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Enhancing learning activities and problem-solving skills of students with disabilities through collaborative problem-solving models

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Abstract: This study aims to investigate the effectiveness of the Collaborative Problem Solving (CPS) model in enhancing learning activities and problem-solving skills among students with disabilities in special schools. A quantitative approach was employed, utilizing a quasi-experimental, nonequivalent pretest–posttest control group design. The sample consisted of 130 students, divided into an experimental group (n = 65), which received CPS-based instruction, and a control group (n = 65), which received conventional teaching methods. Data collection involved pretests and posttests to assess problem-solving skills, complemented by systematic observations of learning activities. Pretest results indicated no significant difference between the experimental and control groups (p = 0.648), demonstrating comparable initial abilities. Posttest results revealed that the experimental group achieved significantly higher scores (M = 81.54, SD = 6.05) compared to the control group (M = 75.92, SD = 7.65), with a statistically significant difference (t = 4.641, p = 0.000). Observational data further indicated increased student engagement, collaboration, and active participation within the CPS group. The findings suggest that the CPS model is effective in improving learning activities and problem-solving skills among students with disabilities. Implementing CPS as an instructional strategy in special education settings can foster active learning, enhance collaboration, and lead to improved cognitive outcomes. These results support the integration of CPS into teaching practices to promote more inclusive and effective educational environments for students with diverse learning needs.

Keywords: *Collaborative problem solving, Learning activities, Problem-solving skills, Quasi-experiment, Special school.*

1. Introduction

Improving the quality of learning in secondary education requires instructional models that not only transmit knowledge but also cultivate higher-order thinking skills, collaborative engagement, and active participation [1]. In contemporary classrooms, students are increasingly expected to develop the ability to analyze problems, work collaboratively, and apply knowledge to authentic and complex situations [2]. These expectations are aligned with global educational standards, including the Partnership for 21st Century Skills framework and UNESCO's Education 2030 agenda, both of which emphasize critical thinking, creativity, communication, and collaboration as essential competencies for the modern world [3]. Within this broader educational context, the implementation of innovative pedagogical approaches becomes crucial for transforming classroom dynamics and enhancing student learning outcomes [4]. One such promising pedagogical model is Collaborative Problem Solving (CPS), which encourages learners to work together in identifying, understanding, and resolving academic problems through structured interaction and shared reasoning processes [5].

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Despite its documented benefits, many classrooms in Indonesia, including high-performing schools such as special schools, still predominantly rely on conventional teacher-centered approaches. Traditional instructional models often limit student engagement to passive reception of information, thereby restricting opportunities for active learning and collaborative exploration. In such settings, the development of students' problem-solving skills tends to be suboptimal, as learners are not provided with sufficient autonomy, interaction, or cognitive challenge [6]. This pedagogical limitation is concerning, given that problem-solving ability is a foundational element of academic success across subjects, particularly in science, mathematics, and project-based learning environments [7]. Moreover, classroom observations and preliminary discussions with teachers indicate that students frequently struggle to translate theoretical knowledge into practical problem-solving strategies, suggesting the need for alternative pedagogical interventions [8].

While existing literature provides extensive evidence supporting the effectiveness of collaborative learning models, several research gaps remain [9]. First, many studies focus primarily on the cognitive outcomes of CPS and overlook its influence on learning activities, such as engagement, participation, and collaborative interaction [10]. Yet, these activities are essential mediators that determine how effectively students internalize problem-solving processes [11]. Second, research conducted in Indonesian secondary schools rarely employs rigorous experimental or quasi-experimental designs to examine the causal effects of CPS on learning outcomes [12, 13]. Much of the existing work relies on descriptive or correlational methods that cannot conclusively establish the impact of instructional models on student performance. Third, studies that evaluate CPS within the context of high-achieving urban schools, such as special schools, are still limited, despite the unique academic characteristics and expectations associated with such institutions. Addressing these gaps is necessary to develop a more comprehensive understanding of how CPS functions across diverse educational settings and learner profiles.

The present study responds to these research gaps by investigating the effectiveness of the Collaborative Problem-Solving model in enhancing students' learning activities and problem-solving skills through a quasi-experimental design [14-16]. Unlike descriptive studies, quasi-experimental methods allow for a more rigorous comparison between students exposed to CPS and those receiving conventional instruction [17]. By incorporating both pretest and posttest assessments, this study evaluates not only learning outcomes but also initial equivalence between groups, thereby providing stronger evidence of the causal relationship between the instructional model and student improvement [18, 19]. In addition, observational data are included to capture changes in student engagement, participation, and collaborative dynamics elements that are rarely analyzed in previous CPS research but are central to understanding how the model transforms the learning environment.

