Analysis of Teacher Roles and Student Problem Solving Skills in Learning Physics Online Collaborative Problem Solving

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Article Info	Abstract
	The development of education needs to adapt to the needs of 21st century skills, including collaboration and problem solving. This study aims to analyze and describe the profile of Collaborative Problem Solving (CPS) online learning, as well as to describe the problem solving skills after learning. This research was conducted at SMA N 1 Gubug in class XI MIPA 1 for the academic year 2021/2022 with a qualitative descriptive method. CPS online learning is divided into virtual meetings using Microsoft Teams and discussions via text messages in WhatsApp. The research data was obtained through data observation's, interviews, and written posttests. Data processing using a fixed comparison method with three stages, namely; data reduction, categorization, synthesis, and determination of hypotheses. The results showed that the role of the teacher appeared with almost the same frequency, namely as a motivator (37%), communicator (32%) and facilitator (31%). Students' problem-solving skills are dominated by the ability to plan and identify problems with the frequency of occurrence of 35% and 31%, respectively. The next two stages of problem solving, namely implementing the plan and checking back only appeared with a percentage of 19% and 15%.

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INTRODUCTION

Communication technology is an important human need today. The importance of technology in communication is further strengthened to meet the needs during the pandemic that hit the world, including Indonesia. Limited mobility in order to reduce the transmission of the covid-19 virus, forcing educational actors to shift the systematics of learning to online . Even though the current conditions due to the pandemic have gradually improved, updating the online learning system is still relevant to continue. Online learning has a positive side that deserves to be maintained and developed according to the needs of the times. Easy access to learning without being limited by space and time are the two main points that are often the reason online learning needs to be developed.

Online communication allow us to collaborate with other people in various places and times. The need for human resources that meet 21st century qualifications is the basis for today's educational goals. Collaboration and problem solving are 21st century skills that need to be trained to students, including online learning. Some of the key skills that should be integrated into learning include critical dialogue, problem solving attitude, active and democratic participation, constructive participation, turning ideas into action, initiative, proactive and empathetic (Angela, 2014).

Online learning needs to be developed in accordance with current developments in communication technology. Technology not only changes lifestyles and ways of communicating, but also changes the way we learn (Stoytcheva, 2018). The development of technological innovations, including online communication, creates new spaces for student meetings and collaborations that result in authentic experiences and unprecedented patterns of collaboration (Gargano & Throop, 2017). Therefore, the selection of communication media and learning approaches must pay attention to the needs of students. One of the communication media that can be used widely is the "Whatsapp" social media application . The use of Whatsapp Groups for online learning is considered effective because it is relatively simple, easy, low data consumption, and can share various types of files so as to facilitate communication and discussion (Wargadinata et al., 2020).

Physics learning needs to be directed at forming students' skills in collaborating through online communication media. The Online Collaborative Problem Solving learning system (online CPS) is the learning method used in this research. Teachers have an important role in designing, implementig, and evaluating the learning process, including problem-based physics learning. The implementation of problem-solving-based learning places the teacher as a facilitator to present problems and assist students (Fitriyani et al., 2019). As a facilitator, there are three indicators, namely the teacher's action to assist the students learning, understanding students through activities in learning, and competence in addressing individual differences. (Rahmawati & Suryadi, 2019). The teacher as facilitator allows studens to determine their learning needs and goals by utilizing various sources.

The online collaborative learning models also underlines the role of interaction in the learning process (Stoytcheva, 2018). The teacher's ability to communicate in order to build interaction is one of the determining factors for learning success. As has been proven that the strength of the coach's communication has a postivie impact on the strength of exercise and the motivation of the athlete's success (Veysi & Dqg, 2016). The credibility of communicator that must be possesed by the teacher includes; planning and implementing activities and conducting communication. Forms of communication for example explaining, asking questions and responding to student questions. As a communicator, the teacher is also required to design structured tasks and choose the right communication media to teach the learning material (Ainiyah, 2016).

In learning, teacher is also expected to be a motivator. The teacher gives motivation to students to be enthusiastic about learning. Motivation is given in the form of opportunities to play an active role, reinforcment, and appreciation of opinions and student learning outcomes (Wulandani & Humaidi, 2021).

In the collaborative problem solving-based learning process, students are expected to be able to confirm any information and concepts used with their fellow groupmates. In the CPS process there are three categories of activities, namely; (1) build knowledge sharing, students actively build ideas and understand other people's ideas; (2) negotiation and coordination, students discuss to reach an agreement; (3) managing teamwork (Sun et al., 2020).

