

# THE REFLECTION OF DIDACTICAL DESIGN RESEARCH LEARNING AS AN EFFORT OF ELEMENTARY SCHOOL TEACHER EDUCATION (ESTE) LECTURERS' PROFESSIONAL DEVELOPMENT

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### Abstract

The determining factors for the success of the learning process are students and the teacher/lecturer as the person most responsible for implementing the learning process. This study aimed to describe the process of learning reflection as the professional development of Elementary School Teacher Education (ESTE) lecturers based on Didactical Design Research (DDR) in learning the Elementary Science Basic Concepts course. The method used in this research is qualitative. The research design used is phenomenology. This research was conducted at the ESTE Study Program, one of the tertiary institutions in Cimahi City. The participants in this study were an ESTE lecturer. Data collection techniques used in this study were participant observation, interviews, and focus group discussions. The data analysis technique used was Interpretative Phenomenological Analysis (IPA). The results showed that there were several learning obstacles in the form of epistemological obstacles, which occurred due to students' lack of knowledge related to the concepts they were learning and caused students to experience misconceptions. Then a hypothetical learning trajectory is compiled as a series of learning paths that students go through to achieve more meaningful learning goals. The limitation in this study is that the analysis of each step in the DDR process has not been fully described, so that for further research each step can be clearly described to see a more real impact from the lecturer professional development process that has been implemented. **Keywords:** learning reflection; didactical design research; professional development; ESTE lecturer

### Abstrak

Faktor penentu keberhasilan proses pembelajaran yaitu mahasiswa dan faktor guru/dosen sebagai orang yang paling bertanggung jawab terlaksananya proses pembelajaran. Tujuan dari penelitian ini adalah untuk mendeskripsikan proses refleksi pembelajaran sebagai pengembangan profesionalisme dosen PGSD berbasis Didactical Design Research (DDR) pada pembelajaran mata kuliah Konsep Dasar IPA SD. Metode yang digunakan dalam penelitian ini adalah kualititatif. Desain penelitian yang digunakan adalah fenomenologi. Penelitian ini dilaksanakan pada Program Studi Pendidikan Guru Sekolah Dasar salah satu perguruan tinggi di Kota Cimahi. Partisipan pada penelitian ini adalah dosen PGSD dengan jumlah satu orang. Teknik pengumpulan data yang digunakan dalam penelitian ini adalah observasi partisipan, wawancara, dan diskusi kelompok terarah. Teknik analisis data yang digunakan dalam penelitian ini adalah Interpretative Phenomenological Analysis (IPA). Hasil penelitian menunjukkan bahwa ditemukan beberapa learning obstacle berupa epistemological obstacle, yaitu terjadi karena kurangnya pengetahuan mahasiswa terkait dengan konsep yang dipelajarinya dan menyebabkan mahasiswa mengalami miskonsepsi. Kemudian disusunlah hypothetical learning trajectory sebagai rangkaian alur belajar yang dilalui mahasiswa untuk mencapai tujuan pembelajaran lebih bermakna. Melalui aktivitas penyusunan hypothetical learning Trajectory para calon guru mendapatkan pengalaman sistematis dalam mencapai tujuan pembelajaran. Keterbatasan dalam penelitian ini adalah analisis setiap langkah pada proses DDR belum tergambarkan secara utuh, sehingga untuk penelitian selanjutnya setiap langkah dapat tergambarkan secara jelas untuk melihat dampak yang lebih nyata dari proses pengembangan professional dosen yang telah dilaksanakan.

Kata Kunci: refleksi pembelajaran; didactical design research; pengembangan professional; dosen PGSD

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### Introduction

Education is a conscious and planned effort in creating learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, nation and state. In this case, carrying out the principle of implementing education must be in accordance with national education goals. To achieve educational goals, good and correct learning must be carried out, because learning is the heart of the educational process in an educational institution. The quality of learning is complex and dynamic, it can be viewed from various perspectives across timelines. At the macro level, through a quality learning system, universities are responsible for the formation of professional teaching staff who can contribute to the intellectual, attitudinal and moral development of each individual student as a member of society. Meanwhile, at the micro level, achieving the quality of learning in tertiary institutions is the professional responsibility of a lecturer, for example through creating meaningful learning experiences, and providing facilities to achieve maximum learning outcomes (Bellanca et al., 2010).

