Journal of the Institute for Educational Research
Volume 54 • Number 1 • June 2022 • 27–39
UDC 37.091.3::51(497.5)
37.014(497.5)

ISSN 0579-6431
ISSN 1820-9270 (Online)
https://doi.org/10.2298/ZIPI2201027B
Original research paper

PRIMARY SCHOOL TEACHERS' EXPERIENCE IN THE PLANNING AND IMPLEMENTATION OF SUPPLEMENTARY TEACHING OF MATHEMATICS

Ines Blažević, Irena Mišurac and Josipa Jurić*
Faculty of Humanities and Social Sciences, University of Split, Croatia

ABSTRACT

The basic characteristic of teaching mathematics is an outstanding hierarchical connection of its contents, so it is important to promptly resolve possible ambiguities in understanding and applying mathematical concepts that we observe in students during their learning. In situations when students fail to achieve satisfactory results during regular classes, it is necessary to organize supplementary classes to improve their results as a means of pedagogical intervention. In this paper our goal was to present the planning and implementation of supplementary teaching of mathematics in primary education in Croatia. The results of the empirical part of the research conducted among 198 primary school teachers through the survey showed us how primary school teachers prepare supplementary mathematics classes, i.e. what they consider to be the key aspects in planning. Descriptive analysis, factor analysis, t-test for independent samples, one-way analysis of variance for independent samples and correlation analysis were used in the data analysis. Results showed that teachers understand the importance of involving students with different types of difficulties and the adaptation of teaching methods during supplementary mathematics classes. They are aware that students need more help so they involve students' parents. The obtained research results are an incentive for teachers to think when planning quality supplementary classes in order to help each student in need as efficiently as possible.

Key words:
Supplementary mathematics teaching, individualization, primary school students, teachers, planning teaching of mathematics.

* E-mail: jjuric@ffst.hr

INTRODUCTION

Mathematical knowledge and skills are necessary for every individual in both professional and private life. Mathematics is all around us, it allows us to understand and describe the world around us, and it is necessary for the technological progress of humanity. Mathematics is a science that develops logical thinking, analytical thinking, creativity, systematicity, and activity of the mind (Li & Schoenfeld, 2019; Metikasari, 2019). That is why mathematical education is given great importance and in more developed countries the success of students in mathematics is carefully monitored. Mathematics is the basis for many other areas of human activity, especially natural and technical sciences, but also engineering. However, it is often considered to be the most difficult subject in school and many students do not achieve satisfactory results in it, which is why they lose the opportunity to continue their education in scientific, technical, or applied disciplines (Devčić, 2019; Li & Schoenfeld, 2019).

Today's society requires a mathematically literate individual who is able to make reasonable judgments, use mathematics, and participate in mathematics in a way that meets the needs of the individual as an active, interested, and thoughtful citizen (OECD, 2003). In order to develop this kind of literacy in each student, it is necessary to constantly improve the modes of working with students through regular classes, but also through other forms of formal education. In general, schools where students receive worse evaluation results should intervene with comprehensive educational measures such as intensive training and mentoring, frequent and abundant monitoring of teaching, development of a positive school climate, providing adequate working conditions, increased work with less successful students, and the activation of compensation programs. (Teodorović Jakšić & Milin, 2020). Success for all students and an individualized approach in which teaching is adapted to the needs of each student are features of most modern mathematics curricula, so special attention should be paid to students with learning difficulties in mathematics (Khaira & Herman, 2020; Kumari, Vyas & Vidyapeeth, 2020).

In order to enable all students to acquire knowledge and skills prescribed by the curriculum in an appropriate way, besides regular classes, there are two additional forms of teaching - supplementary and additional classes through which the above can be achieved. Additional classes are intended for students who can and want more, providing them with broader, deeper and more complex knowledge. They solve more complex problems and achieve additional outcomes appropriate to their abilities. Supplementary teaching is an individualized form of group work for students who cannot follow the regular curriculum with the expected level of success (Državni pedagoški standard osnovnoškolskog sustava odgoja i obrazovanja, 2008). Therefore, it is necessary to react in every situation when there is a difficulty in learning with students and include them in supplementary classes which are a means of pedagogical intervention in situations where regular teaching procedures

