Enhancing Students' Collaborative Problem Solving Competency through Creativity-Based Learning Combined with Collaborative Learning in Chemistry Learning

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Abstract

In an era demanding teamwork and innovation,collaborative problem-solving (CPS) equips students to negotiate diverse perspectives, co-construct knowledge, and tackle complex real-world challenges. This action research study investigated the effectiveness of Creativity-Based Learning (CBL) combined with Collaborative Learning (CL) in developing collaborative problem-solving (CPS) competencies among 18 Grade 10 students in a chemistry unit on Solutions. Conducted over three iterative cycles, the research employed a mixed-methods approach, collecting data through: (1) nine CBL-CL lesson plans, (2) a CPS competency assessment, (3) structured observations of student behaviors, and (4) semi-structured interviews. Quantitative analysis (means, percentages) of assessment scores revealed progressive improvement: 27.8% (5 students) met the high CPS standard in Cycle 1, increasing to 44.4% (8 students) in Cycle 2, and 88.9% (16 students) in Cycle 3. Qualitative findings from observations and interviews highlighted enhanced engagement, communication, and creative problem-solving strategies. The study demonstrates that CBL-CL significantly strengthens CPS skills in science education. Recommendations include integrating CBL-CL into broader curricula, teacher training on facilitation techniques, and extended implementation periods for sustained competency development.

Keywords: Collaborative Problem Solving Competency, Creativity-Based Learning, Collaborative Learning

INTRODUCTION

Collaborative problem solving (CPS) is a vital skill that enhances work efficiency and contributes to the modern economy (Fiore et al., 2018). It represents a synthesis of essential competencies required in today's workplace, enabling individuals to adapt and work effectively in new environments. With the rapid advancement of technology, CPS skills are increasingly applied in various contexts (Graesser et al., 2018; Silber-Varod et al., 2019). The concept of CPS builds on the general problem-solving framework established by the Programme for International Student Assessment (PISA) in 2003, which emphasizes practical problem-solving intelligence (OECD, 2003). Furthermore, the PISA 2015 framework highlights goals that cannot be achieved by individuals alone but require group processes where members share understanding and contribute collectively (Graesser et al., 2020). Successful problem solving depends on communication, idea exchange, and cooperation among team members (Johnson et al., 2007; Hesse et al., 2015). Recognizing its importance, the Organization for Economic Co-operation and Development (OECD) incorporated CPS competency into the 2015 PISA assessment framework (Graesser et al., 2017).

Currently, most students engage in collaborative learning activities with peers in classrooms (Cooper et al., 2008; Johnson & Johnson, 2014; Casey & Quennerstedt, 2020). CPS competency is essential for success in both higher education and the workforce (Griffin & Care, 2015; Bo et al., 2016). According to PISA 2015, CPS is defined as an individual's capacity to effectively work with others to solve problems (OECD, 2017). The PISA framework evaluates CPS through three core dimensions: (1) establishing and maintaining shared understanding, which involves identifying which group members possess relevant knowledge and ensuring that information is shared among the team; (2) taking appropriate action to solve the problem, which includes identifying tasks and implementing effective solutions; and (3) establishing and maintaining team organization, which requires individuals to monitor their own roles, support others in fulfilling theirs, and adjust group dynamics as necessary (OECD, 2017). These competencies reflect an integration of collaborative interaction and individual problem-solving capacity. The assessment is structured around authentic, real-world scenarios

that require students to think analytically, select suitable strategies, and communicate effectively to arrive at a solution (Wang, 2016). Drawing from the general problem-solving process established in PISA 2012, the CPS framework includes twelve specific sub-skills and categorizes student performance across three proficiency levels: high (demonstrating initiative, sharing relevant information, and independently choosing strategies), medium (contributing to group efforts without leading problem-solving activities), and low (minimal engagement that hampers group progress) (OECD, 2013). Preparing students for the demands of the 21st-century workforce necessitates a strong emphasis on critical thinking, creativity, collaboration, and scientific reasoning (Binkley et al., 2012; Levy, 2010; OECD, 2010). Accordingly, cultivating scientific problem-solving skills is a fundamental goal of modern science education, aiming to equip learners with the competencies required to adapt to rapid and continuous changes in both academic and professional contexts (Greiff et al., 2013).

