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CHAPTER 15

PERCEPTION OF TEACHING MATHEMATICS DURING THE PANDEMIC: ATTITUDES OF PROFESSORS AND PRIMARY SCHOOL STUDENTS IN SERBIA³

Abstract: The COVID-19 pandemic's impact on global social systems, including Serbia's education system, has resulted in a health crisis. During the global pandemic in Serbia, teaching took place through a complete or partial online model, or a combined model of teaching. This paper presents the results of the study of opinions on teaching topics in mathematics, those that were found the easiest, and those that were found the most difficult, by students and professors, during the pandemic. A combined mix method was used to collect data, which included a population of primary school teachers, mathematics professors, and students from the territory of the Republic of Serbia. For the purpose of the research, three semi-structured questionnaires were constructed. The research was conducted in two phases. The first phase of the research was conducted in May 2021, where the survey method was used, and it included classroom teachers, mathematics professors, and students from 13 primary schools in the territory of the Republic of

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Serbia. The second phase of the research was conducted through the focus group research in March 2023 and included classroom teachers and mathematics professors from the same population. The results of the research showed that, during the implementation of mathematics classes in the time of the pandemic, students and professors found the easiest tasks in arithmetic, and the most difficult tasks with a theme from life in the field of geometry. The reason for this would be, according to classroom teachers and math teachers in primary schools, the limitations they encountered in the online space, related to didactic-methodical skills.

Keywords: *pandemic, task contexts, mathematics, students, teachers, online teaching*

INTRODUCTION

The virus, called SARS COVID-19, appeared all over the world in early January 2020 and caused consequences that affected the entire system, including education. According to UNESCO, the adoption of measures to contain the spread of the disease has resulted in the disruption of full-time education for over 1.5 billion students in 165 countries around the world (UNESCO 2020). Also, in the Republic of Serbia, based on the decision of the Government of the Republic of Serbia, a state of emergency was declared (*Official Gazette of the Republic of Serbia, no. 29/2020*) in March 2020. Traditional classes, organized in school, were replaced by online distance teaching, which implied a spatial distance between students and teachers, with the main goal of achieving knowledge and skills through submitted information and instructions by applying various technologies and forms (Ristić & Mandić 2019). Students and teachers in the Republic of Serbia encountered the new learning model for the first time. The entire teaching process took place in an online environment, through television and the Internet, and with the pedagogical support of teachers through virtual social and educational platforms, which enabled communication and support for the learning process regardless of space and time. TV lessons were pre-recorded and broadcasted on the channels of the public service according to the established schedule of classes, lasting 25 or 30 minutes, while respecting all didactic-methodical principles. However, this model of teaching also showed its shortcomings, which were reflected in the same approach to all students, i.e., access to the average student, whereby other students (gifted, below average, and students working according to an individualized plan and program) were neglected. This model of teaching was represented until the end of the school year. The very next school year (2020/21), the educational work was organized using two models: *the basic model*, which envisaged teaching through direct school work, and the *combined model*, which included educational work in school through direct work and distance teaching with the use of online learning platforms, which lasted

30 minutes (Kuzmanović 2022). The most commonly used learning platform was Google Classroom, which provided access to teaching content at any time, easy storage of teaching materials and student papers, as well as availability through various technical devices. However, the organization of the model also differed depending on the age of the students. Classes were conducted daily in the school for students in the first cycle, while for students in the second cycle, classes were realized according to the basic or combined model. By analyzing different learning models, it was found that combined learning model was the most appropriate (Lalić 2021: 254, according to: Alqahtani & Rajkhan 2020), but on the other hand, teaching mathematics was one of the disciplines that needed the most the use of the new didactic teaching strategies given its symbolic nature and its emphasis on paper rather than technology (Videla Reyes et al. 2022).

