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Student Collaboration Skills Through Problem-Based Learning Models in Learning Science Electrical Circuit Material at Elementary School

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Abstract: This study uses the problem-based learning methodology to investigate and characterize collaborative skills. Additionally, this research offers theoretical benefits for designing a PBL method to enhance collaborative abilities, particularly in the study of natural sciences. This study employs qualitative narrative approaches with quantitative descriptive results. This study was conducted at Public Elementary School No. 1 Jerukwangi, an educational facility in Bangsri District, Jepara Regency. In this investigation, the researchers used the major (primary) data sources for grade 6 instructors and students at Public Elementary School No. 1 Jerukwangi. To reinforce the data collected and assist the research, extra (secondary) data sources are also gathered from textual sources, including papers, archives, observations, and reference books. The study's findings demonstrated that the sixth-grade science teacher at the elementary school utilized the problem-based learning style to teach her students about electrical circuits. Using the PBL approach has several advantages, according to design: enhancing problem-solving abilities, developing flexibility, increasing learning motivation, and improving cooperation capabilities.

Keywords: Collaboration, problem-based learning, science

1. Introduction

In addition to conveying knowledge, teachers are responsible for developing skills and changing their students' behaviour (Anggraini et al. 2021). Natural Science learning is an integrated lesson at the elementary school level. Science emphasizes students' critical thinking of problems that arise in their environment and experiential learning that is direct, contextual, and student centred.

Based on observations of the class teacher and students in class VI, it concluded that the students did not understand the information the teacher was trying to teach about electrical circuits in science. Researchers continue to find that most teachers use conservative, teacher-centred teaching methods when teaching students. In the teaching process, the instructor is responsible for instilling skills, changing his students' behaviours, and conveying information (Hidayat & Muhson, 2018). Teachers interviewed in the class revealed that class VI still had difficulty working in teams or groups because they did not have many learning conversations. When students rarely conduct discussion activities, work with teams, and exchange ideas, it will make students feel bored and bored during learning. This problem impacts the lack of one skill that cannot be developed: collaboration skills. Cooperation skills are needed for more innovation and application of learning approaches, which impacts student learning outcomes. It means students need help getting science instruction directly through the science learning process. Students tend to be inactive because they need more motivation to follow the science learning process (Sarya et al., 2019).

The problems mentioned above require various learning models or approaches that can revitalize, brighten the classroom atmosphere, and provide opportunities for students to develop their capabilities. Collaboration is one of the skills used to support student learning. The task of researchers is only limited to studying students' ability to collaborate. Thanks to today's collaboration capabilities, cooperation is an interaction framework created to support group efforts to achieve common goals.

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Using the Problem-Based Learning (PBL) paradigm is one method to observe students' collaborative abilities. According to Khairani et al. (2020), problem-based learning is a cutting-edge learning paradigm that can provide students with an active learning environment, improve their learning outcomes, and impact their academic achievement. PBL is an innovative learning model that can create an active learning environment by exposing students to real-world problems. These problems require students to acquire critical knowledge, which helps them become experts in solving problems with their learning strategies and the ability to work in groups (Sari & Antika, 2022).

This study used PBL methodology to investigate and characterize Collaborative skills. This research's theoretical contribution is understanding how PBL strategies can foster collaborative capabilities. Based on observations of daily learning activities, the main purpose of learning is for students to be proficient in the topics discussed in the lesson and then assess their level of proficiency. It is as if learning is becoming an expert in the content of a subject. How can PBL methods relate to collaboration skills that can be used to solve problems in science learning? Students often need to be made aware of the benefits of their education and more aware of whatever they have learned daily. Science learning through the PBL method approach is given to students so that they can apply how to work together between individuals and groups. How can PBL methods improve students' collaboration skills.