This study focuses on two main points, namely the importance of using online communication and collaborative training in physics learning. Based on these two important points, this study analyzes how the role of teachers in facilitating students learn physics through online learning CPS and how the profile of students' problem solving skills after online learning CPS.

METHOD

This study uses a qualitative descriptive research method. The research subjects were students of class XI MIPA 1 for the academic year 2021/2022. The researcher acts as a teacher who carries out CPS online learning through the

WhatsApp group media and the Microsoft Teams application. The physics material taught in this CPS online learning is rotational dynamics. The sub-material of rotational dynamics includes moment of force and moment of inertia, kinetic energy and angular momentum, and equilibrium. Learning takes place in five meetings and ends with a posttest. Researchers made observations during the learning process. Observations were made during virtual meetings through Microsoft Teams, conducting student discussions with their respective groups through WhatsApp groups, and joint evaluation activities in the class WhatsApp group .

The data collected in this study were field notes in the form of video recordings of Microsoft Teams virtual meetings, digital traces of conversations on WhatsApp, the results of each group's assignment and the results of the posttest at the end of the study. Research data analysis using a fixed comparison method which includes four processes, namely; (1) data reduction, the data obtained are identified to obtain the smallest unit of data that has meaning when associated with the research focus, (2) data categorization, data is sorted into parts that have similarities (3) synthesis, looking for links between one category and other categories, and (4) working hypothesis, the researcher formulates a statement that is proportional to answer the research question .

The overall interpretation of the research data uses the triangulation method. The triangulation used in this study is data triangulation, namely the results of observations, interviews, and written test results. Data triangulation generally relates and confirms the results of the synthesis between several data obtained.

RESULTS AND DISCUSSION

I. The role of the teacher during CPS online learning

CPS online learning process in this study is divided into two main activities, namely virtual meetings through the Microsoft Teams application and discussions through chat groups on the WhatsApp application. The steps of CPS online learning and the action of the teacher that appear in each stage of learning are shown in Figure 1.
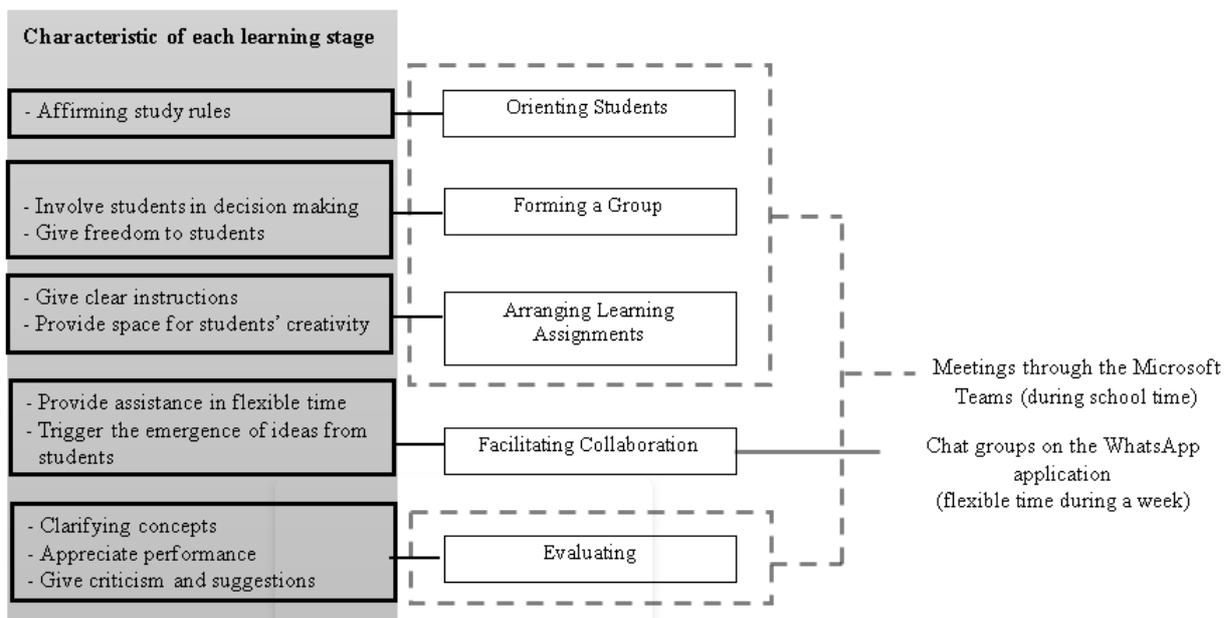

Figure 1. Characteristics of the teacher's role in online CPS learning

The teacher's actions at each stage of learning turned out to refer to the teacher's roles needed to assist student collaboration. The roles of teachers that often appear include teachers as motivators, communicators, and facilitators. These three roles are very influential on collaboration, so this research only focuses on these three roles.

