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Submission date: 13-Feb-2024 02:01PM (UTC+0530)
Submission ID: 2293703309
File name: 4._Identification_Obstacles_Biology_Zuni_Mitasari.pdf (532.14K)
Word count: 4238
Character count: 24618

Indonesian Journal of Biology Education
Vol. 6, No. 1, 2023, pp: 15-21
pISSN: 2654-5950, eISSN: 2654-9190
Email: ijobe@untidar.ac.id
Website: https://journal.untidar.ac.id/index.php/ijobe/index

Identification Obstacles Biology Learning using Sharing and Jumping Task on Didactical Design Research

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Article History
Received : 21 – 03 – 2023
Revised : 15 – 05 – 2023
Accepted : 26 – 05 – 2023

Keywords:
Biology, Didactical Design Research, Learning Obstacle, Sharing and Jumping Task

Article link

Abstract

The purpose of this study is to find out biology learning obstacles using sharing and jumping task. This research is descriptive qualitative. This research method is Didactical Design Research (DDR), which consist of three stages: (1) prospective analysis, (2) metapedadidactical analysis, and (3) retrospective analysis. The results of this study are our students have not been able to understand the concept and have not been able to connect one concept to others, so this is included epistemological obstacle, student knowledge with limited application contexts. If the obstacles have been identified, it can be used as a preparation checklist in lesson design and predict didactic responses during the learning process.

Introduction

The Human Development Index Ranking and Indonesia's Industrial Revolution 4.0 should be a subject of reflection for us, especially in terms of human resource development. A question, have students studied in class? Did you only receive lecture material from the lecturer just to memorize it? Has the lecturer made the class a fun place for students to learn? Such learning makes students bored with learning. This can cause students to be inactive and creative which can cause graduate job seekers not as job creators.

The United Nations (UN) since 2016 has launched the Sustainable Development Goals (SDGs) program and this program is scheduled to be implemented until 2030. The SDGs target improvements in 17 fields, one of which is quality education. The SDGs target in the education sector was strengthened by UNESCO which issued more specific policies in the field of education known as Education for Sustainable Development (ESD) or called Sustainable Education Development. ESD focuses on economic, social, and environmental aspects. In addition, it also emphasizes the development of 21st century skills which include four aspects, namely Critical thinking, Creative, Collaborative, and Communication Skills where these four skills have been adopted in the 2013 curriculum (Kemendikbud, 2020). Many countries consider curriculum reform as an important and also necessary measure to make schools enter the 21st century and respond to a fast-changing the world (Gouëdard et al, 2020).

The existence of curriculum renewal basically must be followed by changes in the implementation of learning in the classroom. Fullan (2015) argues that at least three dimensions of changes should take place: materials, teaching approaches, and beliefs in order to reform in education to be successfully implemented. Educational reforms or innovations must start from within the classroom. The learning paradigm must be changed from teacher-centered learning, where lecturers give a lot of lectures to student-centered learning. Student Centered Learning (SCL) approach, students are expected to be able to

construct and discover their own concepts and knowledge. Lecturers really need to be equipped with effective and efficient learning strategies to improve the quality of lectures, one of which is through lesson study (Kemendikbud, 2020).

Lesson study activities play a very important role in encouraging various parties to do things that are considered the best in improving the quality of lectures and are also able to increase student motivation. In addition, with lesson study activities, lecturers will also be motivated to prepare for lectures that are much better than before. This, indirectly, lecturers have made innovations in learning. Lecturers will also be interested in trying to implement valuable experiences when participating and becoming a lesson study team for other lecturers' lessons (lessons learned) in the class they are teaching.

The development of lesson study at the higher education level is important to do, due to the fact that higher education is still low in the process of evaluating learning activities. The results of the Ghafur (2013) state that lesson study activities until 2013 have not been widely implemented in universities. Tribhuwana Tunggadewi University, especially the Biology Education Study Program, has a characteristic that is the implementation of lesson study in its courses. In addition, this research is also accommodated by research that characterizes the Biology Education study program specifically, namely natural science-based learning and its integration, this research is focused on expanding access and improving the quality of education, curriculum development and innovative learning.

The stages of implementing lesson study activities include: planning, implementation, and reflection. The first lesson planning by the lecturer can be done by compiling a lesson design. Lesson design referred to here is slightly different from the usual Lesson Design format, but the essence remains the same, namely thinking about how students will learn from the beginning to the end of the lesson so that they will be able to achieve learning objectives effectively. When compiling lesson plans, they usually focus on how to facilitate students to learn classically without being preceded by thinking activities and focusing on helping certain students who often experience obstacles in learning (Ibrahim, 2020). In the preparation of lesson design, the lecturer and the lesson study team can arrange sharing and jumping tasks. Both of them used to predict student responses and the anticipation of lecturers to help students who have difficulties and obstacles in biology learning. Sharing and jumping tasks still rarely used as a tools to identify learning obstacles.

