

Problem-Based Learning Model Integrated with Metacognitive Approach Through Flipped Learning in Science Learning Lectures

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Abstrak

Model Pembelajaran Berbasis Masalah melalui pendekatan metakognitif merupakan salah satu hal yang dianggap tepat pada masa Pandemi Covid-19. Salah satu metode pembelajaran online adalah flipped learning. Pada penelitian ini, penerapan PBM melalui pendekatan metakognitif diintegrasikan dengan penerapan flipped learning. Penelitian ini bertujuan untuk mendeskripsikan penerapan model pembelajaran berbasis masalah terpadu dengan pendekatan metakognitif melalui flipped learning dalam pembelajaran IPA perkuliahan. Penelitian ini merupakan penelitian pengembangan dengan menggunakan model Borg and Gall dengan subjek penelitian adalah mahasiswa PGSD Fakultas Ilmu Pendidikan Universitas Negeri Gorontalo yang aktif mengikuti perkuliahan pembelajaran IPA. Berdasarkan hasil penelitian dapat dideskripsikan bahwa model PBL yang diintegrasikan dengan pendekatan metakognitif melalui flipped learning dapat memberikan pengalaman belajar yang baru bagi siswa. Flipped learning menuntut mahasiswa untuk mempelajari materi dasar sebelum perkuliahan berlangsung sehingga selama perkuliahan mahasiswa dapat memanfaatkan waktunya untuk mengaplikasikan materi tersebut melalui pembelajaran aktif dan pemecahan masalah. Pengintegrasian model pembelajaran berbasis masalah yang dipadukan dengan pendekatan metakognitif melalui flipped learning merestrukturisasi pendekatan pembelajaran yang berpusat pada dosen dan menjadikan mahasiswa sebagai pusat pembelajaran.

Kata kunci: PBL, metakognitif, flipped learning

Abstract

Problem-Based Learning model through a metacognitive approach is one thing that is assumed to be appropriate during the Covid-19 Pandemic. One of the online learning methods is flipped learning. In this study, the application of PBM through a metacognitive approach is integrated with the implementation of flipped learning. This study aims to describe the implementation of an integrated problem-based learning model with a metacognitive approach through flipped learning in science learning lectures. This research is a development research using the Borg and Gall model with the research subjects being PGSD

	<p><i>students of the Faculty of Education, State University of Gorontalo who actively participate in science learning lectures. Based on the results of the study, it can be described that the PBL model integrated with the metacognitive approach through flipped learning can provide a new learning experience for students. Flipped learning requires students to study basic material before the lecture takes place so that during lectures, students can spend their time applying the material through active learning and problem solving. The integration of the problem-based learning model integrated with the metacognitive approach through flipped learning restructures the lecturer-centered learning approach and makes students the center of learning.</i></p> <p><i>Keywords: PBL, metacognitive, flipped learning</i></p>
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INTRODUCTION

Natural Sciences (IPA) is a science to find out, understand the universe systematically and develop a scientific understanding of natural phenomena as outlined in the form of proven facts, concepts, principles, and laws. Science is not only the mastery of a collection of knowledge in the form of facts, concepts, or principles but also a process of discovery. In essence, science is built on the basis of scientific products, scientific processes, and scientific attitudes. At the elementary school (SD) level, science is among the subjects that plays an essential role in education because it prepares students to face a variety of global concerns. Students must be able to think rationally, critically, and creatively, debate persuasively, communicate effectively, and collaborate effectively.

Based on observations made by students of the Department of Elementary School Teacher Education (PGSD) during the implementation of PLP II in elementary schools, they often faced problems when they had to teach science learning content. Students tend to be rigid in providing subject matter. They still tend to only provide materials to students who are fixated on the use of student books only. As prospective elementary school teachers, students still lack direct experience to students such as experimental and observational activities. After further study, based on the results of interviews with several students, they admitted that they had problems in teaching science in elementary schools. Some of them admitted that they did not master the science subject matter. They also feel that they are still not skilled in teaching students in elementary school.