cannot achieve satisfactory results with students (one or more of them), so this extra lesson tries to provide time in which the teacher can help a student in an appropriate way. The teacher identifies students to whom such teaching can help and invites them to get involved (temporarily or permanently) in it (Markovac, 2001). Such an identification and work with students who achieve less success presupposes teachers' good knowledge and is a prerequisite for achieving better results (Hill & Chin, 2018). The reasons why an individual student may be included in supplementary classes are varied. It can be a student who otherwise would have difficulty mastering concepts prescribed by the curriculum, students with certain difficulties that prevent them from understanding or learning (Khaira & Herman, 2020; Metikasari, 2019), a student who for some reason missed classes, a student who has certain emotional problems that affect learning outcomes, a student who has forgotten certain previous contents and cannot get involved in further learning to upgrade those contents, as well as students who are not sufficiently motivated to work or have not developed self-confidence and can also be helped with an adapted approach (El-Adl & Alkharusi, 2020; Grigg, Perera, Mcllveen &Svetleff , 2018; Samuel & Warner, 2021).

Primary education is compulsory for all the students in the Croatian educational system. It lasts for 8 years and is divided into two educational cycles - lower class teaching from 1st to 4th grade and upper class teaching from 5th to 8th grade. In the lower grades, the same teacher teaches most of the major subjects, including mathematics, while in the second cycle, from 5th to 8th grade, each subject is taught by a subject teacher. In all primary school grades, the weekly number of mathematics lessons is four and one supplementary lesson in Croatian schools lasts for 45 minutes. It takes place at school, once a week and it is taught by the same teacher who teaches the regular mathematics program. Its organization is obligatory in primary schools (Law on Education in Primary and Secondary Schools, 2020, Article 33) in situations when such a form of assistance to students is needed. Each class is provided with supplementary classes, which are organized for subjects where there is a need, and the student attends them additionally to attendance at regular classes.

The research problem stems from the need to strengthen the role of supplementary lessons in mathematics in eliminating difficulties in mastering mathematical concepts from the earliest age during formal education. The aim of the research was to determine how primary school teachers plan and implement supplementary lessons in mathematics.

METODOLOGY

Sample. 198 teachers from the first cycle of primary education employed in primary schools in the Republic of Croatia took part in the empirical part of the research and volunteered to complete the questionnaire.

The following table shows the descriptive statistical indicators for the variables *age, work experience, qualification and profession* collected from the first part of the questionnaire.

Table 1: Descriptive statistical data on sociodemographic characteristics of respondents

		N =198
age	<30	24
	30-50	102
	>50	72
work experience	<10	48
	10-30	114
	>30	36
qualification	higher education	63
	high education	122
	master of teaching (primary education)	13
title	mentor/advisor	173
	none	25

Out of the 198 respondents, there were 194 female teachers and 4 male teachers. Table 1 shows that the largest share of those are middle-aged (52%), and in terms of work experience 58% of them have worked between 11 and 30 years.

Instrument. An anonymous questionnaire as a research instrument consisting of two parts was constructed to conduct the research. The first part contained questions related to socio-demographic characteristics: gender, age, work experience in the profession, title and qualification. School teachers can advance in their profession in the Croatian education system, and there are two levels of advancement, teacher mentor and teacher advisor. The second part of the instrument included a Likert-type Scale of views on the planning and implementation of additional classes, which contained 25 statements. On this 1–5-point scale, the respondents assessed the

extent to which the individual statements applied to them, with 1 meaning *it doesn't apply to me at all* up to 5 which had a meaning *it completely applies to me.* For the purposes of this research, the authors constructed a questionnaire based on a review of the relevant literature, years-long experience, and direct contact with pupils and students at different levels of the educational system.

Procedure. The authors of the paper conducted the empirical part of the research at the county professional councils for primary school teachers. All participants were familiar with the purpose of the research and could withdraw from participation at any time.

