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Improving Problem Solving Skills using the Collaborative Problem Solving Model

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Abstract:

Introduction: In the twenty-first century, students need to have improved life competences and critical thinking skills. However, teachers also serve as facilitators to ensure the success of the learning process, thus the focus is not solely on helping students develop their skills. The teacher's role in the learning process is essential if pupils are to successfully absorb and comprehend all of the subject matter. According to research, students' comprehension of mathematics is still low both in terms of the material covered and the problem-solving techniques taught. There are certain issues with problem-solving skills in the classroom setting. One of the best ways to deal with these issues is to use a learning model that is appropriate for the difficulties at hand. The collaborative problem-solving model is one of the learning models that may be applied; it combines collaborative learning with problem solving, which is seen to be a solution to the issues experienced.

Objectives: The purpose of this study was to determine whether or not there was an increase in problem solving skills by applying a collaborative problem solving model.

Methods: The research method used quantitative method with experimental research type (quasi experiment) with research design of nonequivalent pretest posttest group design. The research subjects totalled 120 people, 65 students in the experimental group and 65 people in the control group. Data collection using tests conducted pretest and posttest. Data analysis used normality test, homogeneity test and independent sample t test. The results of the research and discussion, it can be concluded that there is an increase in problem solving skills by applying a collaborative problem solving model.

Results: Based on the results of hypothesis testing on the posttest, the significance value> 0.050 and also the mean difference in the posttest of the experimental group and the control group make evidence of differences caused by the application of learning models in the two groups. The experimental group used a collaborative problem solving model while the control group used a conventional model.

Conclusions: The conclusion of this research is that there is an improvement in problem solving skills by using collaborative learning model in the learning process. It is hoped that further studies will be able to look more closely at the collaborative problem solving paradigm in other

subjects, perhaps at different educational levels. Of course, it can also be used with other learning models

Keywords: Collaborative, Problem Solving, Learning Strategy.

1. Introduction

Learners must possess life competencies and improved thinking skills in the twenty-first century. Critical, creative, problem-solving, argumentative, and decision-making skills are examples of high-level cognitive skills [1]. 21st century skills, which include the 4Cs (communication, collaboration, critical thinking, and creativity) or communication, collaboration, critical thinking, and creativity, are just a few of the many different skill types that can be taught and familiarized with by students [2]. These skills are essential for students to succeed in the twenty-first century; critical thinking instruction must be provided during the educational process in order to equip them to join society and participate in social activities. In addition to being essential in the twenty-first century, technology-assisted learning must foster twenty-first century competencies [3].

Nonetheless, the emphasis is not only on students' skill development; teacher also plays a part in the learning process as a facilitator to ensure its success. In order for students to successfully acquire and comprehend all subject matter, the teacher's role in the learning process is crucial. Conducting an assessment is one of the criteria used to determine whether a class was successful or not [4]. Teachers are significant change agents, and how they approach teaching in the twenty-first century can directly affect how they instruct students [5]. Successful teaching is significantly impacted by the attitudes of teachers [6]. The effectiveness of an educational system is significantly impacted by its teachers [7]. Many education professionals believe that teachers are one of the most important factors in students' learning [8]. Teachers can use innovative teaching methods to enhance the standard of instruction in classrooms [9]. Teachers should be able to support one another with feedback that highlights the value of a design that prioritizes collaboration, discovery, and enhanced literacy while also encouraging students to work together, coordinate, share, discuss, and solve problems [10]. With the role of teachers who have good quality and according to standards, the quality of learning will be much better.

The problem's results indicate that, until far, students understanding of mathematics has been weak in terms of both the content and problem-solving skills they are taught. The school's learning environment demonstrates several issues with problem-solving abilities. Furthermore, there are signs that low motivation might negatively affect students' ability to solve problems, making it a crucial component that must be taken into account. The discovery of mathematical difficulties is further corroborated by other studies that indicate mathematics is a challenging and intimidating topic for certain children [11]. Students struggle to apply the correct formula to teacher-given problems, thus the teacher needs to reverse this impression by making math enjoyable. Other research also showed that teachers frequently encounter difficulties when they are teaching in the classroom. These difficulties are frequently caused by students, as many of them continue to ignore the teacher when they are in front of the class and play with their friends when the teacher begins the lesson [12]. Other data show that only a small percentage of students participate in solving problems that arise, that some students are passive when completing group projects, and that students are still not proactive in addressing learning difficulties (Basri et al., 2019). Less cognitive activity from students during the learning process and teacher-centered learning will likely leave pupils docile and less capable of addressing problems [13].