Science Learning Courses in Elementary School are subjects that can accommodate students to be skilled in teaching Science in Elementary Schools. In addition, through this course, students will also review their knowledge related to knowledge of basic science concepts. Lectures are felt to need to be optimized so that students the problems that have been described previously can be overcome. Moreover, learning during the Covid-19 pandemic requires a learning model that is considered effective and able to activate students.

The flipped learning method is among the online learning strategies. Flipped learning is a type of instruction in which students are assigned to actively study the material offered through digital media such as videos, e-books, or other forms of learning tools as preparation

for activities in the classroom (Sutisna et al, 2019:121, Kurniawati et al, 2019:8). In a flipped classroom, students review instructional material before to class and apply it during class (David et al, 2019:1, Suhendri. 2019:288). Flipped learning encourages students to review foundational content before to the lecture so that they can apply the material through active learning during the lecture. This method reorganizes the learner's attitude to traditional lectures and places students, not lecturers, at the center of learning. In flipped learning, lectures are shifted to a virtual world environment, and lecture time is replaced by active learning experiences (Vioren et al, 2019:47). In the past five years, flipped learning has attracted considerable attention in the field of education. Learning approaches have been shown to improve student learning results and alter their perspectives of learning.

In addition, it is deemed vital to find solutions for learning models that must be combined with the implementation of flipped learning in order to overcome the previously outlined issues. Problem-based learning is among the learning models that could be employed as a solution (PBL). PBL is a learner-centered learning strategy in which students gain knowledge about a subject or substance by identifying a solution to a problem (Phungsuk, 2017:1). PBL is an instructional method that uses contextual challenges to motivate student learning. PBL has advantages for teaching students higher - level thinking skills (Sucipto, 2017: 64)

Problem Based Learning adopts a constructivist view in learning and provides opportunities for students including students to develop critical and evaluative thinking skills through analysis of real problems in everyday life. The PBL model is a learning model based on the principle that problems (problems) can be used as a starting point to gain or integrate new knowledge. Based on the cognitive psychology view of three learning principles related to PBL, namely: (1) learning is a constructive process and not acceptance, (2) knowing about knowing (metacognitive), and (3) contextual and social factors influence learning (Nurdin, 2011). 2016:223). In PBL, students will be active, directly involved in learning. PBL is self-directed learning (learning self-direction) (Daryanto, 2014: 31)

Referring to the principles of learning with PBL, one of them is the metacognitive principle. Metacognitive ability is the ability to think how someone thinks. Metacognitive abilities are needed by students to be able to reflect on what they are doing, what is needed to be able to do the given tasks, choose and use learning strategies that can support success in learning (Muhlisin et al, 2016: 493). The metacognitive approach refers to increasing students' awareness to achieve certain (learning) goals. If this awareness is realized, then a student can control his mind by designing, monitoring (monitoring) and assessing what he is learning (evaluating).

Learning that can empower students' potential, such as empowering metacognitive thinking, tends not to be implemented optimally for students, especially in the PGSD Department. There are still students who are less aware of their learning goals so that the learning process becomes less meaningful. There are students who just do assignments and take exams. The learning process takes place in a monotonous and rigid manner, sometimes it does not support the development of knowledge and mastery of concepts, attitudes, morals, and thinking empowerment.

Metacognitive signifies higher-order thinking that requires active regulation of the cognitive process of problem-solving learning. Metacognitive activities include deciding how to address a specific learning task, checking comprehension, and evaluating task completion progress. Metacognition is the capability of thinking about one's own cognitive processes. Students understand how they should learn, their learning abilities and methodologies, as well as the most successful learning practices within the context of learning. Metacognition is the capacity to examine oneself in order to govern one's actions optimally. Students with metacognitive knowledge are aware of their strengths and limitations in learning. This means that when they know their mistakes, they are aware to admit that they were wrong, and try to correct them. For this reason, it is felt necessary for students to have metacognitive abilities and bring them up so that in the end they can improve their science problem solving abilities.

Several studies have previously shown that metacognitive awareness is significantly associated with academic ability. Therefore, the development of metacognition is crucial for learning. The significance of developing metacognition in learning since metacognition is crucial to learning and problem-solving, hence fostering a favorable learning environment (Urena et al., 2011: 324).

