

## APPLICATION OF COOPERATIVE LEARNING IN EARLY MATHEMATICS TEACHING – TEACHERS' ATTITUDES

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### ABSTRACT

*Cooperative learning is a modern teaching strategy in which team work and cooperation become the most important activities of the entire teaching process. The quality of interaction between students and teacher, as main participants in teaching process, is important for successful application of cooperative learning. Beside faster and longer lasting knowledge acquiring, cooperative learning develops critical and creative thinking, communication and social skills and it strengthens self-confidence. Modern methods of teaching mathematics focus on didactical principle of conscious activity above other principles. This means students are major, active factors of mathematics teaching, and not only they participate in the process of teaching, but they also participate in the selection of methods of teaching. This enhances their motivation for work during classes. This means, what is learned through cooperative learning is better used in new situations, knowledge transfer is greater and new knowledge is acquired easier and lasts longer. Specific and abstract contents of mathematics lead to different ways of applying cooperative learning in this subject. That is why we chose this subject, i.e. to explore and point out the possibilities and ways of applying cooperative learning in mathematics.*

**Key words:** cooperative learning, teaching mathematics, teacher, student

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### INTRODUCTION

Application of cooperative learning in classrooms creates more creative and encouraging atmosphere for development of students' potential. When learning in smaller groups, students develop knowledge and their intellectual and problem solving abilities, as well as critical and creative thinking.

Teacher who uses cooperative learning has the roles of organizer, helper, friend, reviewer, and a confidant to his or her students. Every teacher must, according to his or her own abilities, develop and improve professional competencies to

apply this method of work, but also other modern methods.

The importance of cooperative learning, as modern and active method of classroom work, is shown by better achievements of students, better knowledge retention, better motivation, development of social skills, establishing positive relationships between students and teacher. Although one can use cooperative learning in all school subjects, in this work we focused on importance and application of cooperative learning in early mathematics teaching.

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## TRADITIONAL MATHEMATICS TEACHING OR MODERN MATHEMATICS TEACHING

If we compare traditional and modern school, teaching and learning, we may notice great differences between them.

Traditional teaching is a combination of teacher's lectures and demonstration of teaching means and methods. One can notice domination of verbal meth-

ods, as well as dominant status of teacher, who gives prepared information, with high level of leading student's cognitive process and insufficient student's activity (Andrić, 1989).

For better understanding of given characteristics and mentioned differences, here we give a table on relationships between learning in traditional and learning in active classroom.

Table 1. Traditional teaching and student-oriented teaching (Andrić, 1989)

TEACHING	
Traditional teaching	Student-oriented teaching
Information giving	Information exchange
Facts- and knowledge-based	Critical thinking, informed decision making
Students receive information	Students question and solve problems
Formal classroom appearance	Flexible, changeable surrounding
Focus on learning to remember	Focus on understanding/application
Grading mostly through traditional examination	Different types of grading, including work on projects
Passive learning	Active inquiry-based learning
One media	Multimedia
One sense stimulation	Multiple senses stimulation

Only so-called "lower" forms of learning exist in traditional teaching. Those are the forms of learning in which student is active only at the knowledge reproduction level. It is important to emphasize that modern educationalists agree that traditional teaching has to be replaced with modern teaching, in which instead of teacher's lectures - students' discoveries will prevail, instead of teacher's tutoring – independent students' work will take place, instead of problem presentation – students will solve problems individually or in groups, instead of one-way thinking, divergent, creative thinking will happen, etc. (De Zen, 2000, p. 127).

## COOPERATIVE LEARNING AND MATHEMATICS TEACHING

The phrase cooperative learning covers two concepts: cooperativeness and learning. That is why it is important to define these two concepts.

COOPERATIVENESS – tendency to cooperate. Readiness and suitability to cooperate is a complex human characteristic which includes: tendency to work in groups, readiness to develop reciprocal (equal) relationships, certain confidence in other people, tolerance towards different opinions and attitudes, benevolence and sympathies for others, control of one's own emotions and egoistic tendencies (Potkonjak & Šimleša, 1989).