Brousseau (Suratno, 2009), students will naturally face learning obstacles. The factors that cause learning obstacles: (1) ontogeny obstacles, mental readiness in learning, (2) didactic obstacles, due to teaching carried out by lecturers, and (3) epistemological obstacles, student knowledge with limited application contexts. Benefits with the analysis of learning barriers, which can be used as a reference in the preparation of learning tools and to predict didactic responses and anticipation. In preparing learning tools, especially teaching materials, lecturers should consider the diversity of student responses to didactic situations that are expected to arise (Firmansyah, 2017).

Based on this background, the researcher is interested in studying in depth the role of sharing and jumping tasks carried out at the planning to identify student learning obstacles at Tribhuwana Tunggadewi University. This research is important because there are still many students deal with biology learning obstacles so their learning outcomes are low. We don't know the cause of this. By making sharing and jumping tasks at the lesson design stage we will be able to identify them well. The purpose of this study is that the results of this study can be used as a reference in identifying student learning obstacles in other classes.

Methods

This type of research is descriptive qualitative. This research method uses Didactical Design Research (DDR), which consists of three stages: (1) prospective analysis, namely the analysis of the didactic situation before learning. At this stage, an analysis of learning tools was carried out, interviews with lecturers who held courses, and compiled a didactic design of lecture material content so that sharing and jumping tasks could be arranged to predict student responses, (2) metapedadidactical analysis, namely analysis of didactic situations during learning. At this stage, the implementation of the didactic design of materials in the Genetics course, anticipating unpredictable student responses during the implementation of learning, as well as self-reflection on learning deficiencies during the implementation of the didactic design, and (3) retrospective analysis, namely analysis of the didactic situation after learning. At this stage, an analysis of student responses and the anticipation of lecturers was carried out before and during the implementation of the didactic design, analyzing the interaction between lecturers and students and students and students during the process of implementing the didactic design using a transcript of the learning video recording to find out sharing and jumping tasks, in addition to identifying cooperation that occur during the learning process (Gustina et al, 2018).

This research was conducted at the Biology Education Study Program, Tribhuwana Tunggadewi University (UNITRI). The object of this research was Biology Education class of 2019 which consisted of 24 students. The research instrument used is a non-test instrument which includes interviews, observation sheets and documentation in the form of learning video recordings. Interview activities were carried out to model lecturers who were teaching subjects to find out student learning difficulties in the Genetics course. Observation is an activity that aims to directly describe the activities carried out by students during the learning process. In this observation activity also aims to determine the implementation of the didactic design that has been made, so that the image sharing and jumping tasks that occur in students are obtained. Learning video recordings are also an instrument used to complete the observation data.

Research data analysis includes three things, namely (1) didactic situation analysis before learning begins, namely lesson design analysis and interviews with lecturers; (2) didactic analysis during the learning process, at this stage aims to identify the responses of teachers and students during the implementation of the didactic design in the Genetics course, and (3) analysis after learning, which is in the form of video recordings of learning to then make transcripts of conversations in learning activities (Gustina et al, 2018).

Results and Discussion

Students need to learn to think metacognitively to solve genetic problems. Students should understand the interrelationships between concepts to make it easier to understand the next material. Based on this understanding of the concept, then students will be able to solve procedural problems (Nusantari et al, 2018). When the lecturer creates a didactic situation, it can be interpreted that there are three possibilities that will occur in response to the learning. The three possibilities: 1) according to predictions, 2) some according to predictions, and 3) none of them match predictions. This situation becomes a challenge for lecturers to identify various possible student responses that will occur, analyze the situation, and determine the right solution for solving the problem. The actions taken by the lecturer after conducting various appropriate analyzes of the various responses can be didactic and pedagogical (Suryadi, 2010). When this situation occurs, at the same time there is a relationship between lecturer, student, and material which is described as a didactic triangle. This didactic triangle describes the didactic relationship between students and the material, on pedagogical relationship between lecturers and students. However, the relationship between the lecturer and the material has not been explained (Kansanen, 2003). Teacher who cares their student's need and strengths are important. Teacher who holds a supportive relationship with students, giving them the same chances and opportunities to participate in the learning process. These opportunities make students feel comfortable and free to interact in the classroom and improve their academic skills (Soares, 2015).

The didactic and pedagogical relationship cannot be seen as a partial but must be seen as a whole. Therefore, it is necessary to add the relationship between lecturer or teacher anticipation and material called didactic and pedagogical anticipation (Suryadi, 2010). The image of the didactic triangle can be seen in the following Figure 1.

