PRIMARYEDU

Primaryedu: Journal of Elementary Education
Volume 9, Number 1, February 2025

P-ISSN: 2580-9326 | E-ISSN: 2580-7714

Integrating Understanding by Design (UbD) into Elementary Science Learning: A Study on Teacher and Student Responses

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Article Info

Article history:

Received Jan 23th, 2025
Revised Jan 30th, 2025
Accepted Feb 27th, 2025

Keywords:

Understanding by Design
Elementary
Science

Abstract

UbD is a learning activity that focuses on the desired learning objectives. The purpose of this study was to determine the responses of elementary school teachers and students regarding the application of UbD to science learning in elementary schools. This study was conducted using a descriptive qualitative method using questionnaires and interview sheets involving 3 teachers and 52 elementary school students in several areas in Java. This study was conducted on science material in elementary schools. Data collection was carried out using a questionnaire referring to the Likert scale and interviews. The results showed that teachers and students gave a positive response to the application of UbD-based learning in elementary school science material. The average value of the teacher's response, which was 76.62, was in the good category. The average value of the student's response, which was 75.92, was also in the good category. UbD-based learning can make it easier for teachers to plan learning, structure learning activities well, and motivate students to learn and understand science material more easily, resulting in increased student learning outcomes.

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INTRODUCTION

Natural Sciences is a science that is directly related to human life and everything that happens in the universe (Safira et al., 2020). Science is another form of dynamic relationship consisting of scientific bodies, values, methods, and processes (Wahyuni, 2022). Science is an important part of knowledge that is formed through the inquiry process and is carried out continuously by experts working in the field of science. (Sakila et al., 2023). IPA can also be interpreted as literature that teaches how to obtain and use various forms of knowledge (Ifdaniyah et al., 2024). Science has the essence of science in the form of form and nature. The form of the essence of science consists of 3 aspects, namely products, processes, and scientific attitudes. Products in the essence of science are phenomena, behaviors, or characteristics that are packaged into a theory, concept, law, or principle. The process in the essence of science is the process of acquiring knowledge in other words is a scientific method. Meanwhile, scientific attitude is the

instillation of attitudes in a scientist when carrying out the scientific method process and the science learning process (Putri et al., 2021). Science itself contains values that can give rise to curiosity, respect for evidence, flexibility, critical reflection, and sensitivity to living things and the environment (Wahyuni, 2022).

Science is one of the important things to be learned by students in developing scientific knowledge. Through science learning, students can broaden their understanding which can affect the development of science (Achor et al., 2024). Skills in capturing and developing students' curiosity can also be honed through science learning (Deehan et al., 2024). Science learning can also help students solve problems that occur in everyday life (Wisudawati et al., 2022). Students can also be honed in science learning, such as systematic, logical, critical, and objective thinking skills (Gumilar, 2023). In elementary schools, science lessons are mandatory to provide students with information about the environment and daily activities (Ningrum et al., 2024). Science learning at the elementary school level is an important foundation in building students' understanding of natural phenomena and students begin to develop a strong curiosity about the world around them (Arsyad et al., 2024). The role of science is also quite important in the independent curriculum because, through science learning, students' characters will be formed, especially characters based on the Pancasila profile developed in the independent curriculum (Pradipta et al., 2024). However, the facts on the ground say that science learning is one of the subjects that is avoided because students find it difficult to learn (Yusra et al., 2020).

Science learning that is considered difficult by students can occur because, in its implementation, students are required to have a foundation in thinking skills, practical skills, and skills in digesting the material being studied (Gumilar, 2023). In addition, for students, science is a subject that is difficult to understand (Pratama et al., 2023). This causes science learning to be uninteresting for students and has an impact on student learning outcomes in science subjects. Science learning outcomes in Indonesia are still very low, especially among elementary school students. Evidence of this can be seen from the average science achievement scores of students in Indonesia in TIMSS in 2011, 2015, and 2019, which reached 406, 397, and 387, respectively. These scores show that Indonesia was ranked 39th out of 42 countries in 2011, 45th out of 48 countries in 2015, and 38th out of 58 countries in 2019 (Wicaksono et al., 2020).

The low achievement of science learning in elementary school students can also be seen from the still dominant number of students who have not achieved the standard score in science learning (Suryana, 2023). Other studies also say that the understanding of science concepts at the elementary school level is still in the low category. This is because science learning implemented by teachers only uses the lecture method and does not play an active role in students in their learning (Aen et al., 2020). To solve this problem, the application of science learning, especially at the elementary school level, should be implemented interactively, building motivation in students to be active in learning, fun, inspiring, challenging, honing creativity, and curiosity, and providing sufficient space for students to develop their abilities and skills through various learning strategies that have variations and apply student-centered (Wahyuni, 2022). This is in line with the concept of Understanding by Design learning, namely learning using various strategies, emphasizing the importance of varied learning experiences, and student-centered learning (Sutanto, 2024). In addition, Understanding by Design -based learning also has 6 aspects of ability that during the implementation of learning can train students to develop these abilities. The six aspects include being able to explain, interpret, apply, have perspective, empathy, and self-awareness (Natala et al., 2023).