Data processing methods. Descriptive analysis, factor analysis, t-test for independent samples, one-way analysis of variance for independent samples (ANOVA) and correlation analysis were used in the data analysis. Descriptive data are expressed in frequencies and percentages in the presentation of sociodemographic characteristics, while individual factors were observed through the arithmetic mean and standard deviation. The results of the Kaiser-Meyer-Olkin and Bartlett scale tests in the second part of the questionnaire, which included 25 claims, proved to be significant, and the value of the KMO test was .74. Six factors were obtained by the basic components method and Varimax was obtained by normalized rotation to explain 38.07% of the total variance. The reliability and validity of the Cronbach's Alpha scale ranged from .27 to .66, which we find satisfactory.

RESULTS

The following tables shows the statements that were in the survey and their division into factors and the arithmetic mean and standard deviation of each factor. Six factors were singled out and named in turn; *individualization* (F1), *working mode adjustment* (F2), *stigmatization* (F3), *the need for supplementary classes* (F4), *similarities to regular classes* (F5) *and parental involvement* (F6).

Table 2: Factor1 structure matrix with arithmetic means and standard deviations

factor	statement	M ± SD	factor loadings
F1 (3.64 ± .62)	I have special materials for work in supplementary classes.	3.79± 1.04	.342
	Supplementary classes should be represented by more than one hour.	3.67±1.04	.415
	I prepare a special task for each student.	3.54±1.09	.742
	I prepare special material for each student.	3.18±.92	.767
	I spend a lot of time preparing supplementary classes.	3.18±.92	.372
	I carefully choose tasks for supplementary classes, depending on the student's difficulties.	4.39±.75	.453

The first factor is the *individualization* of supplementary mathematics teaching. Most teachers accomplish this by selecting appropriate tasks for each student and teaching materials and they spend a lot of time planning the supplementary classes. They also generally agree that supplementary mathematics classes should be represented by more than one lesson a week.

Table 3: Factor2 structure matrix with arithmetic means and standard deviations

factor	statement	M ± SD	factor loadings
F2 (3,51 ± .59)	In supplementary classes, I encourage students to help themselves with didactic material	3.73±.92	.718
	In supplementary classes, I often have to reinterpret the content.	3.71±.93	.488
	Children who stay in the supplementary classes have very different problems.	3.71±.99	.598
	I rarely use a textbook in supplementary classes.	3.44±.98	.442
	Supplementary classes are mostly attended by children with long-term difficulties.	2.92±1.24	.428

The second factor tells us that teachers, in order to better implement supplementary teaching, *adjust the way of teaching* in order to overcome different and specific student difficulties. Teachers assessed that students in supplementary classes have a variety of problems. Teachers encourage them to help themselves with didactic material, but the frequent use of textbooks as a teaching tool is still present. To a large extent, they need to reinterpret the teaching contents done in regular classes.

Table 4: Factor 3 structure matrix with arithmetic means and standard deviations

factor	statement	M ± SD	factor loadings
F3 (2,45 ± .80)	If the parent does not want the student to attend supplementary classes, I respect the wishes of the parents.	3.09±1.37	.315
	Parents are often embarrassed when children stay in supplementary classes.	2.38±1.21	.642
	Students are embarrassed when they stay in supplementary classes	2.30±1.19	.670
	Supplementary classes stigmatize students.	2.04±1.16	.654

Regarding the *stigmatization* of students (third factor), teachers generally disagree that supplementary classes stigmatize students or that students are uncomfortable when they stay in supplementary classes.

Table 5: Factor 4 structure matrix with arithmetic means and standard deviations

factor	statement	M ± SD	factor loadings
F4 (3,54 ± .99)	Even good students sometimes need extra classes.	3.37±1.11	.704
	If more than half of the class does the exam badly, I leave all students in supplementary classes.	3.50±1.41	.677
	Supplementary classes are needed from time to time for each student.	3.35±1.33	.774

The fourth factor expressed *the need for supplementary classes*. Teachers believe that supplementary classes are sometimes needed for good students, not just the less successful ones. Also, if there is a situation of generally worse test results than expected, supplementary classes are organized for all students.

Table 6: Factor 5 structure matrix with arithmetic means and standard deviations

factor	statement	M ± SD	factor loadings
F5 (2.84 ± .62)	In supplementary classes, we practice the tasks we do in regular classes.	3.37±1.02	.597
	In supplementary classes, we all solve the same task together on the board.	2.93±1.07	.395
	Supplementary classes are always attended by the same students.	2.89±1.15	.412
	The way I work in supplementary classes is similar to the way I work in regular classes.	2.76±1.17	.617
	In supplementary classes, I solve exclusively arithmetic tasks.	2.20±1.17	.443

The similarities between supplementary and regular classes (fifth factor) are mostly reflected in solving the same tasks as in regular classes in a way that everyone solves the same task together on the board.