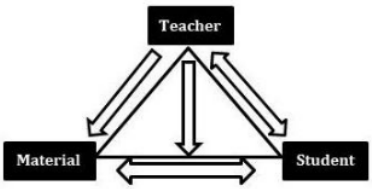

Figure 1: Modified Didactic Triangle
(Source: Suryadi, 2010)

Teacher need to create didactic situations in students' thinking processes. It is intended that students do not experience learning difficulties. In addition, teacher need to reflect on activities after learning to identify difficulties during learning to increase the chances of successful learning. teachers need to design learning systematically by using certain strategies to help identify students' learning difficulties. Given the importance for teachers to create didactic situations in learning, teachers can use sharing and

jumping tasks to help identify student learning difficulties. Didactical Design Research (DDR) consists of three stages, (1) prospective analysis, (2) metapedadidactical analysis, and (3) retrospective analysis.

Prospective Analysis: Didactic Situation Analysis Before Learning Begins

At this stage, analysis of learning tools was carried out, interviews with lecturers who held courses, and compiled a didactic design of lecture material content so that sharing and jumping tasks could be arranged to predict student responses. The didactic design model was developed into a learning design consisting of two stages, namely chapter design and lesson design (Mulyana et al, 2014). Lesson design can be seen in Figure 2 bellow.

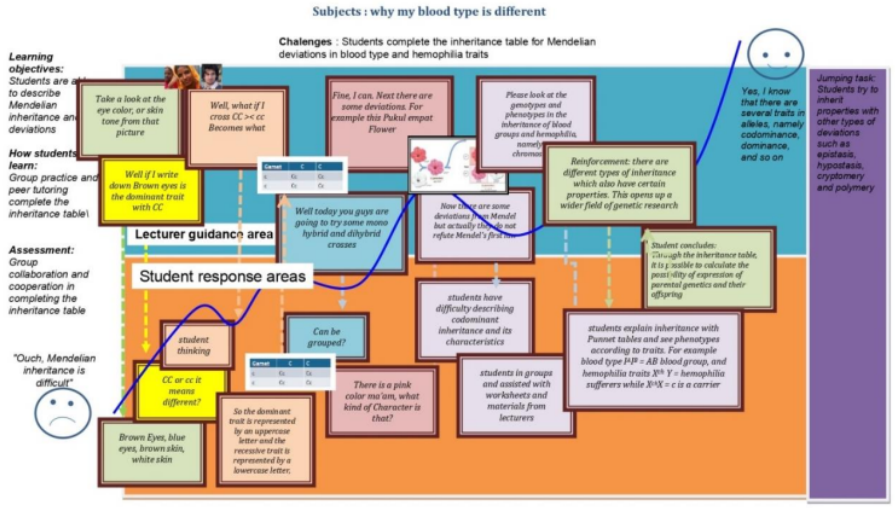

Figure 2. Lesson Design in Genetic: Blood Type

Sharing and jumping tasks are part of the lesson design. Jumping tasks can be used as authentic learning. Through jumping tasks, students feel challenged and enjoy learning. Learners can jump from the level of actual development to the level of potential development (Supriatna and Hendayana, 2016). Tasks in the learning process not only serve as an evaluation tool but also to trigger the implementation of learning steps. It aims to show real learning outcomes that make students understand and learn real material and they encounter in everyday life (Admin & Asari, 2017).

This stage is the stage of analyzing the didactic situation before learning begins. At this stage, the Biology Education lesson study team together composes a lesson design which can be seen in Figure 2. The implementation of learning is carried out in the Genetics course with inheritance material with the theme "Why my blood type is different?" with the following details: 1) Learning objectives: "Students are able to describe inheritance and Mendelian deviations", 2) How students learn: "Students practice independently groups and peer tutors in completing the inheritance table", 3) Challenges: "Students complete the inheritance table on Mendelian Deviation on blood type and hemophilia traits", 4) Jumping task: "Students try to reconstruct the inheritance table with other types of deviation such as , epistasis, hypostasis, cryptomery, and polymery", 5) Reinforcement: "There are various types of inheritance that have certain properties, there are cases of deviations from Mendelian law. This can open up wider insights about genetic research", and 6) Assessment: "Group collaboration and cooperation in completing the inheritance table". Jumping task with sharing task based on creative problem solving impact student's problem solving abilities. Their ability in learning better than conventional model (Hobri, et al, 2020).

Metapedadidactical Analysis: Didactic Analysis During The Learning Process

At this stage aims to identify the responses of lectuer and students during the implementation of the didactic design in the Genetics course, namely analysis of didactic situations during learning. At this stage, the implementation of the didactic design of materials in the Genetics course, anticipating

unpredictable student responses during the implementation of learning, as well as self-reflection on learning deficiencies during the implementation of the didactic design.