LEARNING – Learning is a psychological process which can be defined in several ways. Psychological definition of learning is: Learning is a relatively permanent change of subject's behaviour, which learns under the influence of its own experience. Pedagogical definition of learning is: Learning is knowledge acquirement, skills and habits development, or Learning is mastering the accomplishments of previous generations, i.e. adoption of generation experience (Potkonjak & Šimleša, 1989).

Results of former researches showed that students who had the chance to learn through cooperative learning learn faster and easier, and their knowledge lasts longer. The difference between cooperative learning and group work is interaction and co-dependency of all group members. It is a cooperative learning if all group members work on task implementation, i.e. problem solving, if group success depends on every member and every member's success depends on group. Eric Jensen listed five elements of cooperative learning in his book *Super – teaching* (Jensen, 2003):

1. Positive co-dependency
2. Direct interaction
3. Individual and group responsibility
4. Cooperative skills
5. Group processing.

The most used levels or ways of cooperative learning implementation in mathematics teaching are: cooperative learning approach based on classroom, cooperative learning approach based on pairs of students, and cooperative learning approach based on smaller groups, subgroups or teams. The simplest level is students' cooperation involving the entire class. This level enables application of different teaching methods and techniques, like panel discussions, brain storming, leaded fantasies, etc. The next level of students' cooperation is approach based on work in pairs. This is innovative work form which is infallible part of modern mathematics teaching. Working in pairs is very suitable for students with special needs, whether they are talented or with some learning difficulties. The last level of students' cooperation is implemented in groups. Cooperative learning happens when small groups of students work on a problem which can be solved only through cooperation of all group members. Groups can have three to six students. It is the best to have four students, because those groups have 6-way communication.

Characteristics of group work implemented through cooperative learning are: independent work of one student within the group, cooperation within the group, where every member contributes to the final result, connection between one group's work and work and assignments of entire class and careful planning of group work.

Every student in group or pair has to be active. One student encourages and controls the work of other students, but he also controls his own actions.

Students can do together the following: state the problem, gather information, make a plan to solve it and solve and check the solution of problem.

## ROLE OF THE TEACHER IN ORGANIZING COOPERATIVE LEARNING

Modern school and teaching imply application of new, modern teaching strategies with creative demands and student-oriented teaching.

When it comes to cooperative learning, role of the teacher is to create appropriate cognitive situations, to ask provocative and motivational questions, to prepare didactical material, to plan, guide, and organize work, to leave enough space and time for students for full work and mental activity (Vilotijević, 2008, p. 104).

Innovative teacher can be recognized by following trademarks: originality of ideas, he is an explorer, he uses critical evaluation, he educates himself constantly and he mastered modern technologies.

The goal of cooperative learning is not for teacher to teach students, but for students to learn on their own, while the teacher helps only when necessary. In this new role, teacher has multiple tasks: to prepare assignments, teaching means and materials, making sure there are enough materials for everyone and to decide on size and content of groups, to give every member appropriate tasks and roles, to follow the process of work of every group and to monitor contribution of every individual student in the final result, and if necessary, to correct their work and encourage students, to assess development of every individual student and to inform them on their development, making sure those notifications sound encouraging, to pay attention not only to accuracy of answers, but also the method students use to get it, to demand not the quick work on assignments, but to give them enough time to check the accuracy of their results on their own (Vilotijević, 2008, p. 104).

For students with special needs teachers have to find adequate ways of involving them into the teaching process and work with other students, and to enable them to follow, learn, and acquire knowledge in the most suitable way. Key components of organization of cooperative learning, when working with students with special needs, are involvements that include distribution of work and materials, flexible interpretation of roles and individual students' responsibilities.

## PROBLEM AND SUBJECT OF RESERACH

Previous researches showed that cooperative learning has multiple advantages, and modern school is obligated to improve teaching process by using the methods of active learning. Within the frame of our research, we have following goals:

- To determine if cooperative learning can be successfully integrated in early mathematics teaching,
- To determine advantages of applying the cooperative learning in early mathematics teaching,
- To determine difficulties and restrictions teachers encounter while applying the cooperative learning,
- To determine the possibilities of improvement of cooperative learning,
- To determine if students accept this teaching strategy.