Problem-based learning through a metacognitive approach is one thing that is assumed to be appropriate during the Corona Virus Disease (Covid) 19 Pandemic. In addition, the development of science and technology is increasingly encouraging educators to be able to utilize technology in learning. For example, using a computer, and accessing information via the internet. Currently, there are various internet-based learning media available. This is in compliance with the Minister of Education and Culture of the Republic of Indonesia's Circular Letter No. 4 of 2020 on the Implementation of Education Policies During the Emergency Period for the Spread of Covid-19. This study aims to describe the implementation of an integrated problem-based learning model with a metacognitive approach through flipped learning in science learning lectures. Through this research, it is hoped that it can provide solutive and effective learning for students, especially in improving their skills in teaching science. Students have not only knowledge of basic science concepts, they are also skilled in teaching them. Besides that, students will also get used to using their metacognitive aspects

METHOD

This research is a development research using the [Borg and Gall](#) model with the research subjects being PGSD students of the Faculty of Education, State University of Gorontalo who actively participate in science learning lectures. The research was conducted in two classes with 62 research subjects. Students were involved as research subjects starting from the pre-survey, limited trials, wider trials and model validation. This research was carried out within 6 months, in the even semester of the 2020/2021 academic year.

This study is an example of research and development or R&D. According to [Borg and Gall](#) (1984:624), research and development is "the process of creating and validating educational goods." This perspective suggests that research and development in the realm of education is a process to develop an educational product and validate it further. Therefore, research and

development is a process for creating new products, enhancing old ones, and evaluating their efficacy.

Implemented is the construction of an integrated PBL model with a metacognitive approach utilizing flipped learning in elementary school science learning lectures. for students in elementary school This study utilized [Borg and Gall's](#) model of development (1983). (1) research and information gathering, (2) planning, (3) constructing a prototype of the product, and (4) preliminary field testing. (preliminary field testing), (5) revision of the main product, (6) main field testing, (7) revision of operational products, (8) operational field testing, (9) revision of the final product, as well as (10) dissemination and distribution. Only the phases of information collecting, initial product development, and initial field testing will be discussed in this article. Observation techniques, questionnaires, and a number of validation instruments were used to collect information for this study.

Table 1. Metacognitive Ability Questionnaire Indicator

No	Metacognitive Activities	Indicators	Description
1	Planning	Understanding the problem	<ul style="list-style-type: none"> - Thinking about how to understand the problem - Thought of reading the problem more than 1 time - Thinking about how to collect the information that is known and asked from the given problem
		Thinking through representations and recalling prerequisite material that can help complete the task.	<ul style="list-style-type: none"> - Thinking about how to model the problem in the form of pictures - Thinking about how to annotate notation, symbols in modeling images - Thinking about what prerequisite concepts when reading questions
		Solution strategy that used	<ul style="list-style-type: none"> - Thinking to remember if ever solved this problem before - Thinking about how to arrange the work steps used to solve the problem - Think about what different strategies or ways can be used to solve the problem.
2	Monitoring	Control activity implementation solve the problem	<ul style="list-style-type: none"> - Thinking to check the suitability of the notation, the symbol used from the known information - Thinking about checking the suitability of the prerequisite concepts used to solve the problem - Controlling the accuracy of step-by-step calculations - Thinking about checking every step of completion and putting a checklist on the parts that have been checked.
3	Evaluation	Correction strategy if there is an error	<ul style="list-style-type: none"> - Thinking about repeating some of the steps taken, if you find an error. - Thinking of trying another way, if you find a workmanship error.
		Evaluating the results obtained	<ul style="list-style-type: none"> - Thinking about how to check the suitability of the answer with what was asked

No	Metacognitive Activities	Indicators	Description
			<ul style="list-style-type: none"> - Thinking about how to re-check the method used to make sure the answer is correct. - Rethink whether the answer obtained is something new.
		Evaluating the methods/strategies used to solve problems	<ul style="list-style-type: none"> - Thinking about implementing whether the method used can also be used for other problems - Thinking about what other ways can be used to solve the problem.