From this opinion it can be seen that the successful implementation of a curriculum or a new learning method is highly dependent on the professional competence of the lecturer. Without the professional competence of lecturers, efforts to improve student teacher achievement will not be optimally successful. Then the lecturer also plays an important role in determining the achievement of learning objectives and student academic progress (Barut Tugtekin & Dursun, 2022). The cumulative effect of the lecturer's effective teaching method has an impact on students' way of thinking (Slavit et al., 2021), including in understanding the concepts of temperature and heat in the Elementary Science Basic Concepts course. So that when teaching concepts is not effective, it is feared that the science concept that is formed in students' minds is not in accordance with the actual concept which causes misconceptions. Some of the factors that cause this include the ability of lecturers to understand science concepts that are less detailed and comprehensive. Of course, this is closely related to professional competence.

In fact, a bit of literature shows that Elementary School Teacher Education (ESTE) lecturers teach science concepts effectively (Santaolalla et al., 2020). This is reflected in the lecturer's illustrations which do not reflect broad related concepts, skills, and perspectives that are important in the domain of scientific thinking (Jirout, 2020). Another fact is that lecturers often ignore students' initial conceptions of the material they are studying (Prasetyo, 2018). To strengthen the initial data, a lecturer competency assessment questionnaire was used with 15 Elementary School Teacher Education (ESTE) lecturers as respondents. From the results of the questionnaire, the data obtained was that 46.67% of the lecturers were in the low professional competence category, 20% were in the medium professional competence category. This questionnaire data further proves that the professional competence of ESTE lecturers still needs to be improved.

Based on the description above, there are two factors that determine the success of the learning process, namely the student factor and of course the teacher/lecturer factor as the person most responsible for implementing the learning process. The lecturer/teaching staff factor is a very interesting issue to study based on the Regulation of the Minister of National Education (Permendiknas) number 16 of 2007 concerning teacher/lecturer competency

standards, one of the competencies that teachers must have is to take reflective action to improve the quality of learning. Learning reflection is a form of developing teacher professionalism (Liu & Zhang, 2014). So it is necessary to have an alternative professional development for ESTE lecturers that is oriented towards the process of learning reflection. Didactical Design Research (DDR) is an alternative, where DDR is a theoretical framework that combines didactic situation theory with the reflective thinking process carried out by the teacher before, during and after learning (Suryadi, 2013). DDR is a theoretical, conceptual, and methodological framework in implementing learning reflection (Suryadi, 2019). Because the main goal of professional development is to improve the quality of learning in the classroom (Zhang & Lou, 2022; Lasauskiene et al., 2015).

Reflection and learning are two things that are related to one another. The term learning reflection is closely related to the assessment activities carried out in the teaching and learning process (Chang, 2019). Learning reflection activities provide information related to how learning can be improved in quality by the teacher, and can be used as observation material to find out how far learning objectives have been achieved (Dinata, 2021). Learning reflection activities can also describe how students are satisfied with the teaching and learning activities that have been carried out (Fauzi & Suryadi, 2020). Research by Helyer & Lee (2012) shows that students who practice learning reflection activities are more skilled and successful in work in various fields. Referring to Dewey's theory regarding reflective learning (Maida, 2011), it appears that teaching reflection skills, especially in professional education such as teachers and nurses, is an important activity. Therefore, educators continue to strive to facilitate the professional development of prospective teacher students through various reflection activities such as discussions, essays, journals (Sides & Cuevas, 2020; Nguyen, 2022; Khiat & Vogel, 2022), and through the use of learning designs such as didactical design research (Muhibban et al., 2023).

Didactical Design Research (DDR) is a systematic learning in designing, developing and evaluating or uncovering learning barriers and aims to eliminate them (Supriyadi et al., 2023). There are three stages of activities that need to be carried out in implementing DDR, namely: 1) analysis of the didactic situation before learning such as: determining material, searching for literature, developing instruments, carrying out initial response ability tests, analyzing initial test results, compiling didactic designs that are in accordance with learning obstacles , and make predictions of student responses; 2) metapedidactic analysis in the form of implementing the didactic design that has been prepared and analyzing student responses; and 3) retrospective analysis in the form of associating response predictions with the response obtained, carrying out the final response ability test, analyzing the results of the final response ability test, analyzing the effectiveness of the didactic design and compiling a research report.