## RESEARCH GOAL AND HYPOTHESES

Goal of our research is to investigate, determine, and critically analyse teachers' and students' attitudes towards cooperative learning in early mathematics teaching. Through this research we will determine to which extent is cooperative learning present in our teaching praxis, what are its advantages and what are the results of its application in teaching process.

H0: Cooperative learning as modern teaching strategy can be successfully used in mathematics classroom teaching.

H1: There are several difficulties and limitations in applying the cooperative learning in early mathematics teaching.

H2: Cooperative learning can be successfully used when working with students with special needs.

## METHODS, TECHNIQUES, INSTRUMENTS AND SAMPLE OF RESPONDENTS

The following methods and techniques were used in this research:

- Method of pedagogical theory analysis was used to collect materials and pedagogical theories on the topic of research.
- Descriptive method was used to describe appearances and states in education.
- Survey method is empirical, non-experimental method which was used to collect data and investigate attitudes and beliefs of teachers as participants of educational process.
- Questionnaire was used to investigate teachers' attitudes and beliefs about research problem.
- Scaling was used to get numerical data on teachers' attitudes towards cooperative learning, its advantages, methods and possibilities of application in early mathematics teaching.

Sample was made of classroom teachers from four elementary schools, two urban schools and two suburban schools, from municipality of Visoko. Those four schools were: elementary school "Safvet-beg Bašagić" from Visoko, elementary school "Kulin ban" from Visoko, elementary school "Mula Mustafa Bašeskija" from Donje Moštre and elementary school "Mehmedalija Mak Dizdar" from Dobrinje.

Table 2. Sample of respondents – classroom teachers

		Frequency	%	Cumulative %	
Valid	Urban schools	Kulin ban	17	23,3	23,3
		Safvet - beg Bašagić	18	28,3	51,7
	Suburban schools	Mula Mustafa Bašeskija	8	13,3	65,0
		Mehmedalija Mak Dizdar	17	35,0	100,0
	Total		60	100,0	

Thirty five teachers were from urban schools and 25 from suburban schools.

When it comes to the length of their service, one can

notice that the majority of them (21 teachers or 35% of all respondents) worked for 16 to 20 years as teachers.

## RESEARCH RESULTS INTERPRETATION WITH DISCUSSION

Analysis of data obtained through questionnaire and attitude scale for teachers and students

Since this research was focused on importance and possibilities of applying the cooperative learning in early mathematics teaching, we wanted to determine whether cooperative learning can be successfully used in mathematics lessons, i.e. whether there are limitations and difficulties in applying the cooperative learning and how does this strategy affects average students and students with special needs.

After statistical processing of data, we got the following information: 24 teachers (40%) answered they

know very much about the concept of cooperative learning, 33% of them know much about this concept, 25% of them know enough, and 1,67% of them know a little about it. So, we may conclude that the majority of teachers are familiar with the concept of cooperative learning.

Practical application of cooperative learning in mathematics lessons is especially important for educational praxis. When asked How often do you use cooperative learning in mathematics lessons?, majority of teachers (53,33% of them) answered they use it often, while 43, 33% of them use it sometimes.

The following table shows the distribution of answers to question "How often do you use cooperative learning" regarding different schools.

Table 3. Use of cooperative learning in mathematics lessons in different schools

		How often do you use cooperative learning in mathematics lessons?			Total
		Often	Sometimes	Rarely	
School name	Kulin ban	F 8	F 6	F 0	F 14
		% 57,1%	% 42,9%	% 0,0%	% 100,0%
School name	Mula Mustafa Bašeskija	F 9	F 8	F 0	F 17
		% 52,9%	% 47,1%	% 0,0%	% 100,0%
School name	Mehmedalija Mak Dizdar	F 5	F 2	F 1	F 8
		% 62,5%	% 25,0%	% 12,5%	% 100,0%
School name	Safvet - beg Bašagić	F 10	F 10	F 1	F 21
		% 47,6%	% 47,6%	% 4,8%	% 100,0%
Total		F 32	F 26	F 2	F 60
		% 53,3%	% 43,3%	% 3,3%	% 100,0%

We compared these answers to see if there is a statistically significant difference in answers of urban school and suburban school teachers and we determined there is no statistically significant difference, i.e. teachers had similar responses.

After finding out how often teachers use cooperative learning, we wanted to see which type of lessons they use it with. We determined that 87,8% of teachers use cooperative learning while teaching new lessons or reviewing previous lessons.