The implementation of lesson plans is carried out, it means learning scenarios and lesson designs compiled collaboratively. The flow of activities and student learning processes observed through the zoom meeting session, namely 1) students discussed the answers to questions about inheritance of blood types, 2) during the discussion there were misconceptions, 3) the conclusion of the discussion was correct, 4) new problems emerged from the questions discussion, 5) group discussion, and 6) students conclude the solution to the problem. During the observation, it was found that the results of the group discussion answers were correct, but during the presentation session, what was delivered was different from what was written. Students are also not critical in studying the problem of inheritance from various points of view. Collaboration with fellow learners increases motivation and also helps student take responsibility for their own and their peers (King, et al, 2012). Students showed their difficulty in connecting between concepts with others. There are some factor effect learning transfer: student motivation, simply memorize knowledge, the amount of time spent on the learning task, how the problem is represented, the amount of deliberate practice that is done beyond learning the task, and transfer condition (Dixon and Brown, 2012). The results of the documentation have at this stage can be seen in Figure 3 bellow.

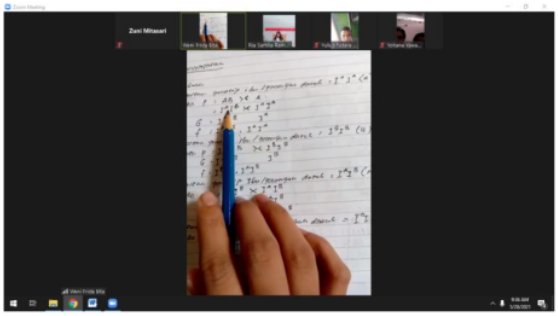

Figure 3. Implementation of Lesson Design on Learning in Genetics Class

Retrospective Analysis: Analysis After Learning

At this stage an analysis is carried out after the learning is finished, this activity is carried out immediately after the learning is finished. Reflection activities are carried out by one lecturer in genetics and two lecturers as observers. At the observation stage, the observer focuses on observations about how students learn? How do students construct their understanding? and what is the supporting evidence in concluding the observations? in the form of transcripts of conversations between students and documentation of learning videos. Reflection on the results of observations can enrich the predictions of various student responses and can be used to discuss various alternative efforts to anticipate them (Mulyana et al, 2014). The ability to understand scientific names is one of the things that dominates students' learning difficulties (Yuhanna et al, 2021).

Table 1 are data from observations by observers and also reflections from the lecturers:

Table 1. The Observation Data

No	Observation Result
1	Students have not been able to link between phenotypic and genotypic traits
2	During group discussions, students were able to conclude correctly but at the time of clarification they still did not understand thoroughly
3	There is a misconception (student An. Weni (transcript 09.35) explains that "The symbol f in the cross is phenotypic, the correct concept is F is Filial"
4	Students do not understand the comparisons and opportunities for the emergence of phenotypic and genotype differences
5	The obstacles found are in the case of inheritance of general nature they understand it but in certain cases that are material development they seem confused and cannot connect concepts with one another

No	Observation Result
6	Students are not yet critical and open in dealing with the problems they are studying
7	Obstacles found: Codominant material tends to be easier than other materials, even though there are some students who do not understand it
8	The answer to the assignment is written correctly, but what is conveyed in the discussion forum is different from what is written
9	Students have not finished studying on sex-related material

The most important role of the lecturer in the context of the didactical triangle is to create a didactical situation so the learning process occurs within students. A lecturer when designing a didactic situation, at the same time also needs to think about predicting student responses to the situation and anticipating it so as to create a new didactic situation. In lesson design, it called sharing and jumping task. Sharing task in this case is a lecturer question "Why my blood type is different?", than students is discussing in a group. Jumping task is given when the lecturer will give a challenge to material that is more difficult and complex. Here the jumping task, "there are different types of inheritance which also have certain properties. This opens up a wider field of genetic research". Suryadi (2010) argues if a lecturer or teacher are able to identify, analyze, and relate thinking processes to events prior to learning (didactic and pedagogical anticipation), tacit knowledge obtained from learning events, and the results of post-learning reflection or retrospective analysis, then this will be a strategy that very good for self-development so that the quality of learning from time to time improved.

Conclusions and Recommendations

Based on the results of the discussion, the conclusions in this study are:

1. Student learning obstacles are included in epistemological obstacles, namely student knowledge with limited application contexts. Students have not been able to understand the concept and have not been able to connect one concept to anothers.
2. The analysis of learning obstacles used as a reference in the preparation of learning tools and to predict didactic responses and anticipations that occur during the learning process.

"There are some children who do not understand, it is better for enrichment to be made a video on strengthening the material for inheritance. In addition, there are some students who have not joined in virtual synchronous learning. Students from the beginning to the end of learning continue to follow the lesson with enthusiasm and enthusiasm, meaning that the material and learning activities carried out are interesting even though the material is quite difficult."

Acknowledgement

Thank you to Tribhuwana Tunggadewi University for facilitating this research grants so that this research can be completed properly.

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