2. Literature Review

Nurwahidah et al. (2021) state that students should pay special attention to collaboration skills, especially in Learning, to help them become second nature in academic and daily life. Improving student learning and growth in education requires collaboration on the part of educators. In collaboration, students can learn from and with others, share ideas, build deep understanding, and develop social skills (Afdareza et al., 2020). The reasons put forward by experts lead us to conclude that collaboration skills are teamwork tools based on habits or life experiences to achieve a goal. This research is important because it can improve scientific learning methods and achievements in electrical circuit materials. Therefore, it is hoped that this experiment can also increase the activities and cooperative learning abilities of grade VI students of Public Elementary School No. 1 Jerukwangi. Our education has been verbalistic and only focused on obtaining material covered in scientific courses. According to Lestari & Sujati (2023), learning is a type of activity focused on learning stages to achieve specific goals, such as learning outcomes.

According to Hidayatullah et al. (2020), collaborative skills are carried out in teams to share ideas, voice opinions, and work together to achieve common goals. Student engagement will be influenced by teamwork. Students' ability to collaborate will be influenced by how actively they learn. Nurkhin & Pramusinto (2023) state learning is necessary to improve students' thinking skills, independence, and teamwork. It involves switching from memorizing concepts to conceptual constructs and from teacher-directed teaching to self-regulated learning. Plan, observe, and assess their Learning to develop into capable collaborators and independent learners.

According to Ojaleye, O., & Awofala (2018), students can learn cooperation skills through design, media, models, approaches, techniques, and other teaching strategies. Other studies have shown that collaboration creates an effective learning process in the classroom (Supena et al., 2021). Therefore, learning methods and strategies must be applied to empower students to learn independence and collaboration skills.

3. Methodology

This study employs qualitative narrative approaches with quantitative descriptive results. Using qualitative investigation is conducted. The purpose of qualitative descriptive techniques is to describe something as precisely as possible by using the data available to determine the picture or condition. Descriptive approach techniques include providing research topic data in more detail using analysis and looking for aspects that correlate with experimental objects to process data (Prabowo & Heriyanto, 2013). This study methodology was chosen to preserve the memory of current and future studies of events that have occurred. Examining the current state of a group of events, an object, a group of people, a condition, or a way of thinking is done through qualitative descriptive research. Therefore, qualitative descriptive analysis techniques are a way of processing data in phrases and categorizations related to an item to obtain broad generalizations.

Public Elementary School No. 1 Jerukwangi located in Jerukwangi Village, Bangsri District, Jepara Regency, Central Java Province, became the location of this research. With 19 children as participants, the subject of the study was a single grade 6 elementary school teacher who used problem-based learning strategies in teaching his students scientific concepts related to electrical circuits. Primary and secondary data are data sources. Direct information from informants is referred to as primary data. Class VI teachers of Public Elementary School No. 1 Jerukwangi conducted interviews to collect primary data. Open-ended interviews are used in this study to discover and understand the attitudes, opinions, feelings, and behaviours of people or groups. Documentation data, archival documents, and other tangible materials related to the research object are examples of secondary data.

The presentation of descriptive research carried out by researchers, including organizing objects into pictures or paintings, describing them, and describing the relationship between the phenomena studied, can be reviewed from the data and research objectives. This method demonstrates tactics that elementary school science teachers can use to help students learn about electrical circuits. The following actions were taken in this study: 1) based on the data source, the teacher conducted a preliminary examination of the research problem. Class VI teachers are used as research subjects,

and research is carried out using interview techniques. In class VI, the instructor makes direct observations by observing how the learning process is carried out and the tactics used by the teacher. The instructor records how instructions are delivered.

