Problem-Based Learning, Its Usability and Critical View as Educational Learning Tools

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Abstract

So far the learning process that takes place in several countries, including developed countries, is still dominated by a paradigm which states that knowledge is a set of facts that must be memorized. In addition, the classroom situation is still largely focused on the teacher as the main source of knowledge based on the curriculum. In order to develop a learning system, observation analysis is needed based on the sources of published journal articles. One of the topics we raised in this case was Problem-Based Learning (PBL). The results of the Analysis Review found that Problem-Based Learning is a learning approach that uses real world problems as a context for students to learn about critical thinking and problem solving skills, as well as to obtain essential knowledge and concepts from the subject matter. Problem-based learning is used to stimulate high-level thinking in problem-oriented situations, including learning how to learn.

Key words:
problem-based learning model, students' character, problem solving ability

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INTRODUCTION

Less effective and efficient learning methods cause unbalanced cognitive, affective and psychomotor abilities, such as monotonous learning from time to time, teachers who are authoritarian and less friendly to students, so students feel bored and lack interest in learning. To overcome this, the teacher as a teacher and educator must always improve the quality of his professionalism, namely by providing learning opportunities to students by involving students effectively in the learning process (Komala Sari, Syazali, & Farida, 2016).

The success of learning in the sense of achieving competency standards, is highly dependent on the ability of teachers to process learning that can create situations that enable students to learn so that it is the starting point for successful learning (Syahrir et al., 2018). The many theories and research results of educational experts indicate that learning will succeed if students participate actively in the learning process. On this basis came the term Active Student Learning Methods (CBSA). One learning approach that accommodates CBSA is Problem-Based Learning (PBL) developed from thinking democratic values, effective learning of cooperative behavior and respecting diversity in the community (Maskur, Syazali, & Utami, 2019).

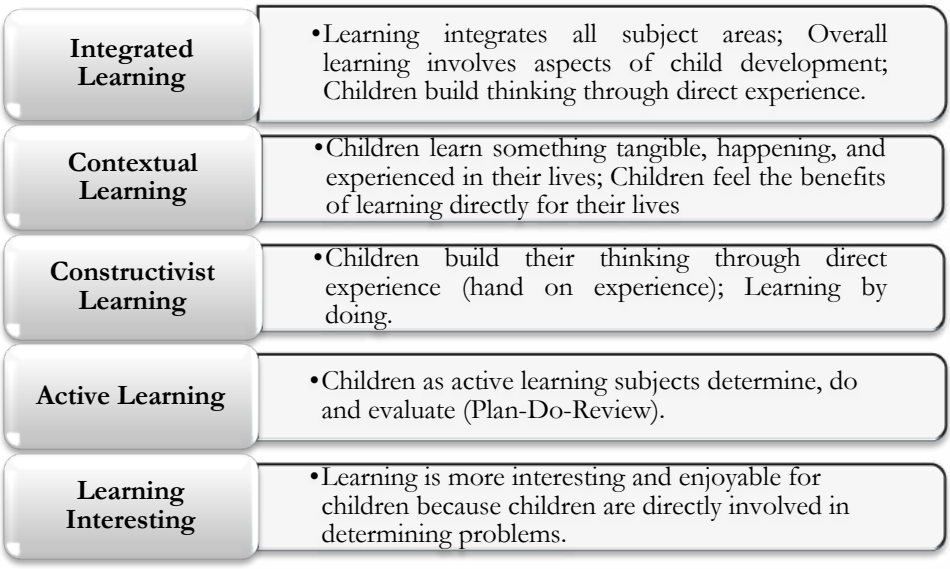
Objectives of Problem-Based Learning

Problem-Based Learning is not designed to help teachers provide as much information aspossible to students. According to Arends (2008: 70) that:

- Problem-Based Learning aims to help students develop thinking skills and problem solving skills, learn the role of adults in an authentic manner, enabling students to gain confidence in their own abilities, to think and become independent learners.
- So in Problem-Based Learning the teacher's task is to formulate assignments to students not to present lesson assignments.

