

Analysis Study of Application of *Problem Solving* and *Creative Problem-Solving* Learning Models, Research Literacy-Based Learning and Connectivism-Based Learning

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Abstract. Problems that are often encountered in learning biology, including the learning applied by the teacher are still more dominant in aspects of knowledge and understanding of concepts, do not require students to be active and train students in thinking and finding their concepts, students tend to memorize concepts more often without knowing how the process of finding concepts resulting in a lack of student's ability to think for problem-solving. This research is carried out to analyze the needs of teachers in applying learning models by basic competencies (KD) according to the material to be taught and the use of learning media suitable for research and technological development. The research method used is a non-experimental quantitative and qualitative survey method. Data retrieval is done online using a questionnaire via a google form. The questionnaire used consisted of 30 choice questions with a Linkert scale of 1-5. The results of the study show that on average teachers have often used *problem-solving* and *creative problem-solving* learning models, in the application of research-based learning, teachers have not often done it and teachers have used technology in learning by applying learning that utilizes blended learning, web learning, mobile learning, and seamless learning (connectivism).

Keywords: Problem Solving, Creative Problem Solving, Research Literacy, and Connectivism.

Introduction

The problems that are often encountered in learning biology are that the learning applied by the teacher is still more dominant in aspects of knowledge and understanding of concepts. It does not require students to be active and has not trained students in thinking and finding their concepts. Students tend to memorize concepts more often without knowing the process to find concepts, resulting in a lack of student's ability to think for problem-solving. Critical thinking ability is a competency that must be possessed by students, as stated by Sudiarta (2009) critical thinking has been proven to prepare students to think in various disciplines because critical thinking is a cognitive activity carried out by students by dividing ways of thinking in real activities with focuses on making decisions about what to believe or do.

The *problem-solving* learning model is expected to develop students' critical thinking skills since problem-solving skills are a provision for students to live life processes, whereas in real life various problems should be faced and should be interpreted positively. The problems will invite students to be more active in learning, understanding the content of learning, challenging students' thinking skills to overcome the problems they face, and finding the right solution. According to Sanjaya (2009), problem-solving is one of the learning models that can improve students' critical thinking skills. Research conducted by Afcariono (2008) shows that problem solving can improve students' thinking skills such as the ability to ask questions and answer problems to be solved. Another study conducted by Adnyana (2009) also showed that the application of problem-solving models was able to create very dynamic student learning interactions and better cooperation between students in groups and between groups.

In addition to *problem-solving* learning models, *creative problem-solving* learning models have now been developed to overcome the lack of trained students in solving problems creatively. *Creative Problem Solving* (CPS) learning model is a learning model that focuses on teaching and problem-solving skills, followed by skill strengthening (Pepkin, 2004). The selection of the CPS learning model in the learning process is due to, first, CPS is included in a learning model with a constructivist approach, where the center of learning is the student (student-centered) so that it is considered capable of activating students. Second, the CPS learning model can be used for students with diverse intellectual abilities. Third, The CPS learning model is not only limited to the level of recognition, understanding, and applying the information, but also training students to be able to analyze a problem and solve it. Fourth, the CPS learning model is easy to understand and apply at every level of education and every learning material

(Asikin and Pujiadi, 2008). Mayasari et al. (2013) concluded that using the CPS learning model can significantly increase students' mastery of concepts and problem-solving abilities compared to using the lecture method combined with discussion (answering questions) or the learning process which is dominated by teachers.

Among the learning innovations that support the CPS model, research-based mini-learning is a model that uses cases as the first step in collecting and processing information (Gani et al., 2020). This model is expected to be able to bring students into the real research atmosphere and further sharpen students' understanding. Meaningful learning can occur if students can connect their new knowledge with previous knowledge. This is in line with Piaget's opinion that knowledge is the result of human thinking processes (organizing and adapting) which is constructed from the process of experience continuously and every time a reconstruction can occur because of the new understanding gained through the process of learning adaptation (Winataputra et al., 2007).

Currently, education is the most important aspect that plays a role in the formation of the nation's character. The portrait of a nation can be seen and measured through the quality of education because education determines a person's future, whether he can provide something to be proud of for the nation and can restore national identity or vice versa. Technology is a system created by humans that are used to increase abilities, assist activities and provide various kinds of convenience. The use of technology in the learning process in schools is currently widely used to assist teachers in delivering learning materials that do require auxiliary components through relevant media. Future learning in the digital era applies learning technology innovations such as heutagogy, seamless learning, blended learning, online learning and mobile learning, and so on.

