



Community Medicine & Education Journal

Journal Homepage:

<https://hmpublisher.com/index.php/CMEJ>



Application of the Discovery Learning Teaching Model in Mathematics Subjects

Marina Rahmayanti^{1*}

¹Department of Math Education, Faculty of Math and Natural Sciences, Universitas Negeri Makassar, Makassar, Indonesia

ARTICLE INFO

Keywords:

Mathematics
Learning achievement
Education
Discovery learning

Corresponding author:

Marina Rahmayanti

E-mail address:

marina_rahmayanti@gmail.com

The author has reviewed and approved the final version of the manuscript.

<https://doi.org/10.37275/cmej.v2i1.113>

ABSTRACT

Discovery learning itself occurs when individuals are involved, especially in using mental processes to find some concepts and principles. By using this model, students are required to carry out various activities to collect information, compare, categorize, analyze, integrate, reorganize materials and make their conclusions. In the discovery learning model, students are expected to be more active by processing information and mathematical concepts. Students are also able to make conclusions from the learning material that has been taught. This literature review was to obtain an overview of discovery learning models. From these results, it can be concluded that student learning achievement with a model of discovery learning differs significantly where the student learning achievement with a discovery learning model is higher than with the direct instruction model.

1. Introduction

Educational issues are always interesting to discuss. This is because education is a very complex problem and humans themselves are the object of study. Along with the rapid development of science and technology, education has experienced a significant shift in terms of achieving its goals. This impacts the quality of education, which is always required to be integrated with the conditions of the times. Education is a conscious effort made to play a role in various aspects of the environment appropriately in the future.^{1,2}

One of the educational materials that need attention in mathematics. Mathematics is one of the fields of study that is very important in everyday life.

Almost all of our life activities are related to mathematics, so it is necessary to have proper mastery of this field of study. However, it is ironic when we look at the situation in the field; most students think that mathematics is a complex field of study. This arises because of the abstraction of mathematics which is sometimes difficult for students to digest. Coupled with the lack of knowledge of teachers using learning models in sharing their knowledge, this one lesson sometimes makes students need more time to understand it.

The low achievement of student learning outcomes is also reflected in the low achievement of Indonesian students both at the national and



international levels. The achievements of Indonesian students at the international level are still lagging in comparison to other countries. The average score of Indonesian students for TIMSS-Mathematics: 397 points (2015) or equivalent to ranking 45 out of 50 countries, 386 (2011) and 397 (2007), more than 95% of Indonesian students are only able to reach the intermediate level, while almost 50% Taiwanese students can reach high and advanced levels. With the belief that all children are born equal, this result concludes that the system/model used in Indonesia is different from other countries, which mainly use a student-centered approach.³⁻⁴

Discovery learning

Discovery learning itself occurs when individuals are involved, especially in using mental processes to find some concepts and principles. By using this model, students are required to carry out various activities to collect information, compare, categorize, analyze, integrate, reorganize materials and make their conclusions. In the Discovery Learning model, students are expected to be more active by processing information and mathematical concepts. Students are also able to make conclusions from the learning material that has been taught.⁵⁻⁷

Jerome Bruner first put forward the discovery learning model; he argues that discovery learning is by the active search for knowledge by humans; students learn best by discovery so that they try to find solutions to problems and the knowledge that accompanies them, producing knowledge that means. With the discovery learning model, the knowledge gained by students will be long remembered, concepts will be easier to apply to new situations, and improve students' reasoning.

Linguistically, the discovery comes from an English word which means discovery. As for the term's meaning, each expert gives a different definition but has the same purpose. Discovery

learning is a learning model that involves various mental processes of students to find knowledge by assimilating various knowledge possessed by students.

In discovery learning, students are encouraged to learn with concepts and principles actively, and teachers encourage them to have experiences and relate these experiences to discover principles for themselves. As quoted by Oemar Hamalik, Sund suggests that discovery occurs when individuals are involved, especially in the use of mental processes to find some concepts and principles.⁸

The principle of discovery learning

As a learning strategy, discovery learning has the same principles as inquiry and problem-solving. There is no principal difference in these three terms; discovery learning emphasizes finding concepts or principles that were previously unknown. The difference with discovery is that in discovery, the problem faced by students is a kind of problem engineered by the teacher, while in inquiry, the problem is not the result of engineering, so students must exert all their minds and skills to get the findings in the problem through the research process.⁹

Problem-solving emphasizes the ability to solve problems. However, the principle of learning that seems apparent in discovery learning is that the material or lesson material to be delivered is not delivered in a final form. However, students as students are encouraged to identify what they want to know, followed by finding their information and then organizing or forming (constructively) what they want to learn. They know, and they understand in a final form.