In the 2015 PISA assessment conducted by the OECD, 15-year-old students were evaluated on their collaborative problem-solving skills through computer-based tasks. Thailand's average score was 436, below the OECD benchmark of 500, highlighting the need to strengthen students' ability to work effectively in teams to solve complex problems (OECD, 2017). This indicated that Thai students still lack collaborative skills. Therefore, developing students' collaborative problem solving competency was necessary to enhance future work skills and effectively resolve contemporary workplace challenges (OECD, 2017).

Additionally, as the researcher also served as the classroom teacher, both direct observations and student interviews revealed that most chemistry lessons were predominantly lecture-based and centered on individual problem-solving tasks. This instructional approach provided limited opportunities for students to engage in meaningful collaboration or to develop effective problem-solving processes. During group activities, while some elements of teamwork were observed, many students exhibited underdeveloped collaborative skills. Common challenges included difficulty in articulating ideas clearly, ineffective communication, poor coordination, and a tendency to imitate peers rather than actively contribute or assume responsibility. Notably, some students disengaged from group work entirely,

resulting in uneven participation and diminished group performance.

These findings align with and extend earlier empirical data, confirming that many secondary students-particularly in science classrooms-lack the CPS competencies necessary for academic and future professional success (Avargil et al., 2012; Tytler & Aranda, 2015). This highlights a critical instructional gap: although students are often expected to work collaboratively to solve complex problems, the prevailing classroom environment does not sufficiently cultivate the skills required for such tasks. This mismatch between pedagogical practice and skill development underscores the urgency for a targeted instructional intervention that intentionally fosters CPS competencies. As Britton et al. (2017) emphasize, such skills are increasingly essential for navigating the demands of modern educational and workplace environments.

This study investigates learning management models by encouraging independent problem identification, critical thinking, group discussion, effective communication, and knowledge sharing. Creativity-based learning, derived from problem-based learning, promotes active learning and positive learner attitudes (Barr et al., 1995). It involves group problem-solving where students creatively apply critical thinking to generate diverse and innovative solutions, thereby developing problem-solving, teamwork, and creative thinking skills (Häkkinenet al., 2016). The approach follows five steps: (1) stimulating interest, (2) problem identification and grouping, (3) information searching and thinking, (4) presentation, and (5) evaluation (Ruechaipanit, 2013). Research shows that Creativity-Based Learning can develop students' collaborative problem solving competency (Tuykhiaw et al., 2020).

Additionally, collaborative learning principles emphasize cooperative engagement and interdependence within groups. Students take responsibility for group work through consultation, discussion, and idea exchange to solve problems collaboratively. Moreover, the principle of dividing responsibilities among group members to achieve collaborative learning objectives, as advocated by Barkley et al. (2004), is essential for fostering effective teamwork and ensuring that all members contribute meaningfully to the group's success. Collaborative learning is applied as the basis for organizing collaborative learning activities among group members. Therefore, the researchers

combine Creativity-Based Learning with collaborative learning, enabling students to exchange ideas and share responsibilities, thereby developing collaborative problem-solving skills necessary for future teamwork.

METHOD

Research Design

This study employed classroom action research, following the model proposed by Kemmis and McTaggart (1998), which consists of three cycles with four key phases: planning, action, observation, and reflection.

Target Group

The target group comprised 18 Grade 10 students from Yangtalad Witthayakhan School, Kalasin, Thailand. These students were selected based on their performance in the PISA 2015 online assessment of collaborative problem-solving competency, in which all scored below the high competency level.