Future learning technology, *seamless learning*, refers to all activities characterized by the continuity of learning experiences through different learning contexts using mobile and ubiquitous technology, in this case, mobile devices such as smartphones play an important role in *Seamless Learning*. Basically, in *seamless learning*, students are allowed to collaborate and interact in various ways with peers, learning resources, and the real world (physical world), besides that this interaction is also carried out through virtual worlds. Therefore, in the interaction between learners, learners and learning resources, learners and the learning environment in terms of the synergistic relationship of learning in the real world and the virtual world, proper design of transitions between scenarios and learning contexts is required. This paper discusses the concept and design of *Seamless Learning* using mobile technology (Ulfa, 2014).

Future learning that is influenced by technological developments will change traditional learning approaches towards future learning which is called the learning age of knowledge, so that people can learn anywhere, whether in the classroom, in the library, at home, or outside the room; at any time, not according to the schedule can be morning, afternoon or evening. Along with the development of the internet, learning strategies have shifted and various information and communication technology-based learning strategies such as blended learning have emerged, namely mixing several strategies or learning methods to get the expected learning outcomes. There are three combinations of blended learning methods, namely a combination of learning strategies, and a combination of learning methods, a combination of online learning and face-to-face learning (Istiningsih and Hasbullah, 2015).

The online learning process or commonly called online learning allows students to access information flexibly without being limited by time and place. Online learning refers to the distance between students and students, where students use computer technology to access subject matter, interact with students and other students, and obtain some form of assistance. Online learning that is developing today offers various advantages such as more flexible learning opportunities without being bound by space and time. Mobile learning is one of the future learning methods using wireless mobile device technology for learning systems that can access desktop-based computer environments. This mobile learning method is a learning method that utilizes information and communication technology (Mulyani and Syah, 2014).

Based on this description, this research will conduct to analyze the needs of teachers in implementing learning models following basic competencies (KD) according to the material to be taught and using learning media that are suitable for research and technology development.

Research methods

This research method uses survey research with a non-experimental qualitative and quantitative approach involving 50 respondents, namely science teachers. Data collection in this survey was carried out online using a google form. The research instrument used to obtain supporting data for the study was obtained from a questionnaire containing 30 choice questions with a Linkert scale of 1-5.

Table 1

Likert scale

Score	Information
5	Always (SL)
4	Often (SR)
3	Sometimes (KD)
2	Seldom (P)
1	Never (TP)

Source: Researcher Data

The questionnaire was about the application of problem-solving and creative problem-solving learning models, research literacy-based learning, and connectivism-based learning. The survey data were analyzed by calculating the average value of the percentage of teachers who answered always, often, sometimes, seldom, and never on each question.

Result and Discussion

Survey data based on the average value of the percentage of teachers who answered always, often, sometimes, seldom, and never on each question based on Table 2, the problem solving and creative problem-solving model variables were found in the first question, the highest percentage, namely teachers often design learning by using a problem-solving learning model. Data from survey results on the application of problem-solving learning models that can improve problem-solving skills in students as much as 49.1%. The highest percentage in the second question is that teachers sometimes prepare lesson plans using an innovative science learning model that applies creative problem-solving models to improve critical thinking skills in solving problems as much as 32.7%. The highest percentage in the third question is that teachers often apply *creative problem-solving* learning models by providing flexibility to students in determining the right strategy to solve problems as much as 52.7%. The highest percentage in the fourth question is that teachers often apply problem-solving learning models by providing a stimulus at the beginning of learning in the form of problems to students as much as 49.1%. The highest percentage in the fifth question is that teachers often apply *creative problem-solving* learning models by providing explanations to students for each problem posed by students and directing students to create *creative problem solving* as much as 49.1%. Based on these results, the average teacher sometimes and often uses *problem-solving* and *creative problem-solving* learning models. This is following Mayasari's research (2013) that the use of the CPS learning model can significantly improve students' conceptual mastery and problem-solving abilities compared to the use of the lecture method combined with discussion (answering questions) or the learning process which is dominated by teachers. Therefore, most teachers have often applied *problem-solving* and *creative problem-solving* learning models. The application of the *creative problem-solving* learning model has weaknesses: (1) the difference in the level of understanding and intelligence of students in dealing with problems, (2) the unpreparedness of students in the field, and (3) it is only suitable for SMA/MA/SMK school levels, and (4) it spends more time (Huda, 2013; 3200). Survey