Reviewing the results of the aforementioned challenges demonstrates how crucial problem-solving skills are for today's students. This is corroborated by advancements in the twenty-first century that emphasize the value of competencies, such as collaborative problem-solving skills [14]. Students' cooperation to solve problems, despite their different skill levels, highlights the value of collaborative

problem-solving strategies in the educational process [15], [16]. It is possible to learn how to solve problems cooperatively and use the various viewpoints and understandings of group members to generate the best solutions [17], [18]. Because it includes collaborative problem-solving strategies where everyone pooled their knowledge and talents, this ability helps individuals guide social relationships and information exchange, improve communication skills, and solve problems more rapidly. Additionally, they have differing perspectives on the issue and its fixes [19],[20], [21]. This demonstrates that students must work to realize that actual team relationships are difficult in collaborative learning. Therefore, in order to facilitate problem-solving, a clear mental image of the team is necessary while working together to solve hard scientific challenges.

A collaborative problem solving paradigm can be used to help kids become better problem solvers. This learning paradigm can demonstrate how well students work in groups to solve challenges. This learning model is suitable to be used in the learning process in order to appropriately accomplish the learning objectives, in addition to the abilities that students need to face the 21st century. Student problem-solving activities that allow students to reach agreements based on their individual natural collaborative processes promote the collaborative problem-solving learning model [22]. Thus, the learning process in the classroom is not conducive and learning objectives are not achieved.

Therefore, if used in learning, this model should be the best option. supported by other studies on this paradigm, specifically that mathematical connection skills are impacted by the collaborative problem solving model (Herdian et al., 2015). Improve higher order thinking skills [4]. Improve students' skills [23], [24]. Improve learning motivation and problem-solving skills [25], [26], [27]. Increase motivation, participation, communication and co-operation [28]. Thus, the positive things that can be taken from the application of the collaborative problem solving model are very good for the learning process. By applying the collaborative problem solving learning model, it is hoped that it can improve students' problem solving skills, can easily understand problems and produce optimal solutions.

The purpose of this study was to identify the improvement of students' problem solving skills by applying the collaborative problem solving model.

2. Literature Review

The following literature is related to support the research and aims to provide a deeper understanding of the variables used in this study, namely collaborative problem solving and problem solving skills.

Collaborative Problem Solving

Using the prior knowledge that each student possesses, collaborative problem solving makes the process of students working together to solve issues the primary means of gaining knowledge of their own. Collaborative problem solving is a learning design that enables group members to solve the problems at hand. It is required of them to solve the challenges offered by utilizing their varied skills and areas of understanding [29]. Critical thinking, problem-solving, decision-making, and teamwork are some of the essential skills that go into collaborative problem solving [30]. A group of students developing a common understanding of an issue, combining their understanding, skills, and efforts, and coming up with a solution is known as collaborative problem solving [31].

Collaborative problem solving is an approach to learning that aims to address issues by pooling information, skills, and effort to find a solution and sharing understanding and effort. Collaborative problem solving helps students develop skills including challenging others' mental processes, elaborating on previously offered knowledge, and expressing and supporting their method or ideas [32]. Two methods of learning are used in collaborative problem solving: problem-based learning as a

cognitive talent and collaborative learning as a social skill [33]. By integrating collaborative learning and problem-based learning, collaborative problem solving places students at the center of the learning process and begins with poorly structured problems from real-world scenarios [34].

A learning strategy known as the "problem-based collaborative learning model" uses issues as a starting point to teach and hone students' group problem-solving skills [35]. When two or more people work together to solve a specific problem, they are engaging in collaborative problem solving [36]. The capacity to successfully collaborate with one or more people to solve a problem by sharing the knowledge and work needed to arrive at a solution, thereby combining their knowledge, skills, and efforts to arrive at that solution, is the competence that exists in collaborative problem solving [20]. It need specific skills, like background knowledge, critical thinking, and effective communication, to accomplish a shared objective [37]. Fundamental skills comprise collaborative problem solving competence: establishing shared knowledge, coordinating or negotiating, and preserving team function [38].