Table 7: Factor 6 structure matrix with arithmetic means and standard deviations

factor	statement	M ± SD	factor loadings
F6 (3,81 ± .72)	I instruct parents of students who go to supplementary mathematics classes on how to work with them at home.	4.26±.79	.448
	My student's parents are partners in supplementary mathematics classes.	3.37±1.07	.730

The last of the factors indicates that teachers believe that it is very important *to involve parents* in the implementation of supplementary classes. Parents are instructed on how to work with students at home and consider them partners in supplementary mathematics teaching.

Furthermore, the t-test for independent samples showed that there were no statistically significant differences in individual factors in relation to qualifications. One-way analysis of variance for independent samples (ANOVA) also showed that there were no statistically significant differences between groups based on years of service except for factor 3 (p=.04); teachers with less than 10 years of service are more likely to believe that students are stigmatized by attending supplementary classes compared to those with years of service between 10 and 30 years. The situation is similar regarding the professional qualifications of teachers; the only statistically significant difference (p = .03) in the F1 factor which tells us that teachers with a master's degree in primary education believe that individualization is less important than those with high and higher education.

We performed a correlation analysis to verify the interrelationship of factors. Those whose association is statistically significant (p<.05) and where the Pearson correlation coefficient is at least relatively weak (r≥.02) are shown in the following table.

Table 8: Correlation between the factors

	r	p
F1 and F2	.22	.002
F1 and F6	.22	.002

From the previous table we see that teachers who consider individualization important in working with students in supplementary classes also attach more importance, will try to adapt the way students work in supplementary classes, and will involve parents in the whole process.

DISCUSSION

An insight into the results of factor analysis shows that teachers, when planning and implementing supplementary mathematics classes, pay the most attention to individualization, the way they work during classes, and the involvement of parents in the whole process. Students who have difficulties with mathematics can benefit from targeted mathematics lessons designed to respond to individual learning needs (Stevens, Rodgers &Powell, 2018). It has been shown that if teachers use individual data and information about an individual student when teaching and access it in this way, the level of student success improves (Connor, Mazzocco, Kurz, Crowe, Tighe, Wood & Morrison, 2018). "Observing the success of primary and secondary school students with learning difficulties, the critical need to change the implementation

of teaching for these students is emphasized. […] individualization based data of the student's previous knowledge and difficulties, provides the teacher with the opportunity for systematic monitoring in order to design interventions that provide targeted and individualized support" (Powell *et al*., 2021: 9). Also, teachers must expand their aspects and perspectives in order to modify the way of supplementary teaching in order to achieve progress with each of the students who need help to master the content that creates difficulties for him during regular classes. In order for teaching to be effective and result in student learning, the adaptability of the teacher and his/her way of working is needed (Hattie, 2009). Based on the results of *similar to regular classes*, we can see that teachers do not have a clear opinion on the similarity of regular and supplementary classes and therefore it is obvious that during the implementation of supplementary classes changes, some must be introduced in relation to the regular mathematics lesson in which the whole class participates. "The teacher has to, using her or his knowledge of students and pedagogical content knowledge, deviate from the original objective of the lesson in order to provide modification to the lesson at hand. […] Teacher metacognition connects the ways educators take knowledge and construct adaptations to fit the complex and social environment of the classroom [...] to meet students' needs" (Parsons *et al*., 2018, 209). They pointed out in the F2 factor, *the way of working* that in working with students in supplementary classes they often help with didactic material, they clearly present abstract mathematical ideas. These are objects that students can visually see, feel, touch, move, i.e. they are suitable for more of the student's senses (Heddens, 1997; Karol, 1991; Moyer, 2001). Furthermore, as supplementary classes are held only once a week, it can be assumed that for students who need additional work this will not be enough to overcome difficulties, so the teacher gives them guidelines for independent work at home. It is certainly good and desirable to involve parents in this, so that the child can regularly learn and practice at home in a way adapted to him (Jay, Rose & Simmons, 2018). The cooperation of parents and teachers is certainly desirable because the parent is usually the one who is most interested in the success of their child, and can help him/her every day through work, repetition, providing time for learning, playing mathematics games to automate some actions such as multiplication and division or addition and subtraction (Husen & Mansor, 2018; Šlogar, 2017). The teacher, as a professional, can recommend literature to the parent, give homework assignments, provide leaflets or other written materials for the exercise, recommend games or practice activities, and the like. In the cooperation of teachers and parents, everyone benefits, both the teacher who can easily work with the student in regular classes, and the parent who receives expert advice on how to help their child, and most of all the student who receives continuous and comprehensive help.