Research Instruments

Instruments used in this study include: 1) Lesson plans in the chemistry subject, focusing on solutions consisting of 9 lesson plans over 14 hours. The steps were as follows: 1) Stimulating interest: teachers presented various situations related to daily life to engage students, 2) Identifying problems and grouping: the teacher used scenarios as a guide, requiring students to identify the problems themselves, and students were grouped by identifying problems with similar characteristics of students, 3) Searching for information and thinking: Each student group worked on a study to find a solution to a problem. Responsibilities were divided within the group. Students helped each other to plan and design methods used to solve problems through a group process, 4) Presentation: Each group of students presented their group work in front of the class, showing how to plan and design a solution. Inquiries would come from roommates to exchange knowledge and opinions with each other and check the accuracy of the information obtained, 5) Evaluation: Activities were organized in which each student summarized the knowledge gained from the learning activities and presented the student's understanding in a reported format to check their understanding. The researcher presented the lesson plan to experts to assess its suitability and found that the average quality of the lesson plan was in the range of 4.90-4.97. 2) The CPS assessment included three sets, each consisting of 2 scenarios with a total of 24 multiple-choice questions, The maximum score is 48 points. In each scenario, the questions were used to measure the three major competencies of CPS competencies: (1) establishing and maintaining shared understanding (2)

taking appropriate action to solve a problem and (3) establishing and maintaining group organization. Students were asked to complete the test at the end of each cycle. The researcher proposed the CPS assessment to the expert to assess the consistency between the question and the situation used. The index of consistency value was 1.00. 3) The researcher used the observation forms on collaborative problem-solving behavior to monitor students' CPS behaviors during the learning activities. The behavior observation covered all three major competencies. The researcher offered the observation forms to the expert to assess the consistency between the behavior and the CPS competency. The index of consistency value was 0.80 – 1.00. 4) In the interview form, the issues were problems encountered in learning activities and problem-solving ability. The researcher extended the students' interview form to the expert to assess the consistency between the issue and the question. The index of consistency value was 0.80 – 1.00.

Research Procedures

In this study, classroom action research was carried out across three cycles, with the following details:

Planning: The researchers observed classroom instruction to identify learning issues related to collaborative problem solving. A review of relevant literature informed the design of a learning management plan integrating creativity-based learning with collaborative learning. Lesson plans and data collection instruments—including observation forms, interview protocols, and a CPS competency assessment—were developed.

Action: The learning plans were implemented over three cycles.

Cycle 1 included lessons on percentages, parts per million (ppm), parts per billion (ppb), molarity (M), and molality (m).

Cycle 2 focused on mole fraction, solution preparation, and concentration calculations.

Cycle 3 addressed dilution, concentration from stock solutions, and colligative properties.

Observation: Student behaviors were systematically observed during learning activities using structured observation forms and semi-structured interviews. After completing each cycle, students took a CPS competency assessment.

Reflection: Data from observations and assessments were analyzed to identify learning challenges and inform revisions for subsequent cycles. All three cycles were conducted sequentially, followed by

comprehensive data analysis and interpretation of results.

Data Analysis

In this study, the researcher utilized data obtained from the observation forms on CPS behavior and interview forms. The data was analyzed and summarized using content analysis. Data from the CPS assessment was analyzed using basic statistics (mean, standard deviation, and percentage). The scores of the evaluation were compared to the PISA 2015 assessment criteria (OECD, 2017). As shown in Table 1.

Table 1. The scoring criteria for the CPS competency assessment (OECD, 2017).

Level	Low	Medium	High
Scores (%)	0 - 33	34 – 66	67 – 100

RESULTS AND DISCUSSION

Results

The action research consisted of three cycles, using Creativity - based learning cooperated collaborative learning to improve the CPS skills of the 18 students. The results could be summarized as the percentage of students who passed and did not pass the criteria in each cycle. As shown in Figure 1.

According to Figure 1 shown that 5 students passed the CPS competency at a high standard, accounting for 27.78 percent in the first cycle. In the second cycle, there were 8 students, accounting for 44.44 percent. In the third cycle, there were 16 students. The researchers implemented a collaborative learning approach while collecting data on students' CPS across all three major CPS competencies, which consisted of 1) Establishing and maintaining shared understanding 2) Taking appropriate action to solve the problem 3) Establishing and maintaining group organization. The scores of 18 of the target group in all three cycles are shown in Table 2.