This experiment used questionnaires designed to measure students' collaboration capacity as a non-test data collection technique. The observer filled out a questionnaire containing ten questions about students' collaboration skills during the learning process. According to Sugiyono (2018), a questionnaire is a method of data collection whose participation is given several written statements to be completed. One learning conference with the class instructor is used to make observations; Conservative learning is not used as an intervention method. The aim is to assess the student's first capacity for teamwork. After completing the initial observation, students received therapy in the form of learning using a problem-based learning model. This subject includes one 35-minute meeting and the stages of problem-based model learning, namely: The problem to be solved in groups is communicated by the teacher; 2) the teacher ensures that each member has an understanding of the assigned task; 3) the teacher supervises student participation in gathering information during the investigation process; 4) the teacher supervises the preparation of reports and monitors discussions so that the work of each group is ready for presentation; and 5) teachers facilitate presentations and provide group motivation to give recognition and responses to other groups. The instructor and students conclude their learning. The assessment parameters shown in Table 1 are used as a guide to assess students' collaborative skills.

Table 1. Scoring guide

Score	Answer
4	SS = Very Often
3	S = Often
2	KK= Sometimes
1	TP = Never

The total related score is only made into percentages using the following formula:

$$\frac{n}{N} = x\ 100\% \qquad (1)$$

Description:
% = Percentage of Cooperation capability
n = Score obtained
N = Total score

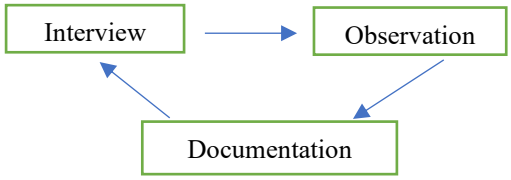
After computational analysis, the data is categorized using predetermined standards. This chart provides guidelines for classifying students' cooperation skills:

Table 2. Guide to grouping student collaboration capabilities. adapted from Arikunto (2010)

Score (x)	Category
$x \geq 80$	Very High
$60 < x \leq 80$	High
$40 < x \leq 60$	Moderate
$20 < x \leq 40$	Low
$x \leq 20$	Very Low

Researchers used data analysis methods from Miles & Huberman (1994), in this experiment by 1) data reduction, 2) presenting or displaying data, and 3) concluding the data. The researcher then provides a broad explanation by summarizing the findings of the conclusions.

Figure 1. Triangulation of data collection



Examination of members, i.e., subjects, was used in the study to verify the accuracy of the data. This study has different opinions on issues such as validity and reliability in qualitative research. Quality standards such as authenticity

and reliability, these two standards are fixed measures for validity and reliability issues.

4. Results

Refers to data analysis that has been implemented science collaboration skills according to Meilinawati et al. (2022), through collaboration indicators, there are several criteria points submitted, and the table below shows the results of science learning through observation in grade 6 when learning about circuit material electricity with PBL models.

Table 3 is not an indication table broken down into many descriptors and judging criteria. However, by summing up the collaboration skills indicators mentioned by the other experts above, collaboration capability assessment criteria can be created using this table.

Table 3. Student collaboration questionnaire grid

Indicators	Item No.	Observed aspects
1. Positive independence	2	Working based on task and interdependence as opposed to doing it alone
	5	Using learning resources (internet or books) in doing assignments
2. Interaction face to face	6	Not separating yourself from a group of friends
	8	Mobile Play (open *YouTube* or play *games*) during group work
3. Accountability and personal responsibility of individuals	1	Take responsibility for the completion of tasks on time
	9	Strive maximally in doing what is given on time
4. Communication skills	2	Discuss with a group of friends in carrying out tasks
	7	Ask a friend when you find a problem
5. Group work skills	4	Actively participate in completing tasks
	10	Complete tasks according to SOPs

Based on Table 4, after observing 19 grade VI students by providing a collaboration skills questionnaire with 5 skill indicators, each of which contained 2 assessment aspects, it was produced that each student had their role in the group. The results obtained before the PBL model carried out the average score obtained were 78%, with a difference in values from indicators 4, 6, and 9. After implementing the PBL model, the average score increased to 82%. The highest achievement in the indicator did not separate itself from the group of 93%. The lowest score before implementation and after the PBL model is carried out, namely on the indicator of playing cellphones, from 64% - 69%.