Context in teaching mathematics

The goals and term outcome of teaching mathematics are achieved by solving mathematical tasks, i.e., by acquiring fundamental mathematical knowledge necessary for understanding and the ability to solve mathematical problems in everyday life (Požgalj 2018: 1). This means that students should be trained from the beginning of their education to solve tasks independently, which is achieved by approaching teaching content through the experience of students in order to motivate them and encourage them to work. A mathematical task is a request or order to find unknown data, number, or size from known data (Markovac 2001). Dejić (2000: 222) defines a mathematical task as a request or question to which an answer should be found, relying on the conditions set in the task while taking into account the context of the task. In the broadest sense, the term context (lat. *contextus*) means that with which the observed phenomenon forms a whole, within which it acquires its true meaning or expression (Klajn & Šipka 2006), and the way in which the situation is described in a mathematical problem, which refers to a situation from everyday life, is called context (Glasnović Gracin 2007). The role of context in teaching and learning mathematics is very important because the understanding of context plays an important role in connecting abstract mathematical concepts with the adequate real-life situations (Gušić 2016). Marja van den Heuvel-Panhuizen (2003) emphasizes that students should learn mathematics by developing and applying mathematical concepts and tools in everyday-life problem situations that make sense for them. Despite the general tendency to highlight the importance of mathematics in solving everyday life problems, students' difficulties with such tasks persist. This is demonstrated by the International Student Assessment Program (PISA) tests that focus on real-life problems that are in line with the definition of numeracy literacy (Plothová et al. 2017), and which are found in the text tasks.

Solving textual tasks is the key activity of teaching mathematics, in which students develop and acquire abilities that enable them to organize and apply the acquired knowledge (Vasojević 2020, according to Gortcheva 2012). Textual tasks are tasks in which data and relationships between them are formed by words that need to be computationally shaped, and then by an appropriate computational operation to determine the unknown data expressed by a number (Markovac 1990: 83). Text is used with or without context. By solving tasks with context, students connect mathematics with everyday life (Kos & Glasnović Gracin 2012). An essential feature of tasks given in the context of real life is their ability to motivate and engage students in learning mathematics (Cheng 2013). This is the most complex type of a task because there is no template, established procedure of work, rule, or unique model for its solution. Solving mathematical tasks in a real context leads to the improvement of students' abilities: research, creative thinking, logical reasoning, evaluation of results (Felda & Cotic 2012: 51), furthermore, perseverance is developed and will is strengthened, etc. In addition to all the advantages, students encounter certain difficulties when solving these tasks: understanding the situation, for example, in terms of insufficient concentration and misunderstanding of the read, the problem of setting the task, choosing the appropriate computational operation (Prediger 2009), fear of failure, and poor grades. The results obtained by authors Anić and Pavlović Babić (2011) showed that students are more successful when solving tasks when data are selected in advance. However, tasks with a theme from real life do not have this feature, so it is necessary exactly the other way around to extract from the large amount of available data only those that are necessary in the process of solving the problem, which creates difficulties for students. In fact, students have difficulty understanding mathematical concepts and choosing strategies for solving problems in everyday life. Therefore, it is very important that students solve textual tasks with a topic from real life from the beginning of their education, as well as that teachers keep in mind the representation of this type of task during different phases of the class (Vasojević, Krnjaić & Vasojević 2021) in order to develop self-confidence, thought operation, logical thinking, and reasoning over time.

The aim of this paper is to determine, based on the opinions of students, teachers, and teachers of mathematics, during classes in altered conditions, i.e., during the pandemic caused by the coronavirus, which are the easiest and which the most difficult teaching topics of mathematics for students when solving tasks with a topic from real life, as well as what are their favorite real-life situations in tasks. We have established a comparison between the opinions of students and teachers/teachers of mathematics.

Based on theoretical understandings and results from the previous research (see Vasojević 2020), the research starts with *the hypothesis* that in the teaching process

the biggest problem arises when solving textual problems with a topic from real life, and that this problem is directly conditioned by the degree of use of textual tasks with a real-life topic by a professor of primary education or a professor of mathematics.