Table 2 indicated that students increased their collaborative problem-solving competency from the first cycle to the third cycle. In the first cycle, the highest average score was 11.24 for taking appropriate action to solve the problem. The lowest average score was 8.78 in Establishing and maintaining group organization. In the second cycle, the highest average score was 11.77 for taking appropriate action to solve the problem. The lowest average score was 9.31 in Establishing and maintaining group organization. In the third cycle, the highest average score was 12.80 in Establishing and maintaining shared understanding. The lowest average score was 11.30 in Establishing and maintaining group organization.

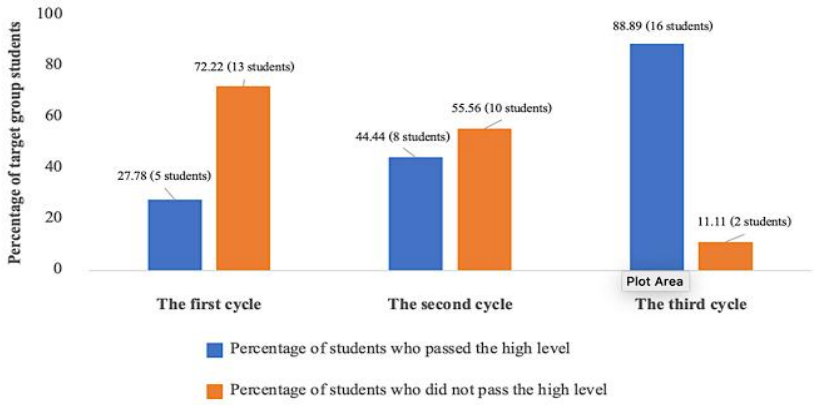

Figure 1. The number of students who passed and did not pass the high-level criteria after completing all three cycles of learning activities

Table 2. The scores of CPS competency for all three cycles.

Students	The first cycle			The second cycle			The third cycle		
	1) Establishing and maintaining shared understanding (16)	2) Taking appropriate action to solve the problem (16)	3) Establishing and maintaining group organization (16)	1) Establishing and maintaining shared understanding (16)	2) Taking appropriate action to solve the problem (16)	3) Establishing and maintaining group organization (16)	1) Establishing and maintaining shared understanding (16)	2) Taking appropriate action to solve the problem (16)	3) Establishing and maintaining group organization (16)
1	10	12	6	13	14	10	14	15	13
2	8	11	8	11	11	9	16	12	12
3	8	11	10	10	13	9	13	14	14
4	16	16	14	15	14	16	14	15	15
5	10	13	6	10	13	9	16	12	12
6	5	11	5	10	11	11	13	14	14
7	10	11	7	9	10	9	16	15	12
8	8	10	5	11	13	6	14	14	11
9	11	11	9	10	13	9	15	14	11
10	10	14	8	10	11	11	13	12	14
11	9	11	9	9	10	9	16	12	12
12	11	11	6	11	13	6	13	14	14
13	3	6	7	12	13	6	16	15	12
14	13	14	7	14	13	10	15	14	12
15	14	14	13	15	13	11	14	15	12
16	13	12	13	14	13	13	13	15	12
17	12	10	10	13	15	9	14	14	13
18	16	15	15	14	16	14	14	15	15
$\overline{X}$	10.39	11.24	8.78	10.77	11.77	9.31	12.80	12.70	11.30
S.D.	3.40	2.28	3.14	2.65	2.17	2.14	4.54	2.50	2.54

The researcher interviewed the students about the learning activities to improve the learning activities. In each cycle, the details are as follows:

The first cycle

The researcher conducted interviews with students to improve learning activities for the next cycle which were summarized as follows:

1. Students were inclined to pay attention to the given situation because it relates closely to their daily lives. This can be observed from the examples of student responses provided as follows: *"I'm interested because, when I read the problem scenario, I recognized its presence in their lives."* (Student4: January 17, 2024)

2. Some students were interested, while others were not, as they perceived certain topics as unfamiliar. This can be observed from the examples of student responses provided as follows: *"Some topics are interesting, such as hand sanitizer alcohol."(*Student 8: January 17, 2024)

3. Some students can identify problems in the given situation. This can be observed from the examples of student responses provided as follows: *"After I read the situation, I analyze what I need to know to solve the problem."* (Student 18: January 17, 2024)