Understanding by Design (UbD) itself is a curriculum design with a backward design. UbD was first introduced to the public by Grant Wiggins and Jay McTighe and has been widely used in the world of education (Sutanto, 2024). The learning design with UbD begins with determining learning objectives, compiling assessments or learning evaluation tools, and then determining the learning steps to be implemented (Halimah et al., 2023). The principle of UbD is that learning

activities are more focused on learning outcomes and desired learning objectives (Sutanto, 2024). UbD learning has been proven to improve students' understanding of science material. This is proven by research by Saodah et al. which states that science learning on force material for grade IV elementary school students using the UbD design shows significant results in improving student understanding (Saodah et al., 2023).

Learning design with UbD has been proven to increase students' enthusiasm for learning because its implementation emphasizes student participation. In addition, teacher learning can ensure that objectives, evaluations, and learning phases are interconnected, making learning more focused. This learning also focuses on the relationship between technology, media, and students' daily lives, making learning more relevant. UbD learning is very important to implement in the 21st century because it helps teachers develop learning plans that are more focused on what they want to achieve (Wulandari et al., 2024). UbD-based learning is also very suitable for implementation in the independent curriculum because it is in line with the teaching and learning planning process in the independent curriculum. The characteristics of the Merdeka curriculum which has varied extracurricular activities and focuses on maximum content are very suitable to be applied to UbD learning because students have enough time to learn concepts and strengthen their competencies (Siregar et al., 2024). Based on the problems that occur, UbD-based science learning will be applied to elementary school students to implement interactive, motivating, and enjoyable science learning with the hope of improving science learning outcomes at the elementary school level in this study. This study was conducted on 5 teachers and 50 elementary school students from several regions in Indonesia. The purpose of this study was to determine the responses of elementary school teachers and students regarding the application of UbD to science learning in elementary schools.

METHOD

This study used a descriptive method with a qualitative approach to determine the responses of teachers and students at the elementary school level regarding the implementation of Understanding by Design (UbD)-based learning in science learning in elementary schools. The use of qualitative descriptive research methods is more appropriate in this study because the purpose of this study is to identify the responses of teachers and students to UbD-based science learning through questionnaires and interviews. In line with the understanding of the qualitative method, namely the process of understanding a phenomenon experienced by the research subject, such as behavior, perception, action, and so on which are described in words (Istianti et al., 2023). Qualitative descriptive research will produce descriptive data in the form of words that describe the results of the study (Kartono, 2024). This study was conducted in 3 different schools, namely one school in West Java, one school in East Java, and one school in West Sumatra with a total of 3 teachers and 52 students. Through differences in regions and different conditions in each selected school, the results of the research can be generalized to other elementary schools in Indonesia. The implementation of this research was carried out for two weeks in November 2024. The instruments used for data collection in this study were questionnaires and interviews. A questionnaire is one of the instruments used to collect research results or information in the form of questions or written statements which are then distributed to the subjects who will be researched (Wicaksana et al., 2020). A questionnaire can also be interpreted as an instrument used by researchers and given to respondents in the form of a series of questions or written statements that are formed to be answered by respondents (Suryana, 2023). The use of questionnaires in this study was intended to determine the responses of elementary school teachers and students after the implementation of UbD-based learning in science subjects. The questionnaire instrument tools given to respondents are explained in Tables 1 and 2.

Table 1. Teacher Response Questionnaire Grid for UbD-Based Learning

No	Statement	Number (+)	Number (1)
1	Teachers' responses to UbD-based learning	1, 3, 5	2, 4
2	Teachers' responses to the implementation of UbD-based learning in elementary school students	6, 7	8
3	Teachers' responses to teachers' implementation of UbD-based learning in science learning at the elementary school level	9, 10, 12	11, 13

Table 2. Student Response Questionnaire Grid for UbD-Based Learning

No	Statement	Number (+)	Number (1)
1	Student responses to UbD-based learning	1, 2	3, 4
2	Student responses to understanding science material through UbD-based learning	5, 6, 7	8, 9, 10

The questionnaire used in this study was based on the Likert scale, namely, the questionnaire scale was divided into four options, namely Strongly Agree, Agree, Disagree, and Strongly Disagree.

The interview is a method of data collection carried out through questions and answers between the interviewer and the respondent directly (Riskiono et al., 2020). The interview can also be interpreted as an interaction in which questions and answers are carried out between two or more parties, at least one of which has a specific predetermined purpose (Suprayogi et al., 2022). The purpose of using interviews is to strengthen the answers that teachers and students have given to the questionnaire so that the answers are not ambiguous and clearer. The interview instrument tools given to respondents are explained in Table 5 and Table 6.