There are previous studies related to DDR-based learning reflection at the practitioner level in Indonesia. In a study conducted by Suciawati et al. (2021) who examined the reflection process of DDR-based learning as an effort to develop the professionalism of early childhood teachers, found that the learning obstacles faced by students lead to difficulty remembering and recognizing geometric shapes and difficulty understanding parts of geometric shapes. Although research on DDR-based reflection on learning has emerged at the practitioner level, there are no studies that specifically examine this matter at the tertiary level, especially in the field of elementary school teacher education

Based on the explanation before, the researchers focused on studying Reflection on Didactical Design Research-Based Learning as an Effort for Professional Development for Elementary School Teacher Education Lecturers. The main objective of this research is to describe the process of learning reflection as a professional development for ESTE lecturers based on didactical design research (DDR) in the learning of Elementary Science Basic Concepts courses.

From the background, research questions can be formulated as follows:

- 1. What are the learning obstacles faced by ESTE students in Didactical Design Research-based reflection learning in the Elementary Science Basic Concepts course?
- 2. What is the science concept of ESTE students in reflective learning based on Didactical Design Research in the Basic Elementary Science Concepts course?
- 3. What is the hypothetical learning trajectory prepared by ESTE lecturers in Didactical Design Research based reflective learning?

## **Research Method**

The method used in this research is qualitative. The research design used is phenomenology. The study of phenomenology is a narrative study that describes the experiences of an individual or several individuals on various life experiences related to a concept or phenomenon (Creswell, 2013). Phenomenology is the study of experience from an individual perspective (introspective human science) to interpret and understand related to observing, measuring, explaining, and predicting (van Manen, 1990). This research was conducted at the Elementary School Teacher Education Study Program (ESTE) at one of the tertiary institutions in Cimahi City. The participants in this study was an ESTE lecturer. The data collection techniques used in this study were participant observation, interviews, and focus group discussions (Creswell, 2013). Participatory observation is a form of data collection that involves people who participate and are observed over a period (Moser & Korstjens, 2018). Observations were made to observe the process of implementing didactical design research-based learning reflection. The interview was conducted when the participants had finished carrying out the reflection stage. The interview approach used was unstructured and informal, allowing for greater flexibility in interpreting the lecturer's experience in reflecting on learning.

The data analysis technique used in this study is Interpretative Phenomenological Analysis (IPA) which aims to understand how a person feels and understands experience. Qualitative analysis is generally not used to find data in terms of frequency but is used to analyze the meaning of the data that appears on the surface (Alase, 2017). The stages of interpretive phenomenological analysis are: 1) reading and re-reading; iterative reading also allows the analyst to build a model of the overall interview structure and understand how narrative can connect different parts of an interview, and 2) preliminary notes; descriptive comments focus on describing the content of what participants say, the subject of conversation in the transcript (standard text), linguistic comments focus on exploring participants' use of certain language. Data validation through triangulation is used as a technique to check the validity of the data by comparing the results of observations, document studies and interviews with research objects

#### **Results and Discussion**

In general, the results of the analysis of research data findings and their discussion are analysis related to issues that become important points at each meeting of the reflection process, including learning obstacles and hypothetical learning trajectories..

Findings based on the results of documentation and interviews at the first meeting of the study, most of the lecturers realized that Elementary School Teacher Education (PGSD) was a place for prospective elementary school teachers to start learning, understand how the development and character of elementary students, and foster teacher competence so that it can provide a foundation of knowledge and build student personality. In terms of instilling a knowledge foundation, elementary school teachers are required to be able to master all concepts and scientific studies in elementary schools such as mathematics, Indonesian, Pancasila Education, Social Sciences, and Natural Sciences (IPA). The issue that will be studied next is related to learning in elementary schools, especially science learning. Science learning is expected to be a vehicle for students to learn about themselves and the natural world around them, as well as prospects for further development so that students are able to be scientific in solving the problems they face. The science learning process in elementary school combines various concepts of physics, chemistry, biology, and space earth with more potential to develop students' experiences and competencies in understanding the natural surroundings. Science plays an important role in human development, both in terms of technological developments used to support their lives and in terms of applying concepts, responsibility, caring for the environment, moral values, hard work, curiosity, love to read, aesthetics, economic values, creative, conscientious. , skeptics, and many other scientific characters. Departing from the importance of the content and context of science in elementary schools, prospective elementary school teachers should first understand the concept of science in elementary schools. The design of science learning designs for prospective teacher students must be able to lead to the goals of science education in elementary schools. For this reason, PGSD science lecturers must also find learning obstacles for prospective elementary school teacher students, especially in the Elementary Science Basic Concepts course..