Equipped with the starting knowledge that each student possesses, this learning emphasizes the importance of students working together to solve issues in order to improve their own knowledge. With a focus on autonomous thinking and problem-solving skills, problem-based collaborative learning promotes learning by doing and highlights the genuineness of the collaborative learning environment. Students participate in the active learning process. In addition to fostering problem-solving skills, collaborative problem-based learning aims to direct the growth of students' cooperation and communication skills.

Implementing collaborative problem solving involves six steps: defining the problem, coming up with all potential solutions, selecting the best solution among the ideas that have surfaced and assessing any potential repercussions, creating a plan based on the selected idea, carrying out the plan, and assessing the problem-solving procedure [29]. Additionally, Widjajanti states that the following are the steps involved in collaborative problem-based learning: Before learning in groups, students are given the chance to identify and create solutions to these difficult problems on their own. They then work in small groups of four to six people to clarify their understanding, critique the ideas of their group members, form assumptions, select a solution strategy, and solve the problems by debating with one another. Following that, each student works through the teacher's assigned problems on their own, and they then present their solutions [22]. Orientation, problem comprehension, planning and exploration, implementation, verification, observation, and listening are the additional stages of collaborative problem solving [39].

Problem Solving Skills

Orientation, problem comprehension, planning and exploration, implementation, verification, observation, and listening are the additional stages of collaborative problem solving [40]. According to a different definition, issue solving is an activity that involves selecting a solution that can be carried out in accordance with one's own capabilities, i.e., the transition from the current state to the desired state [41]. Therefore, issue solving is a cognitive activity that each person does on his own to discover a solution to a situation that does not fit his wishes. When students are given a problem or problems with multiple potential solutions, they engage in problem-solving activities. The process of identifying

potential solutions is a type of problem-solving activity. The procedure a person uses to solve a problem is known as problem solving [42].

The capacity to identify problems and solve them using the knowledge gathered in order to arrive at the correct conclusion is known as problem solving skills. A person has to be able to solve problems because it is a fundamental skill that is applicable to many aspects of daily life [43]. Being able to define an issue, identify its root cause, set priorities, choose from a variety of potential solutions, and put those solutions into action are all components of problem solving skills [44]. Students can recognize community issues and create creative solutions to address them by applying their capacity to solve problems [45].

Planning, decision-making, and thinking are some of the interconnected skills that make up the capacity to solve problems [46]. In a variety of settings and situations, the ability to solve problems is crucial for overcoming obstacles and embracing new ideas. They must be proficient problem solvers and competent experts to meet these problems [47]. The process of recognizing issues, identifying potential solutions, and implementing the optimal answer in a novel situation is the foundation of skills in problem-solving [20], [48], [49]. Zaccaro and Treffinger describe problem-solving skills as understanding and expressing the problem, obtaining and organizing pertinent information, creating and overseeing a strategy or plan of action, utilizing various tools, reasoning, testing hypotheses, and making decisions (Maksum et al., 2023).

3. Methods

This design uses a quantitative approach, with the type of experimental research. The experimental research conducted was a quasi-experiment. Quasi experiments test whether there is a causal relationship between the independent and dependent variables [51]. The independent variable is tested as the variable that influences the dependent variable, which is the impacted variable, in this quasi-experimental study. Nonequivalent pretest-posttest control group design is the type of quasi-experimental design that is employed. This design evaluates the differences between two groups empirically [52], Specifically, the experimental group and the control group have been divided up. The experimental group and the control group are groups that come together naturally, like classrooms, and can be tested using a pretest. One group may then receive treatment under the researcher's supervision, and after receiving treatment, another test may be administered using a posttest. The control group in the pretest-posttest nonequivalent control group design is matched to the group that received the intervention rather than being randomly assigned [53].

This study examines the effect of the independent variable on the dependent variable. The independent variable is the collaborative problem solving model. While the dependent variable is students' problem solving skills. The participants of this study were 130 students. The research object was divided into two treatment groups; one was used as the experimental group (65 students) and the other was used as the control group (65 students). The technique of determining the object of research using cluster random sampling because it is impossible to do randomly.