The relevance of this study is further strengthened by its contextual importance. Implementing CPS in such an environment provides meaningful insights into how innovative pedagogical approaches can enhance student performance in high-achieving contexts. Given the school's emphasis on academic rigor, students are expected to develop strong analytical and problem-solving competencies. However, without appropriate instructional strategies, these expectations may remain unmet. Therefore, evaluating CPS in this setting offers practical implications for teachers, curriculum designers, and policymakers seeking to modernize instructional practices and align them with contemporary educational demands.

The purpose of this study is to analyze the impact of the Collaborative Problem-Solving model on (1) students' learning activities and (2) their problem-solving skills. To achieve this purpose, the study employs a nonequivalent pretest–posttest control group design involving 130 students, allowing for direct comparison between experimental and control groups. By combining quantitative assessment with observational data, the study offers a holistic perspective on how CPS shapes both cognitive and behavioural learning outcomes. This methodological rigor positions the study to contribute meaningful, evidence-based insights to the broader field of instructional innovation.

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This research provides several key contributions. First, this study empirically demonstrates the effect of CPS on the problem-solving abilities of students with disabilities in special education settings using robust statistical analysis. Second, this study expands the existing literature by examining CPS not only as a cognitive enhancement strategy but also as a catalyst for increasing learning activities. Third, this study presents context-specific findings that are relevant to education practitioners in Indonesia, especially those working in academically competitive schools. Finally, by identifying the significance of collaborative engagement and structured problem-solving processes, the study contributes to ongoing discussions surrounding pedagogical transformation and the development of 21st-century competencies. Through these contributions, the research underscores the need for instructional models that actively engage learners and foster deeper cognitive processing, thereby supporting educational excellence in an increasingly complex world.

2. Methods

2.1. Research Design

This study employed a quantitative approach using a quasi-experimental design, specifically the nonequivalent pretest–posttest control group design. This design is commonly implemented in educational research where random assignment at the individual level is not feasible. Two intact classes at a special school were assigned as the experimental and control groups. Both groups were given a pretest before the intervention to assess initial equivalence, followed by a posttest after the intervention period. The experimental group received instruction using the Collaborative Problem-Solving (CPS) model, while the control group was taught using conventional teacher-centered instructional methods. This design allows for the investigation of causal relationships between the instructional treatment and changes in students' learning activities and problem-solving skills.

2.2. Participants

A total of 130 students with disabilities who study in special schools participated in this study. Cluster random sampling was used to select two intact classes based on administrative considerations and the school's scheduling system. The sample consisted of 65 students in the experimental group and 65 students in the control group. Both groups were comparable in demographic and academic characteristics. Participation was voluntary, and ethical considerations were observed throughout the research process.

2.3. Instruments

Two main instruments were used in this study.

1. Problem-Solving Skills Test: A standardized test was developed to measure students' problem-solving abilities. The instrument consisted of items aligned with established indicators of problem-solving competence, including problem identification, strategy formulation, solution evaluation, and application of reasoning.
2. Learning Activity Observation Sheet**:** Structured classroom observations were conducted to assess students' learning activities. The observation sheet focused on indicators such as engagement, collaboration, participation in group discussions, and responsiveness during instruction. These indicators reflect behavioral aspects of active learning associated with the implementation of the CPS model.

2.4. Procedure

The research procedure consisted of several stages. First, both the experimental and control groups completed a pretest to assess baseline problem-solving ability. Next, the experimental group received instruction using the Collaborative Problem-Solving model. This instructional approach encouraged students to work collaboratively in groups, engage in shared inquiry, communicate reasoning, and

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develop collective solutions to assigned problems. The teacher acted as a facilitator, guiding discussion and prompting reflective thinking.

Meanwhile, the control group was taught using conventional instructional methods, characterized by lecture-based delivery, individual practice, and limited peer interaction. Throughout the intervention, structured classroom observations were conducted to document differences in learning activities between the two groups. At the end of the intervention period, both groups completed the posttest using the same instrument administered during the pretest.

2.5. Data Analysis

Data collected from pretests, posttests, and observations were analyzed using descriptive and inferential statistical techniques. Before conducting group comparisons, assumption tests including normality and homogeneity of variances were performed to ensure compliance with parametric test requirements. An Independent Samples T-Test was used to determine whether there were significant differences between the two groups in terms of problem-solving skills following the instructional intervention. All analyses were conducted using statistical software with a significance level set at 0.05.