METHODS

In this paper, a mixed method was used because the study of mixed methods is research that intentionally combines or integrates quantitative and qualitative approaches as components of the research (Ponce & Pagán-Maldonado 2014), and recognizes this approach as the third model of research in the social sciences (Ponce & Pagán-Maldonado 2014). In the first phase of the research, during May 2021, a questionnaire (paper and pencil) was used to examine the attitudes of students, primary school teachers, and mathematics teachers on various aspects of solving tasks during the pandemic period. The questionnaire contained open and closed questions. After the quantitative data were calculated, analyzed, and results obtained, the qualitative phase of the research followed to conduct a group interview with primary and mathematics teachers from the same sample ($N = 11$). For the purpose of the second phase of the research, a semi-structured questionnaire was created, and the examination was carried out through Zoom during March 2023. The conversations were recorded, the audio recordings were transcribed, and they constituted immediate empirical material for analysis. The selected quotes were conveyed literally and they significantly contributed to the understanding of the results, and we will list them gradually during the listing of results (Vesković Anđelković & Vasojević 2023) which lead to an explanation and understanding of the attitudes of the respondents, noticing causal relationships in the obtained data during the first phase of the research, and the qualitative draft was inductive and creates opportunities for examining the existing idea, developing new theories (Sekol & Maurović 2017), and deepening the results that were missing in quantitative research.

RESEARCH METHODS AND DATA SOURCES

Description of the sample from the first phase of the research: quantitative method

The research included 13 primary schools ($N = 1723$) students from the first to the eighth grade, from urban ($N = 1387$) and rural areas ($N = 336$), as well as 75 teachers and 75 teachers of mathematics who are employed on the territory of the Republic of Serbia. Given the gender, the sample of professors is not uniform; 14% of respondents are male and 86% are female. This information is not surprising because women are much more committed to the call of the educator. The sample of

students by gender was uniform (871 boys and 852 girls). The sample is also uniform by class distribution (1st grade N = 150; 2nd grade N = 176; 3rd grade N = 232; 4th grade N = 238; 5th grade N = 247; 6th grade N = 209; 7th grade N = 237; 8th grade N = 234). Also, the distribution of the sample in relation to student achievements at the end of the first semester in mathematics is as follows (grades: insufficient-24 students; sufficient-254; good-291; very good-396; excellent-608; no response-150 respondents, because first graders have descriptive grades).

RESULTS AND DISCUSSION

The first phase of research

Given the defined goal of the research and variables, the subjects were observed as two groups - Sample 1 consisted of students, and Sample 2. consisted of primary school teachers and mathematics professors in primary schools.

Sample 1: The students' answers to the following questions were investigated:

1. In classes during the pandemic, in which area of mathematics you found the tasks with a theme from real life the most difficult, and in which the easiest?

2. What topics in real life did you like the most when they came up in the text of a task?

The largest number of students claimed that in mathematics classes during the pandemic, the most difficult tasks with a topic in real life were those in the field of geometry (a third of students). The result can be linked to Van Hille's theory of learning geometry, where there are five levels of thinking that the student goes through, and by moving from one level to another, they develop the ability to understand geometry (Baranović 2015). If students' levels of thinking do not develop, there is poorer student success and a misunderstanding of geometry. The obtained results are correlated with the previous findings that indicate that the achievements of students in the field of geometry are weaker than in other areas of mathematics represented in school (Milenković et al. 2017), which shows that there is no difference between the realization of the traditional and online models of teaching. 28% of students consider the most difficult tasks of this type to be in arithmetic. The proportion of students who cited equations and inequalities in response is equal, as well as those who were not sure of their position on this issue -12.6% of them. About 5% of students listed algebra, measurement, and a negligible number of data processing and sets.

About 30% of students stated that the most difficult tasks with the theme of real life were in geometry and arithmetic, but also the question of which field was the easiest for them—students primarily choose the same areas. Over half

of the students stated that the easiest tasks were in arithmetic. These contents are introduced from the beginning of schooling, upgraded from grade to class, computational operations are constantly repeated, and new material is gradually added to the old. A fifth of the students listed geometry. Just under 10% of students consider the easiest tasks to be equations and inequalities, and about 5% algebra and data processing. A negligible number of students chose areas of measurement and measurement sets, and 8% of them are unsure of their position on this topic.

