Assessing Prospective Elementary School Teacher Students' Perceptions of Collaborative Problem Solving Strategies in Basic Science Lectures

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Abstract. Collaborative problem-solving (CPS) learning combines problem-solving and collaborative strategies. This strategy entails coordinating students' actions to exchange knowledge or generate new knowledge to solve complex problems. Social skills, problem-solving abilities, critical thinking abilities, creative thinking abilities, and metacognitive dispositions and awareness have all been shown to improve with CPS strategies. This study assesses prospective elementary school teacher students' perceptions of implementing CPS strategies in introductory science courses. In this qualitative study, data was gathered through in-depth interviews and questionnaires. The results of interviews with students and the completion of questionnaires show that CPS learning can assist them in actively exchanging ideas and knowledge, understanding, and problem-solving based on experience. They believe the CPS learning process is more interesting, enjoyable, and challenging. The constructivist and social cognitive theories were used to develop the interview guide and questionnaire. Cognitive, behavioral, and learning environment factors were among the themes identified through deductive thematic analysis. Thematic inductive analysis was used to analyze data from interviews. The data gathered from the questionnaires was reduced, classified, and descriptively analyzed. CPS fosters creativity, critical thinking, and improved performance. Finally, CPS learning offers additional advantages in terms of innovation, problem-solving abilities, and creative thinking.

Keywords: Students Perceptions, CPS Strategy, Basic Science Lectures.

1 Introduction

Nowadays, the world is open and interconnected. Humans are free to interact with anyone in the world with the help of technology. This progress, requires the world of

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education to adapt and transform. Today's educational objectives are literacy in reading, writing, and counting and literature in technology, information, and communication. Today's education's external targets must go beyond the cognitive aspects of metacognitive, critical thinking, and problem-solving. To that goal, learning innovation is needed. Given this challenge, the conventional teacher-centered strategy that has been used for so long needs to be changed. We're in a state where information flows so fast that students need to be directed to filter and choose the correct information to solve problems. Therefore, what needs to be done now is to revitalize learning activities. The learning strategy applied in schools must respond to the needs and demands of today. Classical model lectures are converted into master sessions, poster sessions, or conferences.

The group work model is being developed to be collaborative and integrated with other models. Collaborative problem-solving (CPS) is a learning strategy that integrates collaborative activities and problem-solving. The word problem solving comes from an activity that involves finding a method or way to solve a problem. When combined with problem-solving, a collaborative strategy can involve students asking questions and solving problems together [1]. CPS involves coordinating actions among students as they adapt their knowledge or generate new knowledge to solve new and complex problems [2].

The CPS strategy in today's world of higher education for its ability to enhance the skills of the 21st century. Several studies have shown that CPS can affect high-level thinking skills such as critical thinking, creativity, and problem-solving skills. Recent research has shown that it can enhance soft skills like communication, empathy, and collaboration. CPS may actively involve students in learning by doing, sharpening the ability to think critically and solving problems. In addition, CPS can encourage content exploration and analysis activities from various perspectives, support support and mutual respect amongst each other and develop students' curiosity for lifelong learning.

Although CPS has the potential to develop high-order thinking and soft skills, many weaknesses are still found when applying CPS learning. First, some students find it difficult to engage in collaborative work due to minimal communication and social skills [3].

Second, students with low academic and social abilities will experience difficulties and choose to be passive in discussions and expect the work to be completed by other team members [4]. Third, minimal student contributions can affect imbalances in collaboration and minimal friendship [5]. This leads to counterproductive interpersonal conflicts and can lead to bullying because of homogeneous groups, unequal division of duties, unfair treatment [4, 5].

These difficulties cause the implementation of the CoIL learning strategy to remain very limited. Applied learning activities are more dominated by the transfer of knowledge (cognitive) to pupils, and learning access is still focused on developing individual capacity [6]. At the same time, important aspects such as self-regulation in team cooperation are less of a concern. Students are less trained to ask questions, formulate problems, gather evidence, analyze evidence, and share results. This impacts learners' low competence, especially collaborative, critical thinking, and metacognitive competence [7, 8].