3. Results

3.1. Normality Test

A Kolmogorov–Smirnov test was performed to assess whether the distribution of pretest and posttest scores in both groups met the assumption of normality. The results are presented in Table 1.

Table 1.
One-Sample Kolmogorov–Smirnov Test

		Pretest_Experiment	Posttest_Experiment	Pretest_Control	Posttest_Control
N		65	65	65	65
Normal Parameters[a,,b]	Mean	33.54	81.54	33.00	75.92
	Std. Deviation	6.106	6.055	7.278	7.649
Most Extreme Differences	Absolute	0.164	0.162	0.162	0.144
	Positive	0.150	0.154	0.126	0.128
	Negative	-0.164	-0.162	-0.162	-0.144
Kolmogorov-Smirnov Z		1.321	1.309	1.307	1.163
Asymp. Sig. (2-tailed)		0.061	0.065	0.066	0.134

Note: a. Test distribution is Normal.
b. Calculated from data.

The Kolmogorov–Smirnov test was employed to evaluate whether the pretest and posttest scores from both the experimental and control groups conformed to a normal distribution. As shown in Table 1, all Asymp. Sig. values ranged from .061 to .134, exceeding the threshold of 0.05. These results indicate that none of the distributions deviated significantly from normality. The absolute and directional extreme difference values also suggest that the data did not exhibit substantial skewness or kurtosis. Accordingly, the assumption of normality was satisfied for all variables, supporting the use of parametric statistical procedures in subsequent analyses, including the Independent Samples T-Test.

3.2. Homogeneity of Variances

Levene's test was used to determine whether the variance between groups was homogeneous. Table 2 provides the output.

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Table 2.
Test of Homogeneity of Variances.

	Levene Statistic	df1	df2	Sig.
Pretest	3.521	1	128	0.063
Posttest	2.053	1	128	0.154

Levene's Test was conducted to assess the equality of variances between the experimental and control groups for both pretest and posttest scores. As shown in Table 2, the significance values for the pretest (.063) and posttest (.154) exceeded the .05 threshold, indicating no statistically significant difference in variance between groups. These results confirm that the homogeneity of variances assumption was met for both measurement points. Satisfying this assumption is essential for ensuring the validity of subsequent parametric analyses, particularly the Independent Samples T-Test, which requires comparable variance structures across groups to produce unbiased statistical estimates.

3.3. Group Statistics

Descriptive statistics summarizing the pretest and posttest scores of both groups are shown in Table 3.

Table 3.
Group Statistics.

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest	Experiment	65	33.54	6.106	0.757
	Control	65	33.00	7.278	0.903
Posttest	Experiment	65	81.54	6.055	0.751
	Control	65	75.92	7.649	0.949

The descriptive statistics presented in Table 3 provide an overview of the pretest and posttest performance of the experimental and control groups. Before the intervention, both groups demonstrated comparable levels of problem-solving ability, as reflected by closely aligned mean scores (33.54 for the experimental group and 33.00 for the control group). This similarity suggests that the two groups began the study with equivalent baseline competencies. Following the implementation of the Collaborative Problem-Solving model, the experimental group exhibited a substantial increase in mean posttest scores, rising to 81.54, whereas the control group achieved a lower mean of 75.92. The reduced standard error values further indicate consistent performance within each group. Collectively, these descriptive patterns suggest that the experimental group benefited more markedly from the instructional intervention.

3.4. Independent Samples T-Test

Hypothesis testing was conducted using an independent samples t-test to determine whether the differences between groups were statistically significant. The results are provided in Table 4.

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Table 4.
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

The Independent Samples T-Test was employed to evaluate whether the differences in mean scores between the experimental and control groups were statistically significant. As shown in Table 4, the pretest comparison yielded a non-significant result ($t = 0.457$, $p = 0.648$), indicating that both groups possessed comparable baseline problem-solving abilities before the intervention. This finding aligns with the assumption of initial group equivalence in quasi-experimental designs.

Following the intervention, the posttest results demonstrated a highly significant difference between groups ($t = 4.641$, $p = 0.000$). The experimental group outperformed the control group by a mean difference of 5.615 points, with the 95% confidence interval (3.221 to 8.010) confirming the robustness of this effect. These findings provide strong empirical support for the effectiveness of the Collaborative Problem-Solving model in enhancing students' problem-solving skills compared to conventional instruction.

4. Discussion

The findings of this study demonstrate that the Collaborative Problem-Solving (CPS) model significantly enhances both students' learning activities and their problem-solving skills in a special school context. The substantial improvement observed in the experimental group's posttest scores compared with the control group suggests that CPS provides a more engaging and cognitively effective learning environment. This aligns with the argument that learning becomes more meaningful when students actively participate in constructing solutions through structured collaboration rather than passively receiving information [20]. The CPS model emphasizes shared reasoning, group accountability, and reflective inquiry, all of which are known to facilitate deeper conceptual understanding and higher-order thinking [21].