According to teachers' beliefs (91,7%), students accept cooperative learning methods gladly. Analysing answers to this question, one can see that

students like changes in working methods, more creative and original approach to work and that is why one has to use cooperative learning method while teaching.

Based on distribution of answers to question "How well do students accept cooperative learning methods in mathematics lessons" and the results of chi-squared test ( $p > 0,05$  (0, 206)), we determined that the answers of urban and suburban schools teachers are approximately the same.

We also determined that 76,67% of teachers believe that cooperative learning can be successfully used when working with students with special needs.

We wanted to determine the category of students with which cooperative learning can be successfully used. We constructed the questions so that if teacher agreed cooperative learning can be used with students with special needs, he had to list categories of special needs where it is applicable. Based on the answers and the results of chi-squared test, we determined that there are differences between the answers of urban school and suburban school teachers. Urban school teachers said that cooperative learning can be used with students who have specific learning disabilities

(dyslexia, dyscalculia, dysgraphia), while suburban school teachers didn't say that. Similar thing happened with the talented students category. Suburban school teachers believe that cooperative learning can be used with students who have speech disorder. The answers of urban and suburban school teachers were similar in other categories.

Previous research on cooperative learning lacked data on benefits of applying cooperative learning in school. The following table shows frequencies of teachers' answers to this question.

Table 4. According to your opinion, what are the benefits of applying cooperative learning?

	Frequency	%	Cumulative %
Students acquire knowledge easier	11	16,9	16,9
Social skills	13	20,0	36,9
Development of positive characteristics (friendship, humanity, partnership, cooperation)	8	12,3	49,2
Help in learning; students help each other	3	4,6	53,8
Greater motivation to work	3	4,6	58,5
Active learning/student is active in class	12	18,5	76,9
Valid More open relationship between teacher and student	4	6,2	83,1
Explorative work of student	2	3,1	86,2
Social skills development	2	3,1	89,2
Communication development	2	3,1	92,3
Development of competitive spirit	1	1,5	93,8
Expression of thoughts by student	1	1,5	95,4
More creative teaching	3	4,6	100,0
Total	65 <sup>3</sup>	100,0	

Limiting factors teachers face when they decide to use cooperative learning have great influence on application of cooperative learning. That is why we also had this question, in order to get accurate data which can be used to improve teaching process and application of cooperative learning. Based on the results of chi-squared test, we determined there is a statistically significant difference between the answers of urban school and suburban school teachers. Both urban and suburban school teachers agree that they have a problem of too many students in one class and the lack of necessary material. Since our research was focused on

mathematics lessons, we wanted to determine which techniques teachers use in early mathematics teaching. Based on the results, we noticed teachers are familiar with and are using the cooperative learning techniques. Majority of teachers use "brainstorming" technique (25,86%), then the "jigsaw puzzle" technique (17,24%), etc. To determine the real state of cooperative learning application in schools, we asked the following question: "Do you believe cooperative learning is sufficiently used in schools?". Majority of teachers said NO (63,33%), which is quite concerning (authors' remark).

<sup>3</sup>In this question teachers listed the benefits of cooperative learning and we got more answers than we had respondents.

Table 5. Teachers' suggestions for improving cooperative learning in practice

	Frequency	%	Cumulative %	
Valid	To organize seminars for teachers	10	34,5	34,5
	To make application handbooks	6	20,7	55,2
	To provide teaching materials	3	10,3	65,5
	To create better working conditions in schools	4	13,8	79,3
	To educate and motivate teachers	3	10,3	89,7
	Financial support	2	6,9	96,6
	All schools must have equal equipment	1	3,4	100,0
Total	29 <sup>4</sup>	100,0		

Listed suggestions can serve as initial orientation on how to eliminate obstacles and improve application of cooperative learning.

Based on attitudes scale, formed in this research, and answers we got, we conclude that teachers believe cooperative learning can be used in mathematics lessons.

Also, teachers point out that students have better results when cooperative learning is applied in comparison to teaching with traditional methods. Majority

of teachers agree with this statement. Teachers also believe that cooperative learning demands greater proficiency and preparation of teachers. And the most important part is that majority of urban and suburban teachers believe cooperative learning has a positive effect on the quality of relationship between teacher and student. This attitude shows that cooperative learning is important for creating a positive atmosphere in classroom, not only among students, but also between students and teacher.