(Schraw & Dennison, 1994)

RESULT

Flipped classroom is an alternative form of learning that utilizes information technology, especially in learning during the Covid-19 pandemic. In carrying out the research, at the initial meeting, the lecturer and students dissect the overall scope of the Science Learning courses that will be studied for one semester. Flipped classroom is defined as a class that is reversed. In this flipped classroom model, the lecturer gives assignments to students to actively study the material provided through digital media in the form of videos or e-books or other forms of learning resources as starting material and preparation for activities in class (face to face). While the face-to-face process optimizes practicum and learning simulation activities. Mapping of the assignment has been carried out at the beginning of the lecture process, so that students already know the scope of teaching materials and what tasks they will learn and do later. This is deliberately done so that students can be active and independent in learning. Moreover, in this way, students can better integrate technology in online learning at home.

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Before the lecture is carried out, the lecturer prepares and plans learning tools that will later be used, such as semester learning plans (RPS), teaching materials, evaluation instruments, along with some required learning videos. The steps for implementing flipped learning adopt the theory from Singh et.al (2018: 12), which includes (1) the first pre-class step, (2) the second step in class, and (3) the third step of application. The first step is pre-

class which includes briefing, information transfer, and pre-class evaluation. The second step is in the classroom, which includes team-based learning, problem solving and peer learning. The third step is the application which includes the application of knowledge, final exams and feedback.

In the pre-class phase, a briefing is a brief briefing carried out with the aim of providing an overview related to the objectives of the lecture and what is being done to achieve these goals. Information transfer is an active student learning activity where the instructor has prepared learning materials through electronic media (presentations using powerpoint methods or learning videos). Pre-class evaluation is an act of assessing students' knowledge through multiple choice questions related to the information they have received through electronic media.

In the classroom phase, several activities such as group discussions, debates, or problem-based learning are carried out so that student questions can be answered. The type, number, and quality of activities in the classroom are determined by the instructor. The main role of the lecturer is to monitor, guide, and support the lecture process. Individual activities can be carried out before group activities to help students prepare before doing group activities. Group activities allow students to bring their own understanding of the content into small group discussions and utilize each other's knowledge and understanding to forge new understanding and application of concepts.

Before and after the flipping component both outside the classroom and in the classroom occurs, the teacher has the opportunity to increase and maintain student motivation for engagement outside of class time, and to assess their progress. This process is the application phase. Students can be involved in portfolio projects, comparative studies and surveys. Before finally the students take the final exam. Lecturers provide feedback related to the achievement of learning objectives for each student after the final exam is carried out.

In addition to the application of flipped learning, lecture activities are also carried out by integrating the PBL model in each lesson. The application of the PBL model is also integrated with the student's metacognitive approach in learning. Giving problems in learning can encourage seriousness, inquiry, and thinking in a meaningful and powerful way (Rusman, 2014: 212). PBL is used to stimulate students' higher order thinking in real-world problem-oriented situations, including learning how to learn. While metacognition is a student's awareness of the process of monitoring and maintaining and controlling his own thoughts and actions. Metacognition is very necessary in thinking activities. Metacognition is a learning approach that prioritizes self-awareness of the subject matter whether or not you understand the subject matter being studied, so that collaboration between the two is obtained by an implementation of learning. The following is a schematic of the integration model between PBL and the metacognition approach in lectures (Figure 1).

Table 2. Students metacognitive activities

No	Metacognitive Activities	Indikator	Score (%)			Category
			Class A	Class B	Mean	
1	Planning	Understanding the problem	76,94	72,14	74,54	Good
		Thinking through representations and recalling prerequisite material that can help complete the task.	70,00	73,44	71,72	Good
		Solution strategy that used	72,78	73,18	72,98	Good
2	Monitoring	Control activity implementation solve the problem	72,29	70,31	71,30	Good
3	Evaluation	Correction strategy if there is an error	71,25	72,66	71,95	Good
		Evaluating the results obtained	66,67	66,67	66,67	Enough
		Evaluating the methods/strategies used to solve problems	65,83	67,97	66,90	Enough

As displayed above, [Table 1](#) shows the metacognitive activities of students based on responses to a Likert-scale questionnaire distributed to them. These activities include planning, monitoring, and assessing, which are crucial metacognitive processes. Planning involves selecting the optimal approach and allocating resources that can influence performance. Examples include generating predictions before reading, employing sequencing strategies, and devoting time or focus deliberately prior to beginning a task. Monitoring refers to an individual's awareness of task comprehension. The ability to periodically engage in independent study. Evaluation is the assessment of a person's work outcomes and learning effectiveness.