4. Most students who cannot identify problems from the situation typically ask their friends who can identify them. This can be observed from the examples of student responses provided as follows: *"Some students can identify problems while others cannot, requiring them to ask their friends within the group or inquire from the teacher to identify the problem*." (Student8: January 17, 2024)

5. Most students who cannot identify problems from the situation typically ask their friends who can identify them. This can be observed from the examples of student responses provided as follows: *"Some students can identify problems while others cannot, requiring them to ask their friends within the group or inquire from the teacher to identify the problem."(*Student8: January 17, 2024)

6. Students had no communication within the group and roles were not clearly defined among members. Most groups had only 1-2 students exchanging knowledge. As a result, some students did not participate in group work. This can be observed from the examples of student responses provided as follows: *"We don't assign tasks among ourselves because we saw our friends doing them already, so we thought it was done correctly."*(Student13: January 17, 2024)

7. Most students engaged in consultation and discussion regarding the outcomes of their work. This can be observed from the examples of student responses provided as follows: *"The group collaborates to consult and explain together for mutual understanding, then presents the activity to the class."* (Student16: January 24, 2024)

8. Students enjoy group work because it offers a learning experience that is novel and distinct from traditional methods of instruction. This can be observed from the examples of student responses provided as follows: *"The activity is suitable because it encourages teamwork and mutual assistance among group members."* (Student18: January 25, 2024)

From interviewed with students, most students did not engage in communication with their group members. The lack of clear task division among most students resulted in limited communication and idea exchange among group members. Students were unable to choose problem-solving methods. Furthermore, some students waited for other group members to take action, resulting in only 1-2 individuals actively communicating within the group, thus slowing down progress. This led to the incapacity to plan and design problem-solving approaches for the situation. Additionally, in identifying and solving problems, the majority of the group could not select problems or problem-solving strategies due to a lack of communication.

Analysis of data from the collaborative problem solving competency assessment, behavior observation, and student interviews in the first cycle. As a result, some students showed disinterest in the presented problem situation. Teachers should enhance the level of engagement in the situation. Students were unable to identify problems relevant to the situation and did not understand how to identify these problems. In presentations, members of groups not presenting often engage in off-topic conversations and show disinterest in the presenting group. Teachers should encourage students in non-presenting groups to take an interest in the presenting group and stimulate questions from each group during presentations.

The second cycle

The researcher implemented interventions by engaging students through interactive questioning and introducing a scoring system for students who answered questions. Additionally, the researcher explained each step of the process in detail and clearly to reduce any confusion during the activities. The researcher conducted interviews with students to improve

learning activities for the next cycle by summarizing the points as follows:

1. Students showed increased interest in the provided scenarios because they understood the activity steps and could analyze the situations. This can be observed from the examples of student responses provided as follows: *"It's very interesting. Some of them I used to know, but I never knew it was about chemistry."* (Student1: February 7, 2024)

2. Some students who were not interested and were unable to identify problems in the given situation, couldn't comprehend the problematic situation. This can be observed from the examples of student responses provided as follows: *"Some data relate to my daily life, but some I've never heard of before. Some are familiar names while others seem distant."* (Student2: February 7, 2024)

3. Students were increasingly communicating within their groups as they became more accustomed to group activities and shared information more readily. This can be observed from the examples of student responses provided as follows: *"If there are any topics that I don't understand, I'll ask my friend who understands to explain them to me again."* (Student10: February 7, 2024)

4. Students engaged in more discussions and helped each other with classroom presentations. This can be observed from the examples of student responses provided as follows: *"I collaborate with my friend by explaining parts I understand. However, sometimes I don't quite understand what I should do, so I ask them for help."* (Student7: February 7, 2024)