There are three types of learning obstacles, namely ontogenic obstacles, didactical obstacles, and epistemological obstacles (Brousseau, 1989). Ontogenic obstacles occur because of students' self-limitations related to their mental readiness to accept learning. Didactical obstacles occur because of the method or approach used when conveying learning. Finally, epistemological obstacles occur because of the limited knowledge that students have in certain contexts of knowledge. Based on tests of the ability to understand science concepts made by lecturers and based on the results of the analysis carried out, there are learning obstacles faced by prospective elementary school teacher students which lead to misconceptions about science. The data is presented in Table 1.

Table 1. Identification of Learning Obstacles					
Findings	Category				
The concept of substances needed in the process of photosynthesis	Epistemological Obstacle				
in green plants					
The concept of the process of photosynthesis requires light	Epistemological Obstacle				
The concept of substances produced from the process of	Epistemological Obstacle				
photosynthesis					
The concept of the process of respiration in plants	Epistemological Obstacle				
The concept of green plants getting food from the process of Epistemological Ob					
photosynthesis					

Based on Table 1, the phenomenon that is the object of study of didactical design research is the impact of didactical design which results in learning obstacles for students. The study of learning obstacles faced by students is regarding the concept of the process of photosynthesis. The category of learning obstacles faced by students is the epistemological obstacle category, which occurs due to a lack of student knowledge related to the concepts they are learning and causes students to experience misconceptions/concept errors. The scientific conceptions of prospective elementary school teachers are very diverse, especially in the concept of the process of photosynthesis. Likewise with alternative concepts or misconceptions that occur. Alternative concepts are shown in Table 2.

Table 2. Forms of Alternative Concepts (Misconceptions) of Prospective Teacher Students in
Elementary Science Materials

Scientific Concept	Misconception	
The concept of substances needed	The substance needed in the process of photosynthesis is water	
in the process of photosynthesis in green plants	because water serves to dissolve nutrients in the soil	
The concept of the process of photosynthesis requires light	The process of photosynthesis cannot occur at night because photosynthesis can only occur if there is sunlight	
The concept of substances produced from the process of photosynthesis	The gas produced in large quantities by green plants when there is sunlight is carbon dioxide because oxygen gas is needed in this process	
The concept of the process of respiration in plants	Plants breathe during the day because plants are carrying out the process of photosynthesis	
The concept of green plants getting food from the process of photosynthesis	Green plants obtain food from nutrients in the soil and then use it in the process of photosynthesis	

Epistemological obstacles are obstacles that arise as a result of one's limited knowledge of the context (Suryadi, 2013). Several studies are related to the epistemological obstacles faced by students. One of them is that students only partially or partially understand the concept, so that when faced with a different context students experience difficulties in using it (Insani & Kadarisma, 2020). Epistemological obstacles occur due to limited context in students which causes errors in understanding concepts (Rohimah, 2017). Epistemological obstacles also occur due to students' low ability to interpret knowledge and concepts (Nuraeni & Khaerunnisa, 2021). Then, lastly, epistemological obstacles arise from mistakes in working on questions caused by limited knowledge contexts that students have (Rohimah, 2017). Epistemological obstacles also cause student knowledge to be limited to certain contexts, because teachers/lecturers provide contexts and problems that do not vary (Lestarai, 2019).

Based on previous research, epistemological obstacles occur because the learning process does not provide facilities for students to gain complete knowledge of a concept. Limited knowledge of basic science and limited knowledge of child science development (Novianty, 2018). In this study there were also indications of the design of the learning process used to prevent student teacher candidates from fully obtaining knowledge of the science concept. One of the interventions that can be carried out for the first time is to provide scaffolding and familiarize students with exploring concepts from various sources and learning experiences such as observation, experimentation, etc. as well as integration of scientific problems and content in everyday life (Rismayantini et al., 2021).

Based on the findings of epistemological obstacles, lecturers must reflect more deeply to minimize and even overcome them appropriately according to student needs. The ability to carry out learning reflection is part of the professional development of teachers/lecturers, so that their knowledge is maintained. Because everything that is conveyed by the lecturer in

learning is an illustration of the extent to which the lecturer understands the context he is teaching. Of course this will greatly affect the understanding and process of interpreting the concepts of teachers and students later. The analysis of learning obstacles, especially epistemological obstacles, is closely related to the lecturer's conceptual knowledge in teaching the science concepts again. So that in-depth analysis related to epistemological obstacles can be used as a tool to reconstruct lecturers' knowledge of scientific concepts. The process of implementing reflection on the implementation of learning needs to be used as a reference so that the goals can be achieved optimally.