Problem-Based Learning (PBL) Elements

Problem-Based Learning has several basic elements in education as follows:



Problem-Based Learning (PBL) Phases

PBL takes place in six phases, namely:

Phase 1: Submitting a problem. Questions submitted as stated previously must not be structured properly, in the sense that to solve them, further information or data is needed, it allows many ways or answers, and it is quite extensive in content. Phase 2: What is known about the problem? In this phase each member will see the problem in terms of prior knowledge. The group will discuss and agree on boundaries regarding the problem, and sort out the issues and aspects that are reasonable enough to be investigated further. This initial analysis must produce a starting point for investigation and can be revised if an assumption is questioned or new information emerges.

Phase 3: What is unknown about the problem? Here group members will make a list of questions or learning issues that must be answered to clarify the problem. In this phase, group members will break down problems into components, discuss their implications, propose various explanations or solutions, and develop work hypotheses. This activity is like the "brainstorming" phase with evaluation; an explanation or solution is noted. The group needs to formulate learning objectives, determine the information needed, and how this information is obtained.

Phase 4: Alternative solutions. In this phase group members will discuss, evaluate, and organize hypotheses and change hypotheses. The group will make a list of "What to do?" Which refers to the resources needed, people to be contacted, articles to be read, and actions that need to be taken by the members. In this phase

group members will determine and allocate tasks, develop plans to get the information needed. This information can come from in the classroom, reading material, textbooks, libraries, companies, videos, and from a particular expert. If there is new information, the group needs to analyze and evaluate its reliability and usefulness for solving the problem being faced.

Phase 5: Report and Presentation of Results. In this phase, each group will write a report on their group's work. This report contains the results of group work in the previous phases followed by the reasons why an alternative was chosen and a description of the alternative. At the end of each group explain the concepts contained in the problems raised and the solutions they propose. For example, what formulas do they use. This report is then presented and discussed in front of all students.

Phase 6: Material Development. In this phase the teacher will develop material that will be studied further and in depth and facilitate learning based on the concepts proposed by each group in the report.

By paying attention to activities in each phase, students use a lot of time to discuss problems, formulate hypotheses, determine relevant facts, find information, and define the content of learning itself. Unlike traditional learning, learning objectives in PBM are not established in advance. Instead, each group member will be responsible for developing the content or issue based on the group's analysis of the given problem (Prastowo et al., 2019).

Benefits of Problem-Based Learning

The benefits of Problem-Based Learning include the following:

- With PBL meaningful learning will occur. Students who learn to solve a problem will apply the knowledge they have. This means that learning is in the context of application concepts. Learning can be more meaningful and can be expanded when students are faced with situations where the concept is applied.
- In a Problem-Based Learning situation, students integrate knowledge and skills simultaneously and apply them in relevant contexts. That is, what they do in accordance with the real situation is no longer theoretical, so the problems in the application of a concept or theory they will find at once during learning takes place.
- Problem-Based Learning (PBL) can improve critical thinking skills, foster student initiative, internal motivation to learn and can develop interpersonal relationships in group learning.

Problem-based learning (PBL) aims to provide students with free space to think about concepts and solve problems related to the material presented by the teacher. Because basically mathematics aims to make students understand mathematical concepts with everyday life. Having skills about the natural environment to develop knowledge about natural processes around, able to apply various mathematical concepts to explain natural phenomena and be able to use simple technology to solve problems found in everyday life (Rahmawati, Lestari, & Umam, 2019).

By using the PBL approach, students do not merely receive information from the teacher, because in this case the teacher as a motivator and facilitator directs students to be actively involved in the whole learning process by beginning with problems related to the concepts being learned. Characteristics of PBL refers to the flow of constructivist education, where learning is an active process of learning to build knowledge. the active process in question is not only mental but also physical. That is, through physical activity students' knowledge is actively built based on the process of assimilation of experiences or materials learned with the knowledge they have and this takes place mentally (Habibi et al., 2019).