This research was conducted on both treatment groups, namely the experimental group and the control group. The experimental group was treated using a collaborative problem solving model and the control group using a conventional model. The research gave a pretest with the aim of knowing the initial ability of students in each class, both classes were given a pretest-posttest with the same test tool.

The research data were analysed using descriptive techniques and Independent Sample T-Test techniques. The aim was to determine the significance level of the effect of the collaborative problem

solving model on problem solving skills by testing the difference in the average value of student project competency learning outcomes. However, before conducting this test, researchers first conducted a prerequisite test of research assumptions using normality and homogeneity tests, so that the assumptions of data parameters were met. The normality test used the Kolmogorov-Smirnov technique and the homogeneity test used the Levene's test technique. The research data were tested at a significance level of 5% or 0.05 using the SPSS statistical application.

4. Results

The results of the research findings in the form of the results of the pretest and posttest of the two groups are described below, following the results of the normality test on the pretest and posttest scores of the experimental group and control group:

Table.1 Normality Test

One-Sample Kolmogorov-Smirnov Test					
		Pretest_E	Pretest_C	Posttest_E	Posttest_C
N		65	65	65	65
Normal Parameters[a,,b]	Mean	33.54	33.00	81.54	75.92
	Std. Deviation	6.106	7.278	6.055	7.649
Most Extreme Differences	Absolute	.164	.162	.162	.144
	Positive	.150	.126	.154	.128
	Negative	-.164	-.162	-.162	-.144
Kolmogorov-Smirnov Z		1.321	1.307	1.309	1.163
Asymp. Sig. (2-tailed)		.061	.066	.065	.134

Based on table 1, the normality test results on the experimental group pretest obtained a significance value of 0.061, on the control group pretest obtained a significance value of 0.066. The value on the posttest of the experimental group obtained a significance value of 0.065, on the posttest of the control group obtained a significance value of 0.134. Thus all the results of the normality test on the pretest and posttest of the experimental and control groups above the significance value> 0.05, so the data results of the two groups were declared statistically normally distributed. The results of the homogeneity test on the pretest and posttest of the experimental and control groups are as follows:

Table.2 Homogenity Test

Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	Sig.
Posttest	2.053	1	128	.154
Pretest	3.521	1	128	.063

Based on table 2, the results of the homogeneity test on the pretest of the experimental group obtained a value and the control group obtained a significance value of 0.063. The value on the posttest of the experimental group and control group obtained a significance value of 0.151. Thus all the results of the homogeneity test on the pretest and posttest of the experimental and control groups above the significance value> 0.05, so the data results of the two groups were declared statistically homogeneous. The following are the mean results on the pretest and posttest of the experimental and control groups after statistical testing as follows:

Table.3 Mean Pretest Posttest

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest	Experiment	65	33.54	6.106	.757
	Control	65	33.00	7.278	.903
Posttest	Experiment	65	81.54	6.055	.751
	Control	65	75.92	7.649	.949

Based on table 3, the mean on the pretest of the experimental group obtained 33.54 and the control group obtained 33.00. The mean on the posttest of the experimental group obtained 81.54, on the posttest of the control group obtained 75.92. Thus, the mean pretest of the two groups is not much different, while the mean on the posttest in the two groups is much different.
The following are the results of hypothesis testing on the pretest and posttest of the experimental and control groups after statistical testing as follows:

Table.4 Hypothesis Test

Independent Samples Test

			Pretest		Posttest	
			Equal variances assumed	Equal variances not assumed	Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances		F	3.521		2.053	
		Sig.	.063		.154	
t-test for Equality of Means		t	.457	.457	4.641	4.641
		df	128	124.247	128	121.590
		Sig. (2-tailed)	.648	.648	.000	.000
		Mean Difference	.538	.538	5.615	5.615
		Std. Error Difference	1.178	1.178	1.210	1.210
	95% Confidence Interval of the Difference	Lower	-1.793	-1.794	3.221	3.220
		Upper	2.870	2.871	8.010	8.011

Based on table 4, the results of the independent sample t test on the pretest of the experimental group and the control group obtained a significance value of 0.648> 0.050, thus there was no difference in the initial ability of students in the sense that the problem solving skills were not much different. The value on the posttest of the experimental group and the control group obtained a significance value of 0.000 <0.050, thus problem solving skills increased by applying the collaboration problem solving model.