Virtual meetings are held every lesson schedule for approximately one hour. At the beginning of the meeting, the teacher and students agreed that in every virtual meeting, students must turn on their smartphone cameras and position themselves in an orderly manner in front of the camera. The teacher involves students in making learning rules through making agreements, this aims to foster a sense of responsibility in students for the decisions that have been taken. This is part of self-regulatory which is one of the determining factors for the effectiveness of collaborative activities (Scager et al., 2016) . Virtual meetings are an important part so that teachers still have a special space to interact with students during the

collaborative learning process which tends to be free. As the results of previous studies stated that interaction with students provides an opportunity for teachers to find out students' learning styles, students' opinions as well as space to provide direction to students. (Laal & Ghodsi, 2012).

CPS Online learning activities actually occur outside school teaching and learning hours. The teacher asks the student representatives who are appointed as group coordinators to form groups and then create a WhatsApp group as a forum to coordinate in order to complete group assignments. Students are asked to invite the teacher into each group to help collaboratively complete assignments. The presence of the teacher in the group can make it easier for students to consult without being limited by space and time. Flexibility of time to collaborate is one of the advantages of online CPS. Teachers and students can interact as needed without being limited by time and space. This fact is consistent with previous research which states that flexibility is an important factor in learning through social media because students can contact the teacher when they need it and the teacher can immediately provide assistance. (Mostafa, 2021). Each group coordinator at the first meeting is free to choose its members independently. It aims to train students to make decisions so that students are expected to be more comfortable and more responsible for collaborating with their respective group members. However, on the other hand, a study found that friendship becomes a barrier to collaborative learning because students become less critical and disciplined when collaborating with their friends. (Le et al., 2018) .

Based on observations of research data, the teacher's role can be grouped into three main roles, namely motivator, communicator, and facilitator. The results of data analysis can be seen from Figures 2.
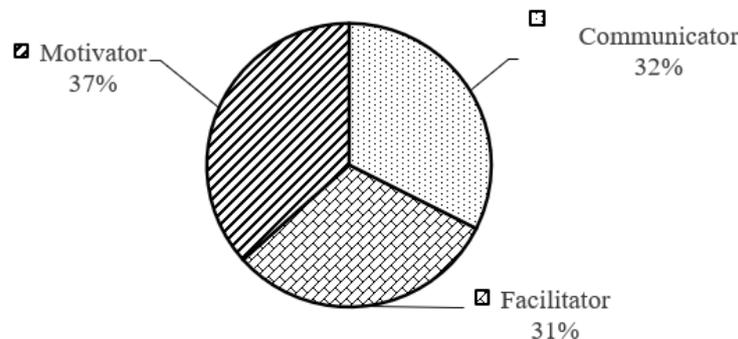

Figure 2. Frequency of teacher roles appearing in online CPS

The results of data analysis showed that the teacher's role that most often appeared was as a motivator. CPS Online Learning gives students the freedom to build knowledge independently. During the learning process, students may encounter difficulties, boredom and failure. In these circumstances the teacher needs to be present to motivate students to continue learning until the planned learning objectives are achieved. In this study, the teacher's way of motivating students, among others, was by giving encouragement when discussing in WhatsApp groups, giving appreciation for students' opinions, praising students' work before giving criticism and suggestions, and giving freedom to be creative in making assignments.

The findings of previous research stated that teachers as communicators must have clear messages to convey to students, teachers must choose the right communication channel to maximize message reception correctly, and teachers need to adjust messages with themes that are close to students as message recipients (Ainiyah, 2016). In this study, the teacher's role as a communicator was seen at the beginning of the activity. The teacher chooses two ways of communicating, namely audio-visual in video conference through Microsoft Teams and written in WhatsApp group. The two ways of communicating that were chosen were based on different needs. Virtual meetings through Microsoft Teams are necessary to ensure student attendance and teacher confirmation media regarding learning and concepts being studied. Meanwhile, communication through digital written conversations via WhatsApp is needed to conduct discussions simply, easily and flexibly. Discussion activities in class as a means of evaluation are managed by giving questions to students. This is done to train students' abilities in communicating and expressing opinions (Purnami et al., 2018).