In learning the teacher must be able to create a learning environment as a social system that has the characteristics of a democratic process and a scientific process. Problem-based learning is an answer to the practice of learning competence and responding to the development of social dynamics in society. Besides problem-based learning is basically a further development of group learning. Thus, the problem-based learning method has the distinctive characteristic of using real-world problems as a learning context for students to learn about critical thinking and problem solving skills, as well as to obtain essential knowledge and concepts from the subject matter (Hartinah et al., 2020).

Problem-based learning is used to stimulate higher-order thinking with problem-oriented situations, including learning how to learn. According to Rahmi Ramadhani (Ramadhani & Narpila, 2018), "Problem-based learning is known by other names such as Project-Based Learning, Experience-Based Education, Authentic Learning, and Anchored instruction (Learning rooted in the real world)". The teacher's role in problem-based learning is to present problems, ask questions and facilitate investigation and dialogue (Ramadhani, 2017). Problem-based learning cannot be carried out without the teacher developing a classroom environment that allows for an open exchange of ideas in an outline. Problem-based learning consists of presenting students with authentic and meaningful problem situations that can make it easy for them to carry out inquiry inquiry (Noviyanti, Sugiharta, & Farida, 2019).

Mathematics education is one complex field of study, complex phenomena in mathematics related to other fields of science, both in the fields of practice,

technology, culture, teaching structures both school learning and community learning (Ramadhani, Umam, Abdurrahman, & Syazali, 2019). The main problem faced in learning mathematics is to link related mathematical content and organized relationship systems to all learning partners (students, teachers and learning environments) who take part in realizing mathematics learning and can integrate it in a comprehensive educational and social context such as problems in everyday life (Steiner, 1985). Besides, there are also several statements that are continuously faced by a mathematics teacher (Diani, Herliantari, Irwandani, Saregar, & Umam, 2019). What is important in mathematics? Who is this math taught to? How can one learn mathematics effectively? What is the relationship between mathematics, technology and the problems that occur in surrounding life? This statement is often heard even faced by mathematics teachers (Raymond, 2018). Mathematics needs to be taught to students because (1) it is always used in all aspects of life; (2) all fields of life require appropriate mathematical skills; (3) is a strong, concise and clear means of communication; (4) can be used to present information in various ways; and (6) providing satisfaction with efforts to solve challenging problems (Cockcroft, 1982). Teachers have an important role to make students more creative and innovative in dealing with real-world problems (Ahmad, Yin, Fang, Yen, & How, 2010).

The standard process of learning mathematics according to the National Council of Teachers of Mathematics (NCTM) is problem solving (reasoning), reasoning and proof (reasoning and proof), communication (communication), connections (connections) and representation (representation). Problem solving is part of a standard mathematical process that is very important because in the learning and completion process, students are allowed to use the skills and experience they have to apply in solving problems that are not routine because after taking education, students will plunge into communities that full of social problems (Midgett & Eddins, 2001).

Problem solving skills have an important place in class management. Problems arise in everyday life and problem-solving skills enable students to overcome various types of problems that come. Types of problems used in mathematics are divided into two groups namely routine problems and non-routine problems. Routine problems are problems found in textbooks and can be solved in the same way using a formula that was known before. Non-routine problems are problems that are mostly found in real life so they do not have special formulas that can be solved using strategies that require creative and innovative thinking skills (Özreçberoğlu & Çağanağa, 2018). Complexity in solving problems can be reflected in the structure of the conceptual field, including problems, problematic situations, problematic spaces and the process of resolution. In mathematics, a problem situation is a learning situation designed by the teacher to create a space for

reflection and analysis around the problem or question to be solved (Diani, Irwandani, et al., 2019). This situation must enable students to increase their knowledge, through new representations as well as through the learning process. In essence, every problem situation must be a reason for the contextualization and operationalization of knowledge processed through mathematics learning (Căprioară, 2015; Csapó & Funke, 2017). The importance of solving math problems in aspects of learning in schools makes it part of the mathematics learning curriculum so that it can be applied comprehensively to improve students' problem solving abilities (Liljedahl, Santos-Trigo, Malaspina, & Bruder, 2016).