Research related to students' perceptions of the implementation of CPS learning needs to be done. Through the perception of students, information related to the advantages and weaknesses of CPS learning can be identified as an attempt to improve the future CPS Learning Plan. Although there is evidence of the use of learning CPS in various courses and levels of education, there is no research focused on student perceptions of the success of the CPS. The purpose of this study is to evaluate and create trends in the perceptions students of prospective science teachers about the learning that CPS is used to teach basic science.

2 Methods

The study uses a case study approach of qualitative methods to find out students' perceptions of prospective elementary school teachers about the CPS learning environment and their interactions in collaborative problem-solving. Primary school teacher education is being focused on because students who will be primary school teachers are supposed to teach the skills of the 21st century. The study began with a questionnaire filled out after several meetings of students following basic science learning activities with CPS strategies. The questionnaires contained students' perception of CPS learning in basic IPA lessons, their interaction with peers and teachers, and their attitude to CPS strategy.

This study's subjects are first-year primary school teacher education students programming basic science courses. The number of them is 90. However, the interview data is only represented by a few students. The research instrument consists of two instruments: a lifted instrument to evaluate student perception of CPS learning and an open interview instrument to obtain data about student perceptions of CSP learning in supporting problem-solving skills.

The data collection in this study consists of two questions and interviews. The questionnaire covers five aspects: 1) personal perception (e.g. CPS learning presents the context of a real problem according to the student's experience2) finding and analyzing problems: CPS Learning allows students to find and analyze problems; 3) Producing Ideas (e.g., CPS allows thinking about qualified ideas when discussed; 4) Making action plans (e.g., setting clear criteria when working in groups; (5) Student negotiation (e.g., 'I talk to other students about how to solve problems'). 6) Persuasion and communication (e.g., "I express my thoughts in a way that others can easily understand). Using the CPS strategy, the student submitted this questionnaire after the birth of the classroom activities, with as many as eight meetings.

The interviews were conducted to refine the data obtained through the questionnaire. In addition, the researchers asked students to respond to the impressions they gained while following the CPS strategy's learning process and to articulate its relevance with their mentor. Interviews are only for selected students. They were selected based on high and low levels of academic ability. The researchers inform the selected students to obtain permission and approval from them. The interview was conducted practically in pleasant conditions. The language used is Indonesian and Ternate, so it is easy for

the students interviewed to digest and respond to. Researchers and research assistants recorded the results of the interviews.

Data collection and interviews are conducted after students follow basic science courses with the CPS strategy. Here are the steps of the CPS learning strategy.

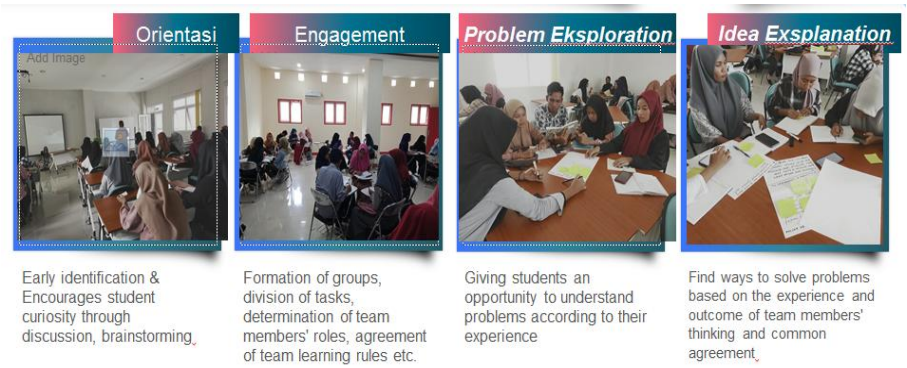

Fig. 1. Learning phases collaborative problem solving

The questionnaire data is analyzed using descriptive statistical analysis to determine mean and standard deviations. For qualitative data, we use basic theory (Glaser dan Strauss 1999). analyze student experiences of learning activities that most facilitate learning and the mechanisms behind the process.