The teacher as a facilitator must help students to achieve learning goals. In this study, the teacher's task as a facilitator begins with giving assignments as a form of planning, to assisting students' performance while working on assignments. The teacher pays attention to several things in carrying out his role as a facilitator, namely; (a) learning must be student-centered, (b) reversal of the meaning of learning, not knowledge transferred from teacher to student, but knowledge development carried out by students with the help of teachers, (c) learning by doing, (d) developing social, cognitive abilities , and emotional.

This study also found several things that teachers need to pay attention to in the implementation of online CPS, including; giving freedom to students to be creative, paying attention to the composition of members in each group, and providing clear guidelines for learning materials. These things greatly affect student performance in implementing CPS online learning.

II. Profile of students problem solving skills

Problem solving in this study is seen as a skill. Problem solving as a skill requires the use of strategies and support especially from experts (Ince, 2018). The problem-solving skills studied in this study include systematic problem-solving steps, namely; understand the problem, plan a solution, execute the plan, recheck the problem solving that has been carried out. The teacher trains problem-solving skills from giving assignments to presenting coherent test questions to make it easier for students to apply problem-solving steps. One of the tasks given is the object's center of gravity practicum.

In general, students' understanding of the center of gravity, which is a practical material, is better than students' understanding of the moment of inertia, which is a concept map assignment material. The results of this study are in line with previous research which stated that the project-based learning model that asked students to work on a props making project was better than the project task of making posters (Munawaroh et al., 2018). Projects for making teaching aids and practical work encourage children to do activities that help build knowledge.
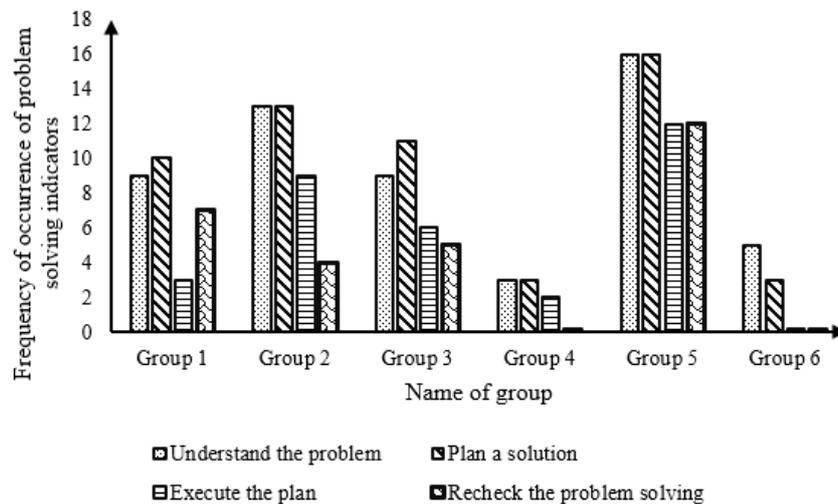

Figure 3. Student problem solving patterns after CPS online learning

The results of the analysis of the problem-solving stages that appear in students' answers after CPS online learning are shown in Figures 3. Group 5 has members whose problem-solving patterns are relatively high and evenly distributed for all stages. This is in line with the group's good performance during online CPS learning and the results of the analysis of concept understanding. It can be concluded that group 5 is able to carry out the collaboration process well, each member has a good understanding of the concepts that have been learned, and is able to show systematic problem solving. The problem-solving stages that dominate each student's answer in each group are problem identification and problem-solving planning. These two stages are the initial stage in the problem solving process. This fact shows that students are able to recognize problems and determine the philosophical concepts related to the problem. Students are able to estimate possible solutions that can be taken. However, the implementation and re-checking stages did not appear much, especially in the answers of students in groups 4 and 6. Students were not able to demonstrate the problem solving process and prove that the answers given were in accordance with the plan or not.
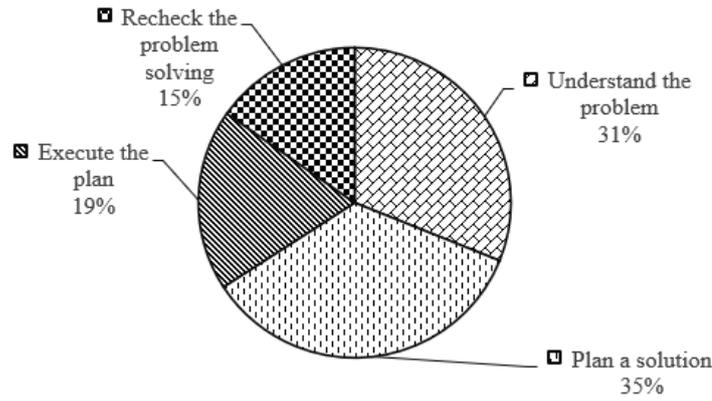
Figure 4. The Frequency of occurrence of student problem solving stages in one class

