

Figure 3
Student Satisfaction in the Control Group N = 12

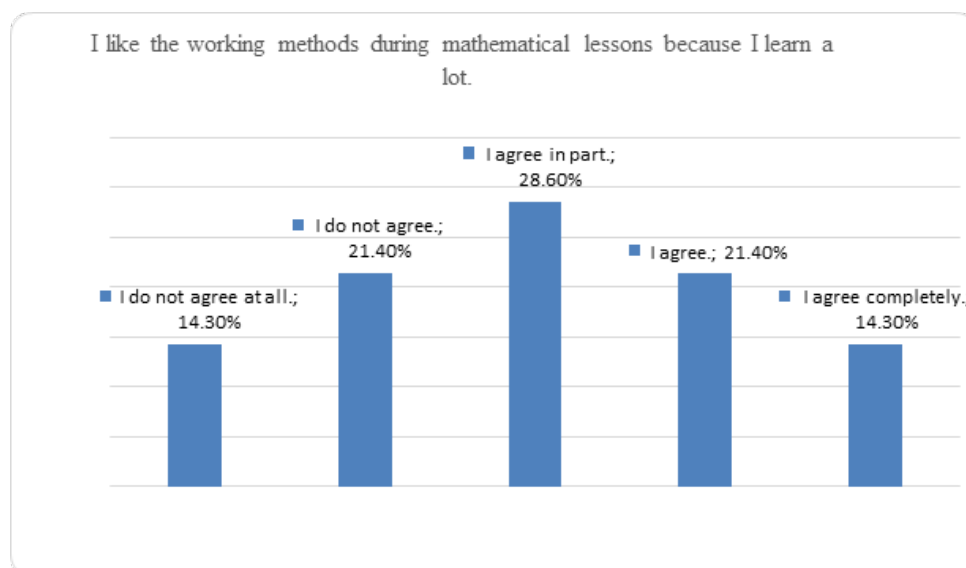


Table 6*Share of Finished Homework in the Control Group $N = 12$*

Share of finished homework in %	0-20	21-49	50-69	70-89	90-100
Share of students in %	16.7	8.3	16.7	33.3	25

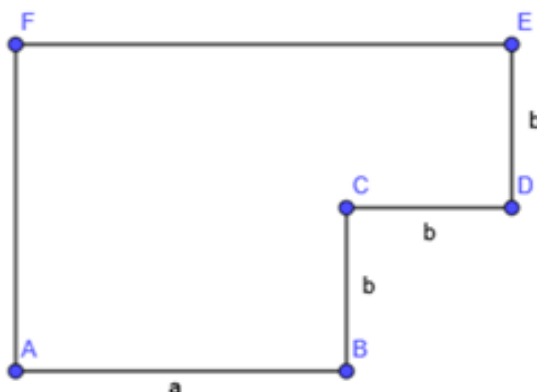
25 % of students finished homework regularly; 25 % of students finished less than half of their homework. The data is very similar to the data in the research group before the start of innovative teaching.

The level of mathematical literacy in terms of using mathematical knowledge in everyday life and new situations was a bit harder to verify because the groups were not entirely analogous. The students of the control group, namely, achieved better learning outcomes on average than the students from the research group.

Students' achievements in problem solving were compared by testing the knowledge during the innovative teaching method. The problems presented to the students did not only test the reproduction of learned knowledge but also the use of this knowledge in everyday life and new situations. The students had to write down specific examples from everyday life with a mathematical equation including a variable and use the knowledge about calculating with variables in a new situation, namely calculating the circumference and area of the polygon.

The figure shows a diagram of a garden (the angles measure 90 degrees).

- Use an equation with a variable to write which length of fence is needed to enclose the garden.
- Use an equation with a variable to write the surface of the garden
- Calculate the length of fence needed and the surface of the garden if $a = 5\text{m}$ and $b = 2.4\text{m}$

Figure 4*Example of a Problem for Verifying the Use of Mathematical Knowledge in Everyday Life*

The students from the research group were more successful in solving this problem than the students from the control group; they scored an average of 53 % and the students of the control group only 46 %. The result was surprising because the students from the control group were again better in solving tests as a whole by an average of 4.9 %. Substantial progress in the research group was also seen in weaker students; their scores were 4 % better than those of weaker students in the control group.

In the scope of using the innovative learning environment MS Teams, the students also gained a lot of new knowledge in the sense of critical use of digital technology because they always had to verify the data they obtained on-line. The credibility of data was verified with the use of textbooks and e-textbooks. There was also a big improvement in the field of communication because they had to practise respectful, linguistically and grammatically correct expression when writing feedback to each other.

Checking prior knowledge and knowledge took place via on-line quizzes. The advantage of this method of testing knowledge is mainly that students and teachers get instant feedback.

Conclusions and Implications

The teaching method definitely influences positive attitude of students towards the subject and student motivation definitely increases with innovative teaching methods. The study found that the share of students in the control group who were unhappy with the teaching method in mathematics decreased by 14.2 %; the share of students who liked the teaching method in mathematics and felt they learn a lot during lessons increased by 28.6 %.

Greater motivation of students in the research group is also confirmed by a 7.1 % increase in the share of students who completed more than half of the homework; there was also a 14.3 % increase in the share of the students who completed more than 70 % of the homework.

The study found that the use of innovative teaching methods also improves mathematical literacy. The students in the research group were 7 % better than the students from the control group in solving problems which tested the use of mathematical knowledge in everyday life and new situations which is mainly the result of better motivation of the students for schoolwork and homework.

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