In fact, when students are confronted with non-routine problems, for example, story problems related to solving problems related to daily life, the grades obtained by students will usually be lower when compared to multiple choice questions. Thus, there is still a large gap between what is expected in learning mathematics and the reality that will be achieved (Murti, Nasir, & Negara, 2019). This has become one of the problems for teachers because problem solving is needed to improve reasoning and train students to be able to think critically, logically and with character (Habibi et al., 2019). From the answers given by students, it can be seen that most students have difficulty in solving problems given in the form of mathematics. In solving problems often found students only concerned with the final answer without understanding how the answer process is correct or not (Maulidi, Apriliani, & Syazali, 2019). This often results in an incorrect student answer process. Students also often find it difficult to determine what concepts are used to solve these problems. They tend to solve these problems with arithmetic operations which they think are correct without understanding the existing problem first (Hartinah et al., 2020).

In order to solve problems that are not routine that require the ability to solve problems students must be able to go through the stages of problem solving as formulated by Polyastates in solving problem solving there are four steps that must be done, namely: (1) understanding the problem, (2) plan the solution, (3) carry out the problem according to plan and (4) re-check all the steps undertaken (Nite, 2017).

In addition to the ability to solve problems in non-routine problems students also need character, because in solving non-routine problems, ways are needed to solve them. In fact, education in Indonesia tends to be limited to the mastery of subject matter or relies on the development of low-level cognitive aspects that are unable to develop student character. Previous research has focused on improving students' mathematical problem solving abilities, especially non-routine problems (Huda, Tsani, Syazali, Umam, & Jermsittiparsert, 2020). The integration of mathematics learning in improving problem solving abilities that occur in daily life

does not necessarily become the only benchmark in improving learning outcomes. One of the goals of education is to form a character in a person which is manifested in a unity of behavior and attitude to life. But the reality is contrary to existing reality. Education tends to only pursue intellectual intelligence, tends to be poor in character, and moral. So that makes humans lose their character (Lestari et al., 2019).

Some researcher said that this kind of learning is called chance learning (Soedjadi, 2000). But along with the development of mathematics, we need a learning that intentionally includes learning the values of these characters in the planning of learning so that the goal to shape the character of students through learning mathematics can be achieved. In addition to improving student character, it can also improve students' mathematical abilities, especially problem solving abilities (Syazali et al., 2019).

After studying various existing learning models, the researcher considers that the problem-based learning model, hereinafter abbreviated as PBL, is a suitable strategy to use. The problem-based learning model is one of learning that is based on cognitive psychologists that depart from the assumption that learning is a process of behavior change thanks to experience. Learning is not merely a process of memorizing a number of facts, but a process of conscious interaction between an individual and his environment (Suriati, 2019). Through this process students will develop as a whole. This means that student development does not only occur cognitively, but also affective and psychomotor aspects through an internal appreciation of the problem at hand (Huda et al., 2019).

Some mathematics education experts have tried to study learning models that can shape student character. Soedjadi (2000) said that learning with a contextual approach with various models and methods, can be used as a tool to build the nation's character. Meanwhile (Prabowo & Sidi, 2012) said that a realistic mathematics learning approach (PMRI) can sculpt students' characters. Problem-based learning also helps students become independent students. In this problem-based learning, the teacher's role is to raise a problem or ask a question, facilitate student inquiry, and support student learning. Mathematics teacher must be able to teach students not only to solve mathematical problems, but also can teach how to solve problems both in everyday life and non-routine problems using mathematics (Macmath, Wallace, & Chi, 2009). When many students can develop their procedural abilities, they can also master and understand concepts that can be used to solve new problems. This can be done by connecting mathematical ideas that students already know with new problems that they want to solve. Teachers can develop students' procedural abilities in solving mathematical problems, teachers

need an effective and appropriate learning model. The learning model is a problem based learning model (Ramadhani et al., 2019; Ramadhani, 2018).