As the topics they like, the students mostly cite those related to real-life situations that are realized during the performance of everyday activities, such as sports (16%), food (13%), and companionship (11%), while they prefer topics about animals and shopping (7%), or money (6%). These findings can be associated with a lack of subjects in financial education. Over a fifth of students cited a topic that does not belong to one of the above categories, and 12% of them believe that such a topic does not exist.

Sample 2: Primary school teachers and mathematics teachers and their attitudes during classes during the pandemic to the following questions:

1. List the topics in which you have used the most often, and topics in which you have not or have rarely used tasks in the context of a real-life situation;
2. List the most common real-life situations represented in the tasks you have solved with students.

As the answer to the first question, nearly half of the respondents stated that there were no such topics. This result is significant and shows that teachers associate teaching topics in mathematics with everyday life, and that the changed model of teaching has not affected the work of classroom teachers and teachers of mathematics. By choosing teaching content, they influenced the development of competencies for lifelong learning in students. This is followed by 25% of those who rarely use tasks of this type in geometry and 12% in algebra. About 7% of the lecturers cited arithmetic, and 5% cited equations and inequality. Among the most common real-life situations represented in the tasks that primary and mathematics teachers have solved with students, were those that included purchase (29%) and money (26%), followed by sports, food, friendship, and animals (2%). Answers that do not belong to any of the above categories make up a set of 17%, while every tenth answer is not the best formulated.

Also, classroom teachers and mathematics teachers were able to list more teaching topics, so the sum of their answers is more than 100%. Nearly half of the respondents said that in arithmetic they most often used tasks in the context of a real-life situation; 46% of them cited geometry, Table 1.

Table 1. Attitudes of respondents

| Area | Percent (%) [*] |
|----------------------------|--------------------------|
| Arithmetic | 49.3 |
| Geometry | 46.0 |
| Equations and inequalities | 33.3 |
| Algebra | 30.7 |
| Measuring and measures | 18.0 |
| Data processing | 14.7 |
| I don't/ don't know | 1.3 |
| Sets | 0.0 |

^{*}The total sum is greater than 100% because respondents had the option of multiple selections.

The research results showed that geometry is the biggest problem for students to solve textual problems with a real-life topic and the results are in the accordance with less frequent use by teachers.

The second phase of research: a qualitative approach

N1⁴ (F, 10y, PM, RV) describes the work during the pandemic as follows: “*It is much more difficult to explain to students the contents of geometry in the online space, especially construction. It takes a long time to prepare such a class on Google Classroom. Not all of the students have the technical skills.*” Similarity is found in the responses of other respondents (N1:9). While N2 (F, 10y, PM, CC) states, “*It required more time to prepare classes; it is more challenging and more difficult compared to the traditional model of teaching; the only advantage is that prepared material can be used later, because I used the Google platform to realize classes. However, views - based on him, the teacher can most often notice what their problem is; not everyone immediately says what they do not understand. Problems of a technical nature each influenced the selection of teaching content and topics.*” Here the match with the other N3:7 respondents was found. Unlike them N3 (F; 8y, PST, CC) describes this situation as “*In the first grade, it is necessary to show the student how to use the ruler, how to set up and hold, and this is possible only with direct contact. The “one-to-one” word and the relationship “one to one” are irreplaceable. The teaching content had to be aligned according to the working conditions.*” This kind of coincidence was found in the responses of other respondents in N3:4. From the results of the interview, it was also found that N1 and N2 recognized a lack of online space and

⁴ In the paper for the socio-demographic description, we use the following labels: For poles: M (male), F (female); the years of service are numerically expressed; primary school teacher: PST; professor of mathematics: PM ; demographic structure: rural environment; RE, city center: CC.

that the traditional teaching model is more suited to this teaching content, while N3 recognized a lack of direct contact with students. Respondents N2, N3, N6, N9, and N10 stated that it was the easiest for them to realize teaching units in the teaching topic of arithmetic (fractions, integers, and rational numbers, numbers up to 100, computational operations), because this required teaching and didactic materials that are easy to use in the online space.