Through the didactical design research process, it is expected to become a means of professional development. In the didactical design research process, it is known as the didactic triangle. Where the didactical triangle is to create a didactic situation (didactical situation) so that a learning process occurs within the student (learning situation) (Suryadi, 2013). The role of a teacher/lecturer is that it is necessary to fully master the concept of the material to be taught and have knowledge related to student knowledge and be able to create didactic situations that can encourage the learning process optimally. The didactic triangle relationship is used as a reference by lecturers in designing learning situations both pedagogical and didactic in nature. To be able to see more clearly the triangular relationship (lecturer, student and teaching materials), look at Figure 1.



Figure 1. Didactical Triangle Relations

Pedagogical didactic anticipation in didactic design studies is the development of an epistemological obstacle analysis which is developed with the main objective of overcoming learning obstacles faced by students and of course the developed didactic design can form concepts that are in accordance with the scientific conception, based on this the paradigm of critical interpretation in the didactical design process research can be used to encourage the creative power of ESTE lecturers, so that they are able to come up with ideas or breakthroughs to develop better didactic designs.

Education, of course, has its own learning objectives. The learning objectives can be achieved if the learning flow used is clear and not misguided. The next step taken in the professional development process for ESTE lecturers is the preparation of a hypothetical learning trajectory, which is a series or learning path that students will go through to achieve more meaningful learning goals. The preparation of a hypothetical learning trajectory is based on the analysis that has previously been carried out, namely the analysis of learning obstacles and misconceptions presented in Figure 2.



Figure 2. Hypotetical Learning Trajectory

There are several sections in the hypothetical Learning Trajectory including learning goals, learning activities, and student ways of thinking. Preparation of a hypothetical Learning Trajectory by paying attention to learning goals means that it is prepared based on considerations of identifying students' thinking abilities in order to achieve learning goals. Furthermore, paying attention to learning activities in this study learning activities pay attention to what has been analyzed, namely learning obstacles and student conceptions which are part of the activity of the reflection process of learning based on didactical design research. Through the activity of compiling a hypothetical learning trajectory, lecturers gain systematic experience in achieving learning objectives. Hypothetical learning trajectory provides directions for lecturers to interact directly with students, observes the extent to which students understand concepts, applies various types of assignments and projects according to their needs, and raises constructive issues that can increase students' thinking skills when understanding new concepts.

The results of research related to the implementation of HLT were compiled based on an analysis of Learning Obstacles, students' thinking stages, and an analysis of course achievements while still being based on the concept of material that students must understand (Yuliani et al., 2018). Well-planned HLT allows lecturers to carry out learning actions according to student needs (Fitriani et al., 2023). HLT is a conjecture flow of students' thoughts in studying a topic, can show the interplay between activities and the learning process (Pamungkas et al., 2020). Various research results use HLT to improve students' conceptual understanding skills (Busaka et al., 2022). The preparation of HLT is the final part of the learning reflection process carried out by the teacher/lecturer. Based on an analysis of learning obstacles as well as an analysis of gaps in scientific concepts and alternative concepts (misconceptions), HLT is prepared according to student needs. All activities carried out become a process that must be carried out by lecturers to improve the quality of learning

### Conclusion

Most lecturers realize that ESTE is a place for prospective elementary school teachers to start learning, understand how the development and character of elementary students, and foster teacher competence so that they can provide a foundation of knowledge and build student personality. The phenomenon that is the object of study of didactical design research is the impact of didactical design which results in learning obstacles for students. The study of learning obstacles faced by students is regarding the concept of the process of photosynthesis. The category of learning obstacles faced by students is the epistemological obstacle category, which occurs due to a lack of student knowledge related to the concepts they are learning and causes students to experience misconceptions/concept errors. The scientific conceptions of prospective elementary school teachers are very diverse, especially in the concept of the process of photosynthesis. Likewise with alternative concepts or misconceptions that occur. The next step taken in the professional development process for ESTE lecturers is the preparation of a hypothetical learning trajectory, which is a series or learning path that students will go through to achieve more meaningful learning goals.

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