This study revealed that the problem solving stage that students mastered the most was planning solutions as shown in Figure 4. Students were constrained in carrying out the solution because they could not operate the mathematical equations that had been written correctly. When students do not carry out the completion plan, students do not get results so students find it difficult to check again.
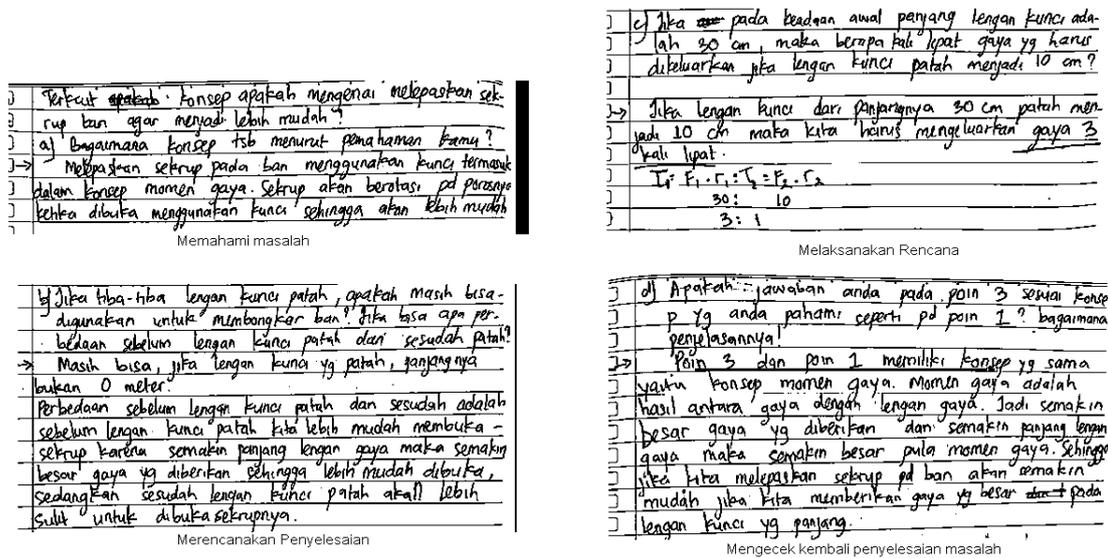

Figure 5. The exemple of student answers that show the stages of problem solving

Some students show that they are able to work on a series of questions in a coherent and systematic manner. At point one, students understand the problem presented. Students mention physics concepts related to the problem, namely the concept of torque in the case of turning a screw using a key. The second point is that students provide alternative solutions if the key used to open the screw breaks is shorter than its original state. Students are able to estimate that to be able to use the key requires a greater force. The student's answer shows that students understand the concept because they are able to provide qualitative explanations as shown in Figure 5. Students who have good problem solving skills, use qualitative arguments based on physics concepts that underlie

cases, evaluate possible solutions, and are able to use representational tools (Uzaedah et al ., 2019) .

CONCLUSION

In this study, there are three teacher roles that are most frequently observed, namely the teacher as a motivator, communicator, and facilitator. These roles have almost equal portions during the CPS online learning process, namely as motivators as much as 30%, communicators 32% and facilitators 31%. The ability of students to solve problems is quite good but not perfect. The most frequently occurring problem solving indicators were identifying problems (31%), planning a solution (35%), execute the plan (19%), and recheck the problem solving (15%). The profile of student

problem solving shows that most students are able to carry out the initial stages of problem solving. While the two last stages, namely execute the plan and rechecking the problem solving, did not appear much.

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