By applying the discovery learning model repeatedly, it can increase the individual's self-discovery ability. The use of the Discovery Learning



model wants to change the passive learning conditions to be active and creative. They are changing teacher-oriented learning to student-oriented. Changing the expository mode, students only receive the general information from the teacher to the discovery mode; they find information independently.

Discovery learning model concept

Discovery learning is oriented towards maximum student activities in the learning process, maximum activity direction in the learning process, developing critical attitudes, and students' confidence about what is found in the discovery process. Although this learning model is centered on student activities, the teacher still plays an essential role as a designer of learning experiences. Teachers are obliged to accompany students to carry out activities. Sometimes teachers need to provide explanations, ask questions, provide comments and suggestions to students. Teachers are obliged to provide ease of learning by creating a conducive climate, by using various media facilities and learning materials.¹⁰

In the teaching and learning process with the discovery learning model, a teacher presenting teaching materials is not in a final form (intact from beginning to end), or the teacher only presents part of it. The rest is left to students to find and find for themselves. Then the teacher provides the most comprehensive opportunity for students to get what has not been conveyed by the teacher with a problem-solving learning approach. This means that the pressure in the discovery learning model is an effort to find and examine patterns of relationships, facts, questions, understanding, conclusions, problems, solutions, and implications highlighted by one of the fields of study so that learning occurs reliable research.

Discovery learning provides students with various concrete experiences and active learning that

encourages and provides space and opportunities for students to develop problem-solving, decision-making, and research skills that enable them to become lifelong learners. Discovery learning involves communication which means there is a space, opportunity, and energy for students to ask questions and views that are logical, objective and meaningful, and report the results of their work. Discovery learning allows teachers to learn about who their students are, what students know, and how students think at work so that teachers can become more effective facilitators thanks to their understanding of their students.¹¹

In the learning process, Bruner emphasizes the active participation of each student and is well acquainted with the differences in abilities. To support the learning process, the environment needs to facilitate students' curiosity at the exploration stage. This environment is called the discovery learning environment, which is an environment where students can explore discoveries that are not yet known or understanding similar to those already known. This kind of environment aims to make students in the learning process run well and be more creative.¹²

To facilitate a good and creative learning process, it must be based on manipulating learning materials according to the level of students' cognitive development. Manipulation of learning materials aims to facilitate students' ability to think (represent what is understood) according to their level of development. In applying the discovery learning model, the teacher acts as a mentor by providing opportunities for students to learn actively, as the teacher's opinion must be able to guide and direct student learning activities by the objectives.

The exciting thing in Bruner's opinion is that teachers should allow their students to become problem solvers, scientists, historians, or mathematicians. In the discovery learning model,



teaching materials are not presented in the final form; students are required to carry out various activities to collect information, compare, categorize, analyze, integrate, reorganize materials and make conclusions. It allows students to find meaning for themselves and learn concepts in a language they understand. Thus, a teacher applying the discovery learning model must be able to place students in opportunities for more independent learning. Bruner said that the learning process would run well and creatively if the teacher provides opportunities for students to find a concept, theory, rule, or understanding through examples that he encounters in his life.¹³

Advantages of discovery learning

The Discovery learning teaching model allows students to develop quickly and at their own pace and helps them refine and enhance skills and cognitive processes. The discovery effort is the key in this process; a person depends on how he learns. The knowledge gained through this model is very personal and powerful because it strengthens understanding, memory, and transfer.

This model can help students strengthen their self-concept because they gain confidence in cooperating with others, creating a sense of pleasure in students because of the growing sense of investigating and succeeding. Discovery learning is student-centered, and the teacher plays an equally active role in issuing ideas. Even the teacher can act as a student and as a researcher in a discussion situation. Students will understand basic concepts and ideas better, encouraging students to formulate hypotheses and intuitions. The learning process includes fellow students' aspects towards the formation of a whole person.^{10,11}

Disadvantages of implementing discovery learning

This model raises the assumption that there is a readiness of mind to learn. Less intelligent students will have difficulty abstracting or thinking, or expressing the relationship between concepts, written or spoken, which will lead to frustration. This model is not efficient for teaching students because it takes a long time to help them find theory or other problem-solving. The expectations contained in this model can be dispelled in the face of students and teachers who are accustomed to the old ways of learning. Discovery teaching is more suitable for developing understanding while developing aspects of concepts, skills, and emotions receive less attention.

Discovery learning model application procedure

According to Shah, in applying the discovery learning model in the classroom, several procedures must be carried out in teaching and learning activities in general as follows.