In [Table 2](#), if it is described for planning aspects, in terms of (1) understanding the problem, (2) thinking about representations and recalling prerequisite materials that can help complete the task, and (3) the settlement strategies used, all three are still in the good category. There is an aspect of monitoring activities, namely the implementation of problem solving activities is also in the good category. The fairly good category is in evaluating activities, namely evaluating the results obtained and evaluating the methods or strategies used to solve problems. As for the improvement strategy indicator if there is an error it is in the good category.

DISCUSSION

Based on the findings of the study, the implementation of the PBL model linked with a metacognitive approach via flipped learning has been successfully implemented in primary school science classes. classroom. During the Covid 19 pandemic, the application of flipped learning provides chances to educate students to be engaged and independent participants in the learning process. Problem-Based Learning (PBL) or Problem-Based Learning (PBM) is a

teaching style that uses real-world situations as a setting for students to develop critical thinking and problem-solving skills, as well as acquire knowledge (Andriyani and Suhenri, 2019: 288). The lecturer becomes a facilitator rather than the primary learning resource, whose responsibility it is to supervise all classroom activities and educational processes so that students attain the intended learning outcomes. Students are intended to be more involved with the learning process (self-learning – individual learning) during this period (Sutisna et al, 2019:122). This strategy promotes active learning and gives students with additional opportunity to engage in critical thinking. This strategy also enables students to independently promote their own learning and to connect with and learn from peers and instructors (Vioren et al, 2019:49).

There are four things that must be considered when discussing problems, namely: (1) understanding the problem, (2) we do not know how to solve the problem, (3) the desire to solve the problem, and (4) the belief in being able to solve the problem (Rusman, 2003). 2014: 218). Based on the cognitive psychology view of three learning principles related to PBL, namely: (1) learning is a constructive process and not acceptance, (2) knowing about knowing (metacognitive), and (3) contextual and social factors influence learning (Nurdin, 2016:223).

By integrating the PBL model with a metacognitive strategy, lecture activities have been capable of motivating students to learn and think logically in order to find answers to what were previously difficulties or queries. This is also consistent with the findings of Ridha's (2016:657) research on flipped learning, which indicates that flipped learning seems to have a beneficial impact on the acquisition of cognitive learning outcomes by students. Cognitive learning outcomes acquired by students taught using flipped learning were much higher than those acquired by those taught using standard methodologies. While other studies on the efficacy of flipped learning concludes that it is an effective strategy, flipped learning has also been shown to be effective. According to the findings of his study, flipped learning is an effective method for boosting student responsibility for investigating online learning materials in order to foster motivation and interest in generating maximal projects (Rindaningsih, 2018: 3, Nouri, 2016:2).

As one of the new methods, flipped learning has various challenges including (1) Students feel that there is too much material to be learned by themselves in pre-class and there are still students who do not do it; (2) The lecturer does not know what to do in class if the students have learned the information beforehand, (3) When facilitating the class, the lecturer feels anxious because the lecturer feels that he may lose control of the class; (4) Lecturers feel that they never have enough time in class to convey all the material topics, so they feel they have to give lectures; and (5) Students are not entirely involved, they spend time on other activities other than those assigned. rather than engaging in classroom activities.

CONCLUSION

According to the study's findings, the PBL model integrated with the metacognitive approach through flipped learning could give students with a novel learning experience. Flipped learning necessitates that students review foundational content prior to lectures so

that they can apply the material through active learning as well as problem-solving during lectures. The merger of the problem-based learning model and the metacognitive approach through flipped learning reshapes the lecturer-centered learning strategy and places students at the center of the learning process.

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