3 Results and Discussion

Three big themes emerged from data analysis. The first theme concerns the perception and conception of students towards CPS learning. The second topic concerns students' perception of the stages of CSP learning, such as describing the positive impact of orientation and engagement in guiding collaboration. The third theme describes students' experience exploring problems to give birth to ideas to solve them. These themes are illustrated by student narratives, reviews of what learning activities are most effective in basic science lectures, and how and why they support their learning. Generally speaking, students who follow learning with CPS strategies respond positively to each stage they go through, from orientation activities and engagement to exploration ideas.

Data in Table 1 show that most students (average total $x = 3.22$) responded positively to implementing CPS strategies in basic science classes. The analysis of elements 1 to 11 shows that most students ($x < 3.15$) agreed to apply the CPS strategy in the basic IPA learning as they solved problems jointly, shared tasks, and motivated each other.

Table 1. Student perceptions of CPS learning in basic science lectures

No	Questions/Statements	Mean	Deviation Standard
1	Basic science lectures with CPS strategies present real-life problem contexts according to my experience	3.67	0.98
2	Basic science classes with CPS strategies can motivate me to study with fun	3.83	0.91
3	I believe collaborative learning is a more effective way of learning.	3.16	1.24
4	Basic science learning with CPS gives me an opportunity to discover and analyze problems	3.79	0.95
5	I feel challenged when working together to solve problems	3.73	1.08
6	Basic science learning with CPS gives me an opportunity to think about quality ideas when discussing	2.93	1.11
7	Basic science courses improve the ability to analyze evidence-based problems	3.66	1.05
8	Basic science courses with CPS sharpen problem-solving skills	3.23	1.08
9	I set clear criteria when working in groups	3.09	1.28
10	Basic science education with CPS makes me dare to put forward ideas and opinions	3.77	1.06
11	I dare to express my thoughts in a way that others can understand.	3.76	1.01
	Average	3.51	0.01

Student interviews supplement the data; according to them, orientation activities at the beginning of classes with the CPS strategy allow them to identify early knowledge while stimulating their curiosity about issues related to basic science in everyday life. In interviews, students provide further insight into such mechanisms and impacts. Almost all the students interviewed, 90%, acknowledged that learning activities initiated with orientation can facilitate their learning. Orientation gives them guidance on the steps in learning. Through orientation, students can learn the main purpose of learning. As perceived by some of the following student:

> "I think the early steps of the lecturer to introduce the steps in learning before starting the material helped me greatly in the learning setting." (Respondent 1).
>
> Respondent 2 stated that: "College contract begins to make me obey and follow every stage of learning properly".

> According to (Respondent 3), "This lesson is somewhat different from the other lessons because, at the beginning of the lesson, instructions are given that can guide us in learning.

In addition to the positive response of students to orientation activities, they also felt that there was a difference between the group work they've been through and what they experienced on CPS learning in basic science classes. Respondents' comments:

> "The cooperation I've been through before is not maximum because there are friends who are active, some are inactive, sometimes tasks are done by one person, but through this learning I feel interested because everyone is actively involved" (Respondent 7).
>
> "I think this lesson is fun, a little different from the previous lessons, although the methods are the same: group work, but because there's an even division of tasks so everyone works." (Respondent 5).

The positive response from the students indicated that they wanted a set of tasks and self-regulation when working in groups. Well-designed collaborative learning can sharpen students' interest in learning. Implementing CPS has allowed students to work together in heterogeneous groups; they share tasks, determine the roles of group members, and even make jointly agreed-upon rules. Activities like this allow students to exchange thoughts and knowledge, enhancing emotional, personal, and interpersonal intelligence.