The results of the above questionnaire show that the PBL approach can be used to build cooperative capabilities. It aligns with previous experiments by Alava et al. (2021) because the methodological learning phase of the PBL model can help students develop their capacity for problem identification and cooperative problem-solving. Research by Hapsari (2014) also supports this, suggesting that task completion success rests relatively on the extent to which team members engage with one another. Collaboration skills can be trained in exchanging ideas and information to create innovative solutions.

Based on research we conducted at Public Elementary School No. 1 Jerukwangi, Bangsri District, Jepara Regency, researchers found that grade VI teachers of elementary science classes use the PBL model in teaching Electrical Circuit material. Among the many popular learning strategies is the problem-solving approach. According to Bonitasya et al. (2021), the PBL model is a practice learning strategy that outlines students' actions during the learning process to produce meaningful behaviour changes that match the desired results.

Table 4. Data recapitulation student collaboration skills questionnaire through PBL

Indicators	Percentage score	
	Pre-PBL	Post-PBL
1. Take responsibility for the completion of tasks on time	64%	73%
2. Discuss with a group of friends in carrying out tasks	64%	73%
3. Working based on task and interdependence rather than doing it alone	78%	80%
4. Actively participate in completing tasks	89%	85%
5. Using learning resources (internet or books) in doing assignments	84%	87%
6. Do not separate yourself from your group mates	87%	93%
7. Ask a friend when you find a problem	85%	89%
8. Mobile Play (open YouTube or play games) during group work	64%	69%
9. Try your best to do the tasks given on time	87%	85%
10. Complete tasks by SOPs	75%	82%
Average score	**78%**	**82%**

4.1 Improve Problem-Solving Skills

In addition to using observational assessment techniques, we also conducted interview assessment techniques for grade VI teachers. The interview was used to obtain primary data on using the PBL approach in the classroom in learning science material electrical circuits. The study aims to describe and determine the relationship between Collaborative skills using the PBL model in science learning as one method to activate student collaboration skills. Based on the results of interviews with teachers, there are several benefits of applying the PBL model to determine the relationship between student collaboration skills in science subjects.

> *"Yes, ma'am, I often provide this problem-based learning method when learning because children like to be invited to discuss solving problems that make them curious. Children discuss they learn to think critically, find solutions based on problems, and learn to find answers. With teacher guidance and material adjusted to the student's ability level."*

The problem-based learning method, one of the methods that many teachers use in teaching today, is a method that can invite students to think critically about solving problems in learning. Students are given problems to be resolved with their team through group discussions. With the PBL method, students will get used to thinking, finding solutions, processing information, and finding answers to improve problem-solving skills in everyday life. Teachers use the PBL method to apply real-life problems as a reference or foundation to discover students' skills and develop student understanding (Khoiriyah & Husamah, 2018). In PBL, teachers invite students to actively conduct research, solve problems, and collaborate with classmates.

4.2 Improve Collaboration / Cooperation Skills in Teams

PBL also encourages student collaboration with peers. Teachers divide their students into small groups to solve problems, and these groups often collaborate to talk about problems, share ideas, and find solutions. Working together fosters the development of critical thinking, communication, and adaptability to multiple viewpoints, in addition to teamwork skills. Students in a PBL environment can consider opposing viewpoints, listen to others, and compromise.

> *"The children, if I invite them to participate or work together in groups, they are very excited. Although sometimes some don't like the members of the group. As a teacher, I give them the understanding to work with the team. That way, they learn to determine their tasks from each member to complete them on time. The PBL method can improve collaboration skills*."

4.3 Increase Learning Motivation

Collaboration skills in science are essential to facilitate better understanding, co-discovery, and development of solutions to complex problems and cover several general and relevant aspects of scientific research. It is in harmony with the definition of science described by Safitri et al. (2023), which argues that studying science in the classroom requires students to actively conduct investigations and combine their knowledge with information from multiple sources. The choice of learning paradigm will influence the degree of motivation and quality of student science learning outcomes. Strong learners will make efforts to obtain better learning outcomes. According to Uno, students' internal and external reinforcement as they learn to change their behaviour is motivational.