data, based on Table 2 about research literacy-based learning variables, were found in the first question with the highest percentage is 45.5%, namely, teachers sometimes apply literacy research on several appropriate KD (basic competencies). The highest percentage in the second question is 43.6%, namely, teachers sometimes train students' problem-solving skills through the application of research literacy in learning. The highest percentage in the third question is 40%, namely, the teacher sometimes gives an example of mini research for providing students to have an idea of doing research. The highest percentage in the fourth question is 34.5%, namely, teachers sometimes allow students to conduct research consultations on an applied KD (basic competencies). The highest percentage in the fifth question is 40%, namely, the teacher often gives an overview to students to search for various literature for research conducted through various journal articles. Based on the data from the survey, it can be concluded that the average teacher in the learning process has not applied all research-based *creative problem-solving* learning models.

Survey data based on the average percentage of teachers who answered always, often, sometimes, seldom, and never on each question based on Table 2 learning variables that utilize *blended learning*, *web learning*, *mobile learning*, and *seamless learning* (connectivism) in the first question has the highest percentage of teachers sometimes understand about the theory of connectivism. Connectivism-based *problem solving/creative problem-solving* learning model applied by teachers in class and according to KD (basic competence) gets a percentage of 36.4%. The highest percentage in the second question is 36.4%, namely teachers often implement *web learning* by facilitating students to find solutions to problems they face by formulating various alternative solutions to problems through web-based information access. The highest percentage in the third question is 40%, namely, teachers often use mobile learning by allowing students to use mobile phones or laptops as learning tools during teaching and learning activities. The highest percentage in the fourth question is 38.2%, namely, teachers often apply seamless learning by integrating each learning material with other disciplines. The highest percentage in the fifth question is 36.4%, namely teachers always and often apply blended learning by providing facilities for various online learning platforms such as google drive, google classroom, and WhatsApp group to facilitate students in learning activities.

Based on these results, some teachers have used technology in learning activities by utilizing *blended learning*, *web learning*, *mobile learning*, and *seamless learning* (connectivism). This is following Rusliadi's statement (2020), that the use of technology in the learning process in schools is currently widely used to assist teachers in delivering learning materials requiring the auxiliary components through relevant media. Future learning in the digital era applies learning technology innovations such as heutagogy, seamless learning, blended learning, online learning, and mobile learning.

Based on the research conducted by Snit Sitti, Saroch Sopeerak, and Narong Sompong (2013) connectivism learning can improve students' problem-solving skills. In connectivism learning theory, it is important to incorporate a problem-solving skills approach to enable learners to acquire 21st-century skills and create a learning environment in which they are engaged in a dynamic process.

Table 2

Questionnaire Results on Aspects of Problem Solving and Creative Problem Solving Learning Models

No.	Questions	Scores				
		5	4	3	2	1
1	I design learning activities using a problem-solving learning model that can improve students' problem-solving skills	12,7 %	49,1 %	36,4 %	0 %	1,8 %
2	I prepare lesson plans using innovative science learning models using creative problem-solving models to improve critical thinking skills in solving problems	18,2 %	32,7 %	34,5 %	12,7 %	1,8 %

3	I apply a creative problem-solving learning model by giving students the freedom to determine the right strategy to solve problems	10,9 %	52,7 %	25,5 %	7,3 %	3,6 %
4	When applying the problem-solving learning model, I provide a stimulus at the beginning of the learning activity in the form of problems for students	38,2 %	49,1 %	9,1 %	3,6 %	0 %
5	When applying the creative problem-solving learning model, I explain to students each problem posed by students and direct students to design creative problem solving	27,3 %	49,1 %	23,6 %	0 %	0 %
6	I prefer to apply conventional learning because it is easier for me to apply	3,6 %	29,1 %	52,7 %	9,1 %	5,5 %
7	I do not apply learning activities that can improve students' ability to solve problems	3,6 %	5,5 %	16,4 %	16,4 %	58,2 %
8	I do not allow students to determine the right strategy to solve the problem	3,6 %	3,6 %	7,3 %	14,5 %	70,9 %
9	I immediately provide learning materials for each teaching and learning activity	9,1 %	18,2 %	38,2 %	12,7 %	21,8 %
10	I let students formulate their problems without giving explanations	5,5 %	3,6 %	18,2 %	21,8 %	50,9 %