A number of students responded positively to the exploration phase of the problem in CPS students. They felt there was an improvement in the ability to understand problems in everyday life related to basic science. They engage and feel responsible for exploring and understanding material based on real-life problems in the CPS learning environment. Students provide comments related to external factors that support their internal awareness within the scope of CPS Learning. In addition, they feel motivated to understand the material and enhance new skills because the class session requires students to understand the problem from their point of view and their peers in the discussion. Some real-life issues were raised in basic science classes using CPS. For example, in a topic about sustainable water management, students were given a problem to solve. For example, when they get stuck on an island, and it is hard to get clean water to survive, what do they have to do while on that island? Is there only available seawater and already polluted water? They then discuss and understand the problems they encounter more deeply and find ways or solutions to solve them. Their responses vary greatly, some stating that they feel that the problem is in line with what they feel, where the crisis about the future of water will occur. It is also suggested that it is very difficult to understand a problem if it is not accompanied by knowledge of the relevant concepts. Here are some of the students' responses:

> "In my opinion, understanding a problem is very difficult especially if the problem given has never been read, seen or naturalized" (Respondent 10).

"I am very happy to solve the problem given because it relates to real life" (Respondent 12).

In the CPS strategy, students collectively explore material with their peers, acquire new knowledge, compare their opinions with peers, and evaluate different perspectives.

"We were asked to discuss at the beginning of the lesson. Then we shared ideas in front of the teacher explaining a new topic." (Respondent 9).

"In other courses, we mostly listen to lectures before going into discussions, but in these courses we are asked to discuss some new science that we don't know at all." (Respondent 15).

"There's plenty of room for us to express our ideas. (Respondent 20).

"Through discussion and brain storming I learned to study science with a deeper impact" (Respondent 16).

The results of qualitative interviews suggest that in the CPS strategy, learners collectively explore material with their peers, acquire new knowledge, compare their opinions with peer members, evaluate different perspectives, and improve their problem-solving skills. This involvement encourages students to develop analytical attitudes and teamwork, enhancing their problem-solving knowledge and creativity. This is consistent with a study by Hobri et al. (2020), which suggests that students engaged jointly in problem-solving affect problem-solving skills. Several studies have proven that CPS strategies are better at boosting disposition and positive attitudes in high-level thinking.[9, 10]. Other studies reveal that collaborative learning and problem-solving activities contribute to cognitive and emotional learning outcomes. Implications emerging from these findings include the importance of applying constructive pedagogical strategies, considering the characteristics of students and the characteristics of the materials taught.

4 Conclusion

Research on collaborative learning has yielded varied outcomes, with most researchers focusing on designing pedagogies from the teacher's perspective. However, there's a lack of research exploring the student's perspective as the recipient of collaborative learning.This research offers in-depth insights into how individuals with different backgrounds interact to solve problems, shedding light on simple and enjoyable ways to enhance collaborative and problem-solving skills. The method is straightforward: prepare material that mirrors students' daily lives, initiate CPS learning activities with clear guidelines and group task set-up, involve students in problem exploration, and guide discussions when finding solutions to problem-solving. This activity ensures students participate actively, exchange ideas and knowledge, and solve problems based on experience, fostering high-level thinking skills such as collaboration, problem-solving, critical thinking, and creativity. This investigation offers in-depth insights into the perspectives of students involved in collaborative learning and problem-solving

(CPS), although with certain limitations. Initially, the sample's limitation to a specific group of students with particular backgrounds makes the findings difficult to generalize. Furthermore, the shortened duration of the activities hinders the observation of changes in behavior patterns or collaborative skills over an extended period. As a result, further investigations may explore the application of collaborative methodologies across various subjects or educational levels, as well as examine the impact of technology, such as online learning environments or digital collaboration tools, on the dynamics inherent in collaborative learning.

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