> *"That's right, mom, children are used to being discussed; if I apply the PBL method, the learning target that I hope can be achieved. Because of different ideas, from the problems they face, new kinds of knowledge emerge that can increase the drive to learn."*

4.4 Develop Adaptability

PBL exposes students to challenging real-world situations, and sometimes there is no clear solution. Students gain the ability to adapt to changing circumstances and circumstances and come up with innovative solutions from them. Having the flexibility to adjust is very important for children to overcome obstacles in the future. Sirotiak & Sharma (2019) defines collaboration as a pattern and type of relationship between people or organizations who want to share, participate fully in each other's lives, and mutually agree or agree to carry out joint actions with various resources, benefits, and information and share responsibility in making joint decisions to achieve common goals or overcome various problems faced by those who collaborate.

> *"Yes, by using this PBL method, children are required to be able to collaborate to unite their ideas and perceptions. Children who are lazy and do not want to think must be able to adapt to their team to keep up with the abilities of other friends. That way, they can develop adaptability. Because these abilities are indispensable later in the future."*

5. Discussion

Problem solving is emphasized in PBL, a learning method. Using the PBL approach, students are given tasks to complete by the teacher. Such challenges can be applied to learning environments and come from real-world situations. Instructors provide homework that involves problem identification, cause analysis, and solution discovery. Students can gain new information through problem-solving, but they can also hone their communication, critical thinking, and teamwork skills.

Saiful et al. (2020) stated that integrating the PBL model into the classroom produces meaningful learning, improves critical thinking skills, fosters internal learning motivation, and helps foster interpersonal interaction in group projects. Students acquire problem-solving abilities, simultaneous integration of knowledge and skills, and application in related situations. Instructors encourage students to recognize each problem presented, examine pertinent data, and develop logical and analytical reasoning skills before making conclusions. Since children may face various problems in daily life that require critical thinking, these skills are important to develop.

According to Safarini (2019), collaboration skills are seen as important in learning, because it can improve students' academic performance and cultivate a strong sense of social justice. By the affirmation of Saldo & Walag (2020), learners can improve their cooperation skills in various ways such as media, models, approaches, techniques, design, and other learning strategies. Collaboration is a talent that seeks to increase collective intelligence by offering help, giving advice, receiving, and negotiating through relationships with others facilitated by technology (Pratama et al., 2019). From some of the expert explanations above, it can be concluded that collaboration skills include the ability to pay attention to the needs and perspectives of others, work in teams, listen actively, and work together to achieve common goals. Especially collaboration skills in science learning at Public Elementary School No. 1 Jerukwangi. Science skills relate to several aspects, including understanding scientific concepts, practical skills, and critical and analytical thinking skills.

PBL focuses on solving real-world problems and helps increase students' learning drive, especially in science learning at Public Elementary School No. 1 Jerukwangi. Students feel more confident and responsible for their understanding because students are actively involved in the learning process with this approach. PBL teaching that uses real-world issues also gives students a strong sense of relevance, which increases their motivation to learn, grow, and find answers. Thus, PBL can reduce boredom and increase students' interest in learning science.

6. Conclusion

In conclusion, students' collaboration skills in learning science material for electrical circuits at Public Elementary School No. 1 Jerukwangi use the PBL model. It can be seen from several collaboration indicators as a consideration for developing collaborative skills through the PBL approach. Through the PBL approach, the benefits can: 1) improve problem-solving skills so that students can orient problems and get solutions; 2) through conducting research and data collection, one can strengthen cooperation skills, practice teamwork, and compromise to address current issues by sharing viewpoints among group members; 3) increase learning motivation to train students' ability to compromise and assign tasks to each other to make a result. Investigative and information-gathering activities can help group members develop adaptability, teamwork, and compromise skills to solve difficulties by exchanging ideas. In addition, this exercise encourages students to participate (flexibly) in their groups so that a consensus of choice can lead to the best choice.

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