From the interviewed students, they could identify problems that aligned with the situation but some students don't understand how to identify the problems. The increased communication within student groups has led to a clearer identification of problem-solving methods. However, some groups rely on copying from others, which hinders independent problem analysis. The frequency of inquiries for additional questions or information post-presentation has increased. Some students had difficulty understanding their own roles and responsibilities and struggled to explain the roles of their peers within the group. Furthermore, there was limited communication among group members, leading to the incomplete sharing of information. As a result, the researchers advised students to distribute tasks based on individual abilities and promote active listening and adherence to group agreements, consistent with their guidance. Analysis of data from the collaborative problem-solving

competency assessment, behavior observation, and student interviews in the second cycle. Some students did not understand the identification of problems from given situations or were able to identify but did not correspond to the situation. Teachers should use probing questions to guide students in thinking within the provided context and define relevant problems. Some students did not cooperate in their work. Teachers should encourage each group to allocate roles to individual members for activities by inquiring from each group.

The third cycle

The researchers stimulated group work and queried each group's problem-solving approach in order to facilitate student communication in selecting suitable problem-solving approaches for the given scenarios and for classroom presentations. The researcher conducted interviews with students to improve learning activities for the next cycle by summarizing the points as follows:

1. Students understand situational problem identification and identify problems that correspond to the situation. Students engaged in reading and critical analysis to discern key points from the scenarios, allowing them to identify problems effectively. This can be observed from the examples of student responses provided as follows: *"I can identify problems by reading, understanding, and dissecting the key points of the scenarios.* (Student 6: February 22, 2024)
2. Some students can't identify problems in the scenarios because of a lack of understanding. This can be observed from the examples of student responses provided as follows: *"I don't quite understand why it's necessary to specify the problem."* (Student13: February 22, 2024)
3. The students were increasingly cooperating in group work because they were beginning to understand the steps of the group activity. This can be observed from the examples of student responses provided as follows: *"I explain the part of the task I am assigned (research), then I discuss it with other friends, and they guide me again."* (Student8: February 21, 2024)
4. The students were satisfied with working in groups and want to work in groups with close friends because they believe they can perform better when working with familiar individuals. This can be observed from the examples of student responses provided as follows: *"I would like to choose my own group because I'm currently with classmates I'm not very close to. I prefer to be with friends I'm more familiar with."* (Student13: February 22, 2024)

From interviewed with students, most students were engaged with the presented scenarios, but there were still 1-2 who appeared indifferent and disinterested. Students were able to independently identify and analyze issues that correlated with the situation. Students communicated and discussed within their groups, exchanging knowledge to identify group issues and propose solutions effectively. When all three cycles were completed, it showed that students' collaborative problem solving competency tended to increase. The students' skills in collaborative work, enable them to communicate, engage in discourse, and exchange knowledge proficiently. There was a commitment to the roles and responsibilities outlined, along with collaborative planning and execution within the group.

Discussion

The findings of this study demonstrate that implementing Creativity-Based Learning integrated with Collaborative Learning (CBL-CL) effectively enhances students' CPS competencies. By the end of the three action research cycles, 16 out of 18 students (88.89%) had attained a high level of CPS competency, indicating a clear progression and positive impact of the instructional approach.

In the first cycle, only 5 students achieved high-level CPS competency. The highest performance was observed in the dimension of taking appropriate action to solve the problem, with an average score of 10.83. This suggests that students were able to select and apply effective problem-solving strategies, communicate their reasoning, and reflect on the appropriateness of the approaches used—skills aligned with Capraro et al. (2013), who emphasize the importance of shared reasoning and role clarity in collaborative tasks. Meanwhile, the competency establishing and maintaining shared understanding scored 10.30 on average, reflecting students' growing ability to exchange knowledge and consider peers' perspectives. However, establishing and maintaining group organization received the lowest score (mean = 8.78), highlighting challenges in role allocation and group coordination.

By the second cycle, improvement was evident as 8 students reached a high level of competency. The highest score again appeared in taking appropriate action to solve the problem (mean = 11.77), reflecting greater confidence and fluency in problem-solving processes. Shared understanding also improved (mean = 10.77), while group organization showed moderate progress (mean = 9.31). These results

suggest that students were becoming more comfortable with collaboration, including sharing opinions, evaluating ideas, and organizing group tasks effectively.