CONCLUSION

Based on theoretical and empirical research presented in this paper, it is evident that teachers understand the importance of supplementary math classes, involving students with different types of difficulties in them, but sometimes not individualizing the teaching itself to the extent that it would certainly help students with difficulties more and make this teaching effective. Certainly, it is a good sign that teachers are aware that some students need help more often than the supplementary classes themselves allow, so they involve students' parents and adapt their homework assignments to them. Supplementary classes of mathematics should include visible pedagogical action through cooperation between teachers, parents, and students, which teachers are aware of. The step that should be taken requires further education in this area through professional development programs, but also in the initial teacher education. Modern education, especially in its compulsory part, must ensure the success of all students in mathematics, and teachers have shown that they are aware of this. Of course, one lesson of supplementary classes will not be enough for a student who has deeper difficulties, so we should strive to introduce more lessons in which teachers as professionals will be able to work with students and adapt teaching methods, tasks and forms of work in learning mathematics.

The limitations of this research are visible in the methodology because certain relevance parameters were not at the highest level. Yet, due to the lack of similar research in this area, we decided to present them in full. Namely, the descriptive results of all examined items can give us a broader insight into the research issues and be an incentive for experts and scientists in this field for further research. In considering the overall issue of planning and implementation of supplementary mathematics classes, it would be important to examine the attitudes of students attending these classes and the attitudes of their parents. Finally, it would be useful to examine the effectiveness of supplementary classes by testing differences in an individual student performance and mastering mathematical knowledge before and after attending supplementary classes.

References

- Connor, C. M., Mazzocco, M. M., Kurz, T., Crowe, E. C., Tighe, E. L., Wood, T. S. & Morrison, F. J. (2018). Using assessment to individualize early mathematics instruction. *Journal of School Psychology*, *66*, 97–113. DOI: https://doi.org/1.1016/j.jsp.2017.04.005.
- Devčić, M. J. (2019). Razlozi neuspjeha u nastav i učenju matematike [Reasons for the failure in mathematics teaching and learning]. In M. Nikolić & M. Vantić-Tanjić, (ur.), *1. Međunarodna naučno-stručna konferencija „Unapređenje kvalitete života djece i mladih" II dio*, Full Papers, Tuzla, (pp. 155–165). Tuzla: Udruženje za podršku i kreativni razvoj djece i mladih.
- Hrvatska, R. & Športa, O. I. (2008). *Državni pedagoški standard osnovnoškolskog sustava odgoja i obrazovanja [National Pedagogical Standard of the Primary School Education System].* Retrieved February 1st, 2022 from the World Wide Web https://narodne-novine.nn.hr/clanci/sluzbeni/2008_06_63_2129.html.
- El-Adl, A. & Alkharusi, H. (2020). Relationships between self-regulated learning strategies, learning motivation and mathematics achievement. *Cypriot Journal of Educational Sciences*, *15*(1), 104–111. DOI: 10.18844/cjes.v15i1.4461
- Grigg, S., Perera, H. N., McIlveen, P. & Svetleff, Z. (2018). Relations among math self efficacy, interest, intentions, and achievement: A social cognitive perspective. *Contemporary Educational Psychology*, *53*, 73–86. DOI: 10.1016/j.cedpsych.2018.01.007
- Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement.* New York: Routlege.
- Heddens, J. W. (1997). *Improving mathematics teaching by using manipulatives.* Retrieved October 23, 2011 from the World Wide Web http://www.fed.cuhk.edu.hk/~fllee/mathfor/edumath/9706/13hedden.html.
- Hill, H. C. & Chin, M. (2018). Connections between teachers' knowledge of students, instruction, and achievement outcomes. *American Educational Research Journal*, *55*(5), 1076–1112. DOI: 10.3102/0002831218769614
- Husen, S. D. & Mansor, R. (2018). Parents Involvement in Improving Character of Children Through Mathematics Learning. *JurnalIlmiahPeuradeun*, *6*(1), 41–5.
- Jay, T., Rose, J. & Simmons, B. (2018). Why is parental involvement in children's mathematics learning hard? Parental perspectives on their role supporting children's learning. *Sage Open*, *8*(2). DOI: 1.1177/2158244018775466
- Karol, Y. (1991). *Manipulatives: Motivating Mathematics.* East Lansing, MI: National Center for Research on Teacher Learning. Retrieved February 1, 2022 from the World Wide Web ERIC Document Reproduction Service No. ED 355 097.
- Khaira, U. & Herman, T. (2020). Assessment processes for slow learners in mathematics learning. *Journal of Physics: Conference Series*, *1521*(3), p. 032097.
- Kumari, A., Vyas, C. & Vidyapeeth, B. (2020). Challenges Faced by Slow Learners in Mathematics at Primary Level of Education. *Journal of Xi'an University of Architecture & Technology*, *12*(3), 4639–4644.
- Li, Y. & Schoenfeld, A. H. (2019). Problematizing teaching and learning mathematics as "given" in STEM education. *International Journal of STEM Education*, *6*(1), 1–13.
- *Law on Education in Primary and Secondary Schools* (2020). Retrieved February 1st, 2022 from the World Wide Web https://www.zakon.hr/z/317/Zakon-o-odgoju-i-obrazovanju-u-osnovnoj-i-srednjoj-%C5%A1koli