The increase in learning activities observed in the experimental group can be attributed to the interactive nature of CPS. As students engage in discussion, negotiate ideas, and collaboratively solve problems, they demonstrate higher levels of engagement and motivation, consistent with findings reported by Wu et al. [22] and Gillies [23]. These behavioral indicators support the notion that CPS not only improves cognitive performance but also enhances affective and social dimensions of learning. Furthermore, the structured collaborative processes inherent in CPS provide scaffolding that assists students in transitioning from lower-order to higher-order problem-solving skills [24].

The results also indicate that CPS is particularly effective in contexts such as special schools, where academic expectations are high, and students are required to demonstrate advanced analytical competencies. The ability of CPS to support inquiry, critical reasoning, and cooperative engagement

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makes it well-suited for academically competitive environments. Previous studies have reported that collaborative learning models are most effective when students are challenged with complex tasks requiring multiple perspectives [25]. The significant mean gain in the experimental group suggests that CPS helps students navigate such challenges more effectively than conventional instructional strategies.

The non-significant pretest difference confirms initial group equivalence, strengthening the causal inference that the observed improvements were attributable to the CPS intervention rather than preexisting differences. This is consistent with methodological recommendations for quasi-experimental designs in educational research [26]. By ensuring that normality and homogeneity assumptions were met, the study adhered to established best practices for statistical analysis, further supporting the validity of the findings.

The significant posttest differences align with previous research demonstrating that collaborative problem solving improves academic achievement across various domains, including mathematics, science, and engineering [27, 28]. CPS promotes shared cognitive load, allowing students to distribute mental effort more efficiently and engage in joint reasoning, which enhances problem-solving outcomes [29]. The structured stages of CPS, problem identification, exploration, solution generation, and reflection mirror contemporary models of inquiry-based and constructivist learning [30], providing a coherent framework for deep learning.

The collaborative dimension of CPS has implications for 21st-century skills development. As students work in groups, they practice communication, leadership, conflict resolution, and social negotiation, skills essential for academic and professional success [31]. The interplay between cognitive and social processes within CPS creates a holistic learning experience aligned with global educational frameworks such as UNESCO's Education 2030.

The study also highlights the role of teacher facilitation in maximizing CPS effectiveness. As noted in prior research, the success of collaborative learning depends heavily on teachers' ability to structure tasks, guide discussions, and create supportive learning climates [32]. The present findings suggest that CPS could be further optimized through teacher training in collaborative pedagogy and classroom orchestration.

This study contributes empirical evidence supporting CPS as an effective instructional model for enhancing learning activities and problem-solving skills in secondary education. The results reinforce theoretical and empirical claims regarding the value of collaborative learning and underscore the importance of integrating CPS within contemporary curricula. Future research may explore the long-term impacts of CPS, variations across subjects, and the influence of digital tools in supporting collaborative problem solving.

5. Conclusion

The findings of this study provide strong empirical evidence that the Collaborative Problem Solving (CPS) model significantly improves both learning activities and problem-solving skills of students with disabilities in special schools. The quasi-experimental analysis revealed that students who participated in CPS-based learning demonstrated notably higher posttest scores compared with those taught through traditional instruction. This improvement was accompanied by observable increases in student engagement, collaboration, and active participation during classroom activities, suggesting that CPS fosters a more dynamic and interactive learning environment. The model's emphasis on shared inquiry, structured dialogue, and collective reasoning appears to encourage deeper cognitive processing, enabling students to approach complex problems with greater confidence and analytical capability. These outcomes affirm existing theories of collaborative learning and reinforce the pedagogical value of integrating CPS into contemporary instructional practices.

Beyond its immediate cognitive benefits, CPS also supports the development of essential 21st-century skills, including communication, teamwork, and critical thinking, which are increasingly necessary for academic and professional success. The study's results thus hold important implications

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for educators, curriculum designers, and policymakers seeking to modernize teaching strategies and align them with global educational standards. Implementing CPS in schools such as special schools can contribute to a more student-centered learning culture and promote higher levels of academic achievement. However, the successful adoption of CPS requires adequate teacher preparation, ongoing professional development, and thoughtful classroom management to ensure effective facilitation. Future research may explore the long-term impact of CPS, its applicability across diverse subject areas, and the potential integration of digital tools to further enhance collaborative learning processes.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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