Table 3*Questionnaire Results on Aspects of Research Literacy-Based Learning*

No.	Questions	Scores				
		5	4	3	2	1
11	I apply research literacy to several appropriate KD (basic competencies).	16,4 %	29,1 %	45,5 %	9,1 %	0 %
12	I train students' problem-solving skills through the application of research literacy in learning.	12,7 %	29,1 %	43,6 %	12,7 %	1,8 %
13	I give an example of mini-research that I have done so that students have an idea in doing research.	10,9 %	23,6 %	40 %	18,2 %	7,3 %
14	I allow students to conduct consultations on research on KD (basic competencies) that can be applied.	16,4 %	30,9 %	34,5 %	9,1 %	9,1 %
15	I provide an overview of students looking for various literature for research conducted through various journal articles.	23,6 %	40 %	18,2 %	12,7 %	5,5 %
16	I apply a problem-solving learning model connected with research literacy according to the material being studied.	12,7 %	29,1 %	45,5 %	7,3 %	5,5 %
17	In learning with creative problem solving, I do not make demands for students to have research literacy skills.	3,6 %	9,1 %	49,1 %	12,7 %	25,5 %
18	I let students do their research without giving any examples or illustrations.	1,8 %	7,3 %	10,9 %	5,5 %	74,5 %
19	I leave students without giving consultation opportunities about the research to be carried out.	3,6 %	1,8 %	5,5 %	5,5 %	83,6 %
20	Every student can always apply research literacy both in problem-solving models and creative problem-solving on certain materials.	10,9 %	21,8 %	45,5 %	14,5 %	7,3 %

Table 4

Questionnaire Results on Learning Using Blended Learning, Web Learning, Mobile Learning, and Seamless Learning

No.	Questions	Scores				
		5	4	3	2	1
21	I understand the theory of connectivism and can apply it to problem-solving/creative problem-solving learning models according to KD (basic competence).	12,7 %	23,6 %	36,4 %	12,7 %	14,5 %
22	I implement web learning by facilitating students to find solutions to problems they face by formulating various alternative solutions to problems through access to web-based information.	10,9 %	36,4 %	32,7 %	7,3 %	12,7 %
23	I use mobile learning in learning by allowing students to use mobile phones or laptops as learning tools during teaching and learning activities.	27,3 %	40 %	20 %	7,3 %	5,5 %
24	I apply seamless learning by integrating every learning material with other disciplines.	12,7 %	38,2 %	25,5%	7,3 %	16,4 %
25	I apply blended learning by providing facilities for various online learning platforms such as google drive, classrooms, and WhatsApp groups to facilitate students in learning.	36,4 %	36,4 %	20 %	5,5 %	1,8 %
26	Practical reports (experiments) on the results of groupwork with creative problem-solving learning models I ask students to go to the web address that I have.	14,5 %	25,5 %	25,5 %	7,3 %	27,3 %
27	I only advise students to find solutions to the problems they face by formulating various alternative solutions to problems through textbooks.	9,1 %	25,5 %	38,2 %	12,7 %	14,5 %
28	I forbid students to use smartphones or laptops as a learning tool during teaching and learning activities because it can interfere with their concentration.	3,6 %	10,9 %	25,5 %	7,3 %	52,7 %
29	I only teach material which is following the subjects I teach.	36,4 %	32,7 %	18,2 %	3,6 %	9,1 %
30	I instruct students for practicum reports (experiments) and practicum videos to my web address by providing me the web to the link.	25,5 %	23,6 %	23,6 %	5,5 %	21,8 %

Conclusion

Based on the survey results, the average teacher has often applied *problem-solving* and *creative problem-solving* learning models. The application of research-based learning models is still not widely applied by teachers in the learning process. The use of technology in the learning process that utilizes *blended learning*, *web learning*, *mobile learning*, and *seamless learning* (connectivism) is still not maximally implemented by most teachers.

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