- Markovac, J. (2001). *Metodika početne nastave matematike* [Methodology of initial mathematics teaching]. Zagreb: Školska knjiga.
- Metikasari, S. (2019). Mathematics learning difficulties of slow learners on a circle. *Journal of Physics: Conference Series*, *1227*(1), p. 012–022.
- Moyer, S. P. (2001). Are we having fun yet? How teachers use manipulatives to teach mathematics. *Educational Studies in Mathematics*, *47*, 175–197.
- OECD (Organisation for Economic Co-operation and Development). (2003). *Mathematics Teaching and Learning Strategies in PISA.* Paris: OECD Publishing.
- Parsons, S. A., Vaughn, M., Scales, R. Q., Gallagher, M. A., Parsons, A. W., Davis, S. G., ... & Allen, M. (2018). Teachers' instructional adaptations: A research synthesis. *Review of Educational Research*, *88*(2), 205–242. DOI: 10.3102/0034654317743198
- Powell, S. R., Lembke, E. S., Ketterlin-Geller, L. R., Petscher, Y., Hwang, J., Bos, S. E., ... & Hopkins, S. (2021). Data-based individualization in mathematics to support middleschool teachers and their students with mathematics learning difficulty. *Studies in Educational Evaluation*, *69*, 100897.
- Samuel, T. S. & Warner, J. (2021). "I can math!": Reducing math anxiety and increasing math self-efficacy using a mindfulness and growth mindset-based intervention in first-year students. *Community College Journal of Research and Practice*, *45*(3), 205–22. DOI: 10.1080/10668926.2019.1666063
- Stevens, E. A., Rodgers, M. A. & Powell, S. R. (2018). Mathematics interventions for upper elementary and secondary students: A meta-analysis of research. *Remedial and Special Education,* 39(6), 327–34. DOI: https://doi.org/1.1177/0741932517731887
- Šlogar, S. (2017). Izvanškolska dopunska nastava matematike [Extracurricular supplementary teaching of mathematics]. *Poučak: časopis za metodiku i nastavu matematike, 18*(70), 4–18.
- Teodorović, J., Jakšić, I. & Milin, V. (2020). Value added of schools in Serbia. *Zbornik Instituta za pedagoska istrazivanja*, *52*(1), 81–135. DOI:10.2298/ZIPI2001081T

Recieved 18.03.2022; Accepted for publishing 06.06.2022.