DISCUSSION

The results of this research showed that, during the course of classes during the pandemic, the most difficult tasks with a topic in the real life for students were those in the field of geometry. The most common life situations that were represented in the tasks that class teachers and mathematics teachers have solved with students are also situations that students like the most when they come up with tasks and relate to the real-life situations: sports, food, money, and shopping. However, the results suggest that teachers rarely use assignments in the context of the real-life situation in geometry. The interview revealed that they see the online space as a constraint for this type of teaching, that there is a lack of social interaction (student-teacher-student), and that the traditional teaching model is more suited to these teaching contents. Also, these answers indicate that the choice of a teaching model is influenced by how qualified the teacher feels to work in this teaching model. Such data corresponds to the findings of the previous research that reveals the shortcomings of online learning models and indicates teacher preferences (Vučetić, Vasojević & Kirin 2020; Vasojević, Vučetić & Kirin 2021), therefore, it is necessary for management education to be focused on improving computer equipment (Kirin, et, al., 2022: 8) and encouraging teachers to acquire additional IC skills. On the other hand, 50% of students reported that the easiest tasks were in arithmetic, which is consistent with the attitudes of teachers. In these tasks, there is a development of the thought processes of students where they acquire a sense of quantity, assessment, etc. The results obtained by the research allow the acceptance of the starting hypothesis because the students' biggest problem in solving tasks is textual tasks with a theme from real life, which are related to the degree of use of textual tasks with a topic from real life by the teacher of mathematics, and vice versa. When interpreting the results, one should also take into account the limitations of the research, which refer to the fact that the respondents are from one country.

CONCLUSION

The fact is that this research has opened up new questions and problems and that it is one of the first studies of this kind in our region. Therefore, such studies are represented in the foreign literature, and on the other hand, in the relevant

domestic literature, there is no research that applies a mixed research methodology in education, which is why there are certain limitations in this paper. The results obtained can be partially related to the space and time in which they were realized. These results contribute and should be seen as a starting point for future research, and at the same time, they contribute to a better understanding of the topics that study the context of tasks from the perspective of students and teachers. On the other hand, these findings contribute to a broader view of the application of new digital technologies in mathematics teaching.

REFERENCES

- Anić, I., Pavlović Babić, D. (2011). "Solving Mathematical problems in real context: Qualitative and Quantitative analysis of achievement". *Nastava i vaspitanje*, LX(2), 193-205. [In Serbian]
- Baranović, N. (2015). "On the development of geometric thinking in the teaching of mathematics according to van Hiele's theory". *Symposium on Mathematics and Applications VI* (1). [In Serbian]
- Cheng, L. P. (2013). "The Design of a Mathematics Problem Using Real-life Context for Young Children." *Journal of Science and Mathematics Education in Southeast Asia*, 36(1), 23-43.
- Dejić, M. (2000). *Mathematics teaching methodology*. Jagodina: Faculty of Teacher Education. [In Serbian]
- Felda, D. and Cotić, M. (2012). "Teaching and learning – Goals, Standards and Outcomes". In: S. Marinković (ed.). *Mathematical literacy and realistic problems*. Užice: Univerzitet u Kragujevcu - Pedagoški fakultet u Užicu, 51-60. [In Serbian]
- Glasnović Gracin, D. (2007). "Mathematical literacy, part 1". *Matematika i škola*, VIII (39), 155-163. [In Croatian]
- Gušić, M. (2016). "The role of the teacher in the formation of mathematical concepts in students", *Poučak*, 17(67), 4-12. [In Croatian]
- Klajn, I. & Šipka, M. (2006). *Large dictionary of foreign words and expressions*. Novi Sad: Prometej [In Serbian]
- Kirin, S., Vučetić, I., Vasojević, N., Kirin, S. (2022). "Lean Tools for Improving the Teaching Process in Serbia - Empirical Research". *Management* 27 (1), 1-10. [In Serbian]
- Kos, D. & Glasnović Gracin, D. (2012). "The problem of text tasks". *Matematika i škola*, XVI(66), 5-8. [In Serbian]
- Kuzmanović, D. (2022). *Formal education in Serbia during the coronavirus pandemic: research findings and recommendations*. Užice: Užice Center for Children's Rights. [In Serbian]