Stimulation

First of all, at this stage, students face something that confuses them, then proceed not to give generalizations so that the desire to investigate themselves arises. Besides that, teachers can start PBM activities by asking questions, recommending reading books, and other learning activities that prepare for problem-solving. Stimulation at this stage serves to provide conditions for learning interactions that can develop and assist students in exploring the material. In this case, Bruner provides stimulation by using a questioning technique, namely, asking questions that can expose students to internal conditions that encourage exploration. Thus, a teacher must master the techniques of giving stimulus to students to enable students to explore.⁹



Problem statement

After stimulation, the next step is that the teacher allows students to identify as many problem agendas as possible that are relevant to the subject matter, then one of them is selected and formulated in the form of a hypothesis (quick answers to problem questions). Meanwhile, according to the selected problems, it must then be formulated in the form of questions, or hypotheses, namely statements as quick answers to the questions posed. Allowing students to identify and analyze the problems they face is a valuable technique in building students to be accustomed to finding a problem.

Data collection

When the exploration takes place, the teacher also provides opportunities for students to collect as much relevant information as possible to prove whether the hypothesis is true or not. At this stage, the function is to answer questions or prove whether the hypothesis is true or not. Thus, students are allowed to collect relevant information, read literature, observe objects, interview resource persons, conduct their trials. The consequence of this stage is that students learn actively to find something related to the problems at hand. This students inadvertently link the problem to the knowledge they already have.

Data processing

Data processing is an activity to process data and information that students have obtained through interviews, observations, and then interpreted. All information from reading, interviews, observations is processed, randomized, classified, tabulated, even if necessary, calculated in a certain way, and interpreted at a certain confidence level. Data processing is also known as coding/categorization, which forms concepts and generalizations. Students

will gain new knowledge about alternative answers/solutions that need to be logically proven from these generalizations.^{1,3}

Verification

At this stage, students conduct a careful examination to prove whether or not the established hypothesis is correct with alternative findings linked to the results of data processing. Verification, according to Bruner, aims that the learning process will run well and creatively if the teacher provides opportunities for students to find a concept, theory, rule, or understanding through examples that he encounters in his life. Based on the results of processing and interpretation, or existing information, the statements or hypotheses that have been formulated previously are then checked, whether they are answered or not, whether they are proven or not.²⁻⁵

Generalization

The generalization stage is the process of drawing a conclusion that can be used as a general principle and applies to all events or the same problem, taking into account the verification results. Based on the verification results, the principles underlying the generalization are formulated. After concluding, students must pay attention to the generalization process, which emphasizes the importance of mastering the lesson on the broad meanings and rules or principles that underlie one's experience, as well as the importance of the process of organizing and generalizing from those experiences.

The relationship between discovery learning models and learning outcomes

Learning is not only passively absorbing information but actively creating knowledge and skills. Learning efforts depend on students. The



teacher only acts as a facilitator. However, in reality, many students tend to be passive in participating in learning, especially learning mathematics. This is inseparable from the model or teaching strategy used by the teacher, resulting in low student mathematics learning outcomes.⁶⁻¹⁰

Mathematical material with many concepts cannot be explained to students using the lecture model alone because it will force students to imagine the concepts that should be explained by visualizing the concept. Therefore, applying the discovery learning model can change passive learning conditions into active ones. The change teacher-oriented teaching to student-oriented, as Bruner said, the learning process will run well and creatively if the teacher provides opportunities for students to determine a concept, theory, rule, or understanding through examples encountered in life.

Learning that uses discovery learning can improve student learning outcomes because students are trained to observe, ask, try, reason, and communicate through syntax. The Discovery learning teaching model is a way to develop student learning by discovering for themselves, investigating themselves, then the results to be obtained will be long-lasting in memory, not easily forgotten by students. In this learning model, students find and construct their own to find new concepts that have never been known before. In addition, it provides opportunities for students to be able to use their reasoning abilities.⁹⁻¹¹

The use of learning models is prioritized to create a passion for learning, learning motivation, stimulating students to play an active role in the learning process. The discovery learning model is expected to make it easier to understand the subject matter provided and later enhance the quality of the learning process, which can further improve student learning outcomes.

The application of the discovery learning model can lead to interactions in the teaching and learning process. This interaction can also occur between students in both small groups and large groups (classes). In addition to affecting students' mastery of the material, this kind of condition can also improve students' social skills.^{12,13}

2. Conclusion

With this discovery learning model, it is possible that knowledge construction will be more significant and students can arrive at the expected conclusions, and student understanding will be embedded in students' minds in a relatively long period.

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