Table 6. General teachers' attitudes towards cooperative learning (descriptive statistics)

	N	Minimum	Maximum	Mean	SD
Cooperative learning can be applied in mathematics lessons in every classroom	60	0	3	,78	,715
Knowledge gained through cooperative learning lasts longer	60	0	4	1,15	,936
Cooperative learning doesn't affect the quality of relationship between teacher and student	60	0	4	2,60	1,196
Cooperative learning demands greater teacher's proficiency	60	0	4	1,20	1,038
Cooperative learning demands greater preparation of teacher	60	0	2	,78	,585

<sup>4</sup>It was an open-ended question. Teachers wrote their answers and that is why the total number of answers doesn't match the total number of respondents.

Based on the scale means, we can establish that teachers have positive attitude towards the application of cooperative learning in early mathematics teaching (0,78). They also have a positive attitude towards statement that the knowledge gained through cooperative learning lasts longer (1,15). Teachers have negative attitude towards statement that cooperative learning doesn't affect the quality of relationship between teacher and student (2,60), which means that teachers believe that cooperative learning improves relationship between student and teacher. Teachers have positive attitudes towards statements that cooperative learning demands greater proficiency and preparation of teachers (1,20 i 0,78).

We found out that teachers have positive attitude (0,57) towards the influence of cooperative learning on students. Teachers have positive attitude and believe that cooperative learning develops students' social skills, communication and freedom of thoughts (0,47). They also have positive attitude and believe that cooperative learning leads to better learning results, compared to traditional approaches to teaching.

We also calculated the Spearman's rank correlation coefficient in order to determine whether the length of teacher's service is influential factor on attitude towards the application of cooperative learning and its influence on students.

Table 7. General teachers' attitude towards cooperative learning (correlation)

Spearman's rank correlation coefficient		Cooperative learning can be applied in mathematics lessons in every classroom	Knowledge gained through cooperative learning lasts longer	Cooperative learning doesn't affect the quality of relationship between teacher and student	Cooperative learning demands greater preparation of teacher	Cooperative learning demands greater teacher's proficiency
Length of service in school	correlation coefficient	,096	,084	-,089	,131	,192
	Sig. (2-tailed) <sup>5</sup>	,467	,524	,498	,317	,141
	N	60	60	60	60	60

All correlation coefficients are very low, so we can conclude that there is no correlation between length of service and teachers attitudes.

## FINAL CONCLUSIONS

Studying the topic of cooperative learning, we got some interesting results we tried to show in this work. Having in mind that cooperative learning is organized through group work, work in pairs or sometimes with the whole class of students, teachers have to have good didactical skills, great knowledge, creativity, originality, and innovation skills.

Based on the results of our research, we got to conclusion that teachers have positive attitude towards application of cooperative learning in early mathematics lessons and that there is no difference in attitudes of teachers from urban and suburban schools. This way we confirmed our general hypothesis that cooperative

learning, as a modern teaching strategy, can be used in mathematics classroom teaching.

Limiting factors and difficulties teachers face have a great influence on application of cooperative learning. Teachers said they have problems with: lack of materials and means for work, too many students in one class, time for preparation and organization and work conditions in schools, space and technology.

This way we confirmed our first special hypothesis that there are some difficulties and limitations in applying the cooperative learning in early mathematics teaching. We can conclude that a bit more support and more financial means for schools would lead to greater application of cooperative learning in teaching process. Limiting factors and difficulties are different in urban and suburban schools.

Cooperative learning has positive effects on students with special needs since the work is done in heterogeneous groups with students of different abilities.

<sup>5</sup>Statistical significance (2-tailed). Sig. (2-tailed) shows how confident are obtained results. If Sig. (2-tailed) < 0,05, then it is a significant correlation.

Teachers claim that cooperative learning can be used with students with special needs and this way we confirmed our second special hypothesis.

Given everything we wrote in this work, our final conclusion is that it is necessary to change educational praxis in our schools by applying modern, active and innovative methods, due to all their benefits.

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