5. Discussion

Based on the results of the research, the experimental group and control group data were normally distributed and statistically homogeneous. As based on the independent sample t test on the pretest, it shows that there is no difference in the initial ability of students in the sense that critical thinking skills are not much different. Meanwhile, based on the independent sample t test on the posttest, it shows that problem solving skills increase by applying the collaboration problem solving model.

Examining the difference between the experimental and control groups' pretest scores, which were 33.54 and 33.00, respectively, reveals that there is little variation in the two groups' pretreatment means or students' starting skill levels. Regarding the difference, the experimental group's mean posttest score was 81.54, which was greater than the lower control group's score of 75.92. This is because, whereas the control group employed a traditional learning paradigm, the experimental group adopted a different one the collaborative problem solving model. This is the reason why the two groups' averages differed following the research process. The results of this study are supported by previous research showing that the collaborative problem solving model can improve problem solving skills [54]. Other research results show that simulation-based collaborative problem solving can improve problem solving skills on the concept of Simple Harmonic Motion [55]. Other research results show that simulation-based collaborative problem solving can improve students' problem-solving skills [56].

The students in the collaborative problem-solving model group produced higher-quality work than the students in the conventional model group. Students immediately adjusted to their learning environment and were excited about their work in the collaborative problem-solving setting. This is due to the task's well-organized progression from basic to sophisticated. As long as they were working on the assignment, they were challenged to finish the next one right away rather than feeling overburdened. This outcome is corroborated by the benefits of collaborative problem-solving education, which has been shown to be successful in promoting students' completion of a variety of challenging assignments [57], [58]. The development of students' social, cooperation, and collaborative skills is further supported by collaborative activities that take place both within and outside of the classroom. It has been demonstrated that group projects or conversations greatly increase students' comprehension [59]. According to other literacy research, effective collaborative problem solving may also improve students' problem-solving skills [60]. In order to raise the standard of student learning, the collaborative problem solving paradigm has been applied extensively in elementary schools, higher education, and informal learning [61]. Thus, the application of this model in learning activities is very good and highly recommended to be used by teachers.

In collaborative problem-solving learning, students interact purposefully to change current conditions into desired goal conditions while using their teamwork, communication, leadership and problem-solving skills [62]. This collaborative learning in learning helps improve understanding of subject matter, enriches learning experiences, and develops students' social skills and problem-solving abilities [63]. A more efficient division of work, the integration of information from many sources of knowledge, views, and experiences, and the quality of solutions resulting from group members' ideas are the reasons why collaborative issue solving is superior to individual problem solving [20]. The OECD defines collaborative problem solving as the capacity of students to participate successfully in a learning process with two or more students, with the goal of resolving issues via mutual effort and understanding. In this process, the information and skills needed to solve an issue are combined [64].

This model's implementation is very helpful for students' problem-solving skills, which should be developed early in life to deal with a variety of issues later. It is also supported by the fact that by studying social challenges in the real world, students learn how scientific concepts are applied practically to comprehend and resolve local issues, which improves their capacity to apply knowledge in real-world situations. In order to learn, one must be able to solve problems. Students will steadily

improve and gain greater significance in their problem-solving skills as they conquer all obstacles to finish the project [65]. In addition to being a learning objective, problem-solving skills are also highly relevant in daily life and have numerous advantages in the workplace [66]. Thus, there are many supporters of improving students' problem-solving skills by applying the collaborative problem-solving model as a learning model that is proven to support the quality of learning.

6. Conlusions

Research and discussion findings indicate that using the collaborative problem solving paradigm improves students' skills in problem-solving. Results from the independent sample t test on the posttest indicate a significant value greater than 0.050, and the mean difference between the experimental and control groups' posttests provides proof that students' problem-solving skills have improved. Whereas the control group employed a traditional paradigm, the experimental group employed a collaborative problem-solving approach. It is hoped that further studies will be able to look more closely at the collaborative problem solving paradigm in other subjects, perhaps at different educational levels. Of course, it can also be used with other learning models

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