This was confirmed in research (Ajai, Imoko, & O'kwo, 2013) that the post-test results of students taught by using problem-based learning models are higher than the results of post-test students who are taught using conventional learning models on algebra material. In research (Ajai et al., 2013), it was stated that by using the problem-based learning model, learning begins with a problem being solved and the problem is a problem that students need to improve their new abilities before they can solve problems (Lestari et al., 2019). Ajai added that problem-based learning is a model of learning that is based on constructivism, that students construct their knowledge and relate it to the experiences they have to find solutions to a given problem. It found that students who were taught by using problem-based learning models had better test results obtained than those who were taught using ordinary learning (Ajai et al., 2013). They concluded that the significant difference between the test results obtained by students was caused by the use of problem-based learning models.

In addition to being seen from the aspect of the ability to solve the problem of the story also considered aspects of gender differences, gender differences have been in the spotlight since ancient times. Sex differences are no longer only related to biological problems, but later developed into differences in abilities between men and women (Sumarni et al., 2019).

Krutetski explains the differences between men and women in learning mathematics as follows:

- Men are superior in reasoning, women are superior in accuracy, and equality of thinking.
- Men have better mathematical and mechanical skills than women, this difference is not evident at the elementary school level but becomes more apparent at higher levels (Mawaddah, Ahmad, & Duskri, 2018).

Meanwhile (Maccoby & Jacklin, 1974) said men and women have different abilities, among others, as follows:

- Women have higher verbal abilities than men.
- Men are superior in visual spatial abilities than women.
- Men are superior in mathematical abilities.

Gender differences not only result in differences in abilities in mathematics, but the way to obtain mathematical knowledge is also related to gender differences (Zhu, 2007). Keitel said "*Gender, social, and cultural dimensions are very powerfully interacting inconceptualization of mathematics education*". Based on Keitel's opinion that gender, social and culture influence mathematics learning (Leder, 2019). Gender

differences have an effect on mathematics learning occurring during middle school (Frost, Hyde, & Fennema, 1994).

Based on the results of the research described above shows that there are diversity of research results regarding the role of gender in learning mathematics. Some results show the existence of gender factors in mathematics learning, but on the other hand some studies reveal that gender has no significant effect in learning mathematics (Huda et al., 2020).

By applying this problem-based learning model, it is hoped that the learning that students will get is more meaningful, gives a stronger impression to students, can overcome students' difficulties in learning mathematics and students themselves can also solve problem solving related to daily life and can shape student character (Huda et al., 2019).

Criticism of the PBL

The Truth of Crowded Classes

There is a lot of research on the effectiveness of the PBL model in small groups. Ideally, this approach should be applied in small groups. But the reality is that in many developing countries, classes are crowded (Azer, 2001). Can this model be applied effectively in these classes? This is not possible. In case the crowded classes are divided into groups, the existence of a problem for each group may also create a separate problem (Celik, Onder, & Silay, 2011). In this model, where active participation is important, it is very difficult to ensure active participation in crowded classes.

Vicious Circle Due to Locality in Problem Finding

In the PBL model, the spark starts with problem finding. The problems to be found will be from the environment in which students live in accordance with the "From Close to Away Principle" which is one of the important principles in learning. The problems that students will find in developing countries will not be similar to those in developed countries. Important infrastructure and environmental problems are the primary problems that students will choose. The new horizons of technology and science developed in developed countries will be students' problems (Pagander & Read, 2014). In order to solve these problems, the student will surpass the existing scientific knowledge. This will enable effective use of the PBL model (Argaw, Haile, Ayalew, & Kuma, 2017). However, students in developing countries will never be able to learn about the science of the future. Similar, unresolved problems that do not require much research and active participation will put students into a vicious circle of learning.

Not Suitable for Every Student

The claim that the PBL model is appropriate for every student may not be entirely accurate. This is because it takes a lot of time for students who have not been able to provide prior learning, even to comprehend the facts. This may make the use of time difficult to use the model. Students who face real-life problems are often gifted students. This can be an effective instructional tool for students PBL model (Culclasure, Longest, & Terry, 2019). However, this may not be the case for normal students.

Lack of Teacher Competencies

Not all teachers want or do not apply the PBL model. The comfort areas of teachers in teaching can push them to teach without much effort. Although the PBL model puts teachers in a facilitating role, this task requires more performance, knowledge and experience than traditional teaching. This reduces teachers' desire to implement the PBL model.

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