- Lalić, B. (2021). "Distance learning systems and collaborative tools in the time of the COVID-19 pandemic". *XXVII Skup trendovi razvoja: on-line nastava na univerzitetima*, 253-256.
- Markovac, J. (1990). *Methodology of elementary mathematics teaching*. Zagreb: Školska knjiga. [In Croatian]
- Markovac, J. (2001). *Methodology of elementary mathematics teaching*. Zagreb: Školska knjiga. [In Croatian]
- Milinković, J., Marušić Jablanović, M., Gutvajn, N. (2017). Students' Achievement In Mathematics: Main Results, Trends, And Curriculum. In: M. Marušić Jablanović, N. Gutvajn and I. Jakšić (eds.). *TIMSS 2015 in Serbia* (27-50). Beograd: Institut za pedagoška istraživanja.
- Official Gazette of the Republic of Serbia*, no. 29/2020. [In Serbian]
- Ponce, A.O., Pagán-Maldonado, N. (2014). "Mixed Methods Research in Education: Capturing the Complexity of the Profession". *International Journal of Educational Excellence*, 1, (1), 111-135
- Plothová, L., Páleníková, K., Naštická, Z., Florková, M. & Šubová, L. (2017). "An analysis of students' use of mathematical models in solving tasks with real-life context", *Conference on Applied Mathematics APLIMAT*, 1207-1223.
- Požgalj, V. (2018). *Text tasks with context in mathematics classroom teaching*. (Diploma thesis). Zagreb: University of Zagreb - Faculty of Education, Department of Teacher Studies. [In Croatian]
- Prediger, S. (2009). "Inhaltliches Denken vor Kalkül – Ein didaktisches Prinzip zur Vorbeugung und Förderung bei Rechenschwierigkeiten. Unredigierte Vorversion eines Beitrags für den Sammelband: Fritz, Annemarie / Schmidt". Siegbert (Hrsg.): *Fördernder Mathematikunterricht in der Sekundarstufe I*, 213-234.
- Ristić, M. and Mandić, D. (2019). *Distance education*. Beograd: Učiteljski fakultet. [In Serbian]
- Sokol, I., Maurović, I. (2017). "Mixing quantitative and qualitative research approaches in Social science- Mixing methods or methodology?", *Ljetopis socijalnog rada*, 24 (1), 7-32. [In Croatian]
- UNESCO (2020). COVID-19 Educational Disruption and Response. Retrieved 22. 06. 2022. from <https://en.unesco.org/covid19/education-response>.
- Van Den Heuvel-Panhuizen, M. (2003). "The didactical use of models in realistic mathematics education: An example from a longitudinal trajectory on percentage", *Educational Studies in Mathematics*, 54/1, Springer, 9 – 35.
- Vasojević, I. (2020). "Fourth-grade students' achievement in solving arithmetic problems depending on the context of the problems". *Nastava i vaspitanje*, 69(1), 85-98. [In Serbian]

- Vasojević, N., Vučetić, I. and Kirin, S. (2021). “The Serbian primary school teachers’ profiles regarding the preference for a teaching model during the COVID-19 pandemics”. *Norma*, XXVI(1), 27-38. [In Serbian]
- Vasojević, I., Krnjaić, Z., Vasojević, N. (2021). “Developing Creativity in Mathematics Instruction”. *Nastava i vaspitanje*, 70 (2), 165-176. [In Serbian]
- Vesković Anđelković, M., Vasojević, N. (2023). “(Re)construction of the identity of highly educated returnees: The case of Serbia”. *Sociološki pregled*, 57 (4), 1074–1098. DOI: 10.5937/socpreg57-46750
- Videla Reyes, R., Rossel, S., Muñoz, C., Aguayo, C. (2022) “Online Mathematics Education during the COVID-19 Pandemic: Didactic Strategies, Educational Resources, and Educational Contexts”. *Educ. Sci.* 12, 492. doi.org/ 10.3390/educsci12070492
- Vučetić, I., Vasojević, Kirin, S. (2020). “Opinions of High School Students in Serbia on the Advantages of On-Line Learning during the COVID-19 Pandemic”. *Nastava i vaspitanje*, 69(3), 345–359. [In Serbian]