In the third cycle, the number of students demonstrating high CPS competency doubled from the first cycle, with average scores of 12.80 (problem-solving action), 12.70 (shared understanding), and 11.30 (group organization). These results confirm that iterative, hands-on learning experiences contributed significantly to the development of all three CPS dimensions.

The observed improvements can be attributed to the implementation of the CBL-CL model, which prioritizes experiential learning, student autonomy, and interdependence within groups. Sustained engagement in collaborative settings enabled students to develop key competencies such as metacognitive awareness, effective communication, and teamwork skills (Habiddin, 2023; Xu et al., 2023). Furthermore, this model fosters the development of social skills by promoting constructive communication and encouraging collaborative thinking and critical thinking in problem solving process (Gillies, 2016; Lazonder & Harmsen, 2016; Polat et al., 2021). It actively involves students in researching information and jointly solving problems, thereby providing meaningful opportunities to practice and strengthen CPS abilities (Herro et al., 2021; Tang et al., 2025). These findings are consistent with previous studies by Wongchachom and Cojorn (2016) and Cojorn (2017), which demonstrated that active, team-based learning environments effectively support both cognitive development and the cultivation of social competencies. Additionally, it is emphasizing the importance of structured and interactive learning environments in fostering CPS skills (Rummel & Spada, 2005; Järvelä et al., 2014). Antonnenko et al. (2014) demonstrated that the DEEPER learning framework, which incorporates goal setting, information exchange, and interactive dialogue, effectively cultivates CPS competencies. Supporting this, Burns et al. (2014) argued that collaborative learning environments provide authentic contexts for students to co-construct knowledge and solve problems collectively. Likewise, Gu et al. (2015) underscored the significance of well-structured instructional strategies in supporting the development of CPS, reinforcing the value of intentional design in promoting collaboration and problem-solving abilities.

The findings of this study align with and extend prior research

emphasize the value of collaborative learning environments in developing essential problem-solving skills. Across various contexts, collaborative approaches have been shown to enhance both cognitive and affective outcomes. For instance, group-based science learning has been linked to improved problem-solving capabilities and increased self-confidence among teacher education students (Fuad et al., 2019), while blended learning models integrating CPS strategies have proven effective in strengthening students' ability to collaborate (Bonitasya et al., 2021). Pruner et al. (2021) further underscore the role of access to diverse information sources in promoting critical communication competencies central to CPS. These findings collectively suggest that collaborative learning, when strategically structured and supported, not only cultivates core CPS skills but also fosters a supportive and interactive environment that enhances the overall learning experience (Kaendler et al., 2015; Leeuwen & Janssen , 2019; Lin et al.,2020). This supports the interpretation that structured collaborative tasks are not merely beneficial for task completion, but are instrumental in nurturing the interpersonal and cognitive skills essential for 21st-century learning (Rogat & Linnenbrink-Garcia, 2011).

In summary, the findings of this study confirm that Creativity-Based Learning integrated with Collaborative Learning not only enhances students' ability to solve problems collaboratively but also supports their growth in communication, organization, and shared understanding. These results contribute to the growing body of literature advocating for instructional practices that blend creativity, collaboration, and real-world application.

CONCLUSION

This study aimed to enhance the CPS competencies of secondary school students through the integration of Creativity-Based Learning and Collaborative Learning (CBL-CL) within a classroom action research framework. The results clearly indicate that this instructional approach significantly improved students' CPS skills across all three cycles. By the end of the study, 88.89% of the students achieved a high level of CPS competency. Students demonstrated increased abilities in problem-solving, shared understanding, and group organizations skills essential for 21st-century learning.

The success of this approach can be attributed to the structured, hands-on learning experiences that emphasized active participation, peer collaboration,

and real-world application. Each cycle provided opportunities for students to reflect, revise, and refine their collaborative strategies, fostering both individual growth and collective learning.

Based on the results, it is recommended that Creativity-Based Learning combined with Collaborative Learning be integrated into regular science instruction. Teachers should be supported through training to design activities that emphasize teamwork and creativity. Furthermore, special focus should be given to strengthening students' ability to organize and manage group work effectively. Over time, such instructional models could be expanded to other subjects to reinforce collaborative skills across disciplines and foster holistic student development.

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