Table 5. Teacher Interview Grid for UbD-Based Learning

No	Statement
1	Teachers' opinions of UbD-based learning
2	Teachers' opinions on the implementation of UbD-based learning in elementary school students
3	Teachers' opinions on teachers' implementation of UbD-based learning in science learning at the elementary school level

Table 6. Student Interview Grid for UbD-Based Learning

No	Statement
1	Students' opinions on UbD-based learning
2	Students' opinions on understanding science material through UbD-based learning

RESULTS AND DISCUSSION

Results

The results of the study regarding teacher responses to UbD-based learning, overall received a positive response as seen in Figure 1.

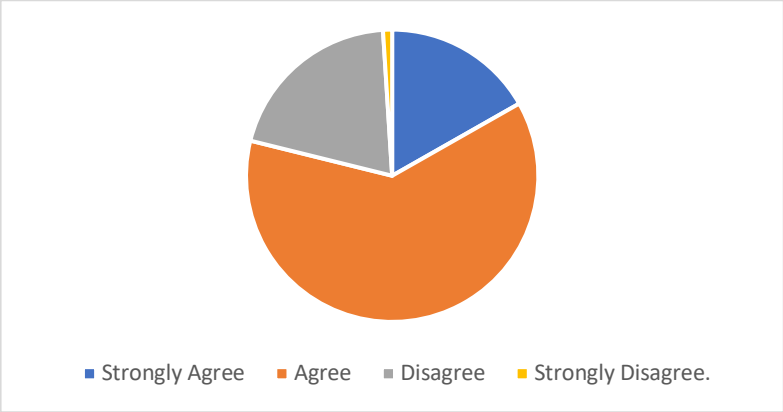

Figure 1. Teacher Response to UbD-Based Learning

Based on Figure 1, as many as 16.67% filled in strongly agree, 61.67% filled in agree, 20% filled in disagree, and 1.67% filled in strongly disagree. The average value of teacher responses to UbD-based learning is 73.33 with a good category. For teacher responses to the implementation of UbD-based learning in elementary school students, overall also received a positive response as seen in Figure 2.

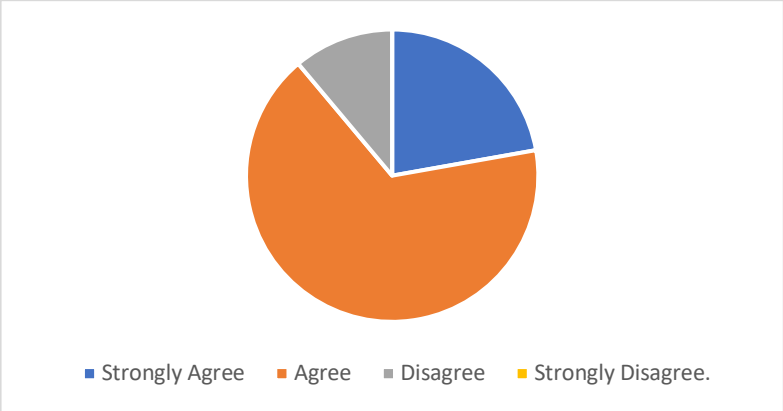

Figure 2. Teachers' Responses to the Implementation of UbD-Based Learning in Elementary School Students

It can be seen in Figure 2, that as many as 22.22% filled in strongly agree, 66.67% filled in agree, 11.11% filled in disagree, and 0% filled in strongly disagree. The average score of teacher responses to the implementation of UbD in elementary school students is 77.78 with a good category. Meanwhile, teacher responses to the implementation of UbD-based learning in science learning in elementary schools as a whole received a positive response as in Figure 3.

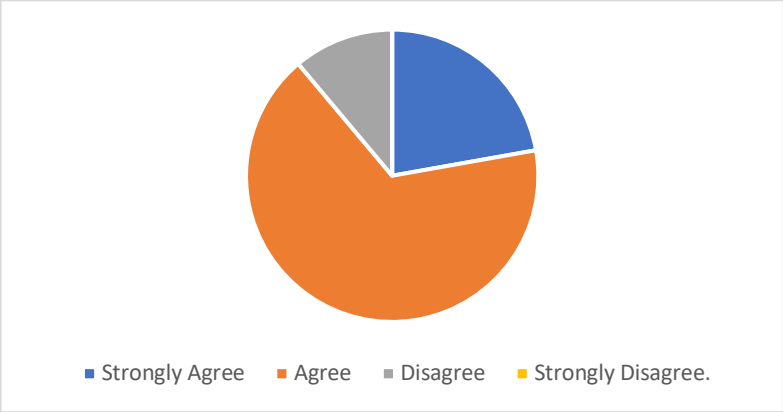

Figure 3. Teachers' Responses to the Implementation of UbD-Based Learning in Science Learning in Elementary Schools

In Figure 3, it can be seen that 20% filled in strongly agree, 75% filled in agree, 5% filled in disagree, and 0% filled in strongly disagree. The average score of teacher responses to UbD learning on science material in elementary school is 78.75 with a good category. The results of the study regarding student responses to UbD-based learning, overall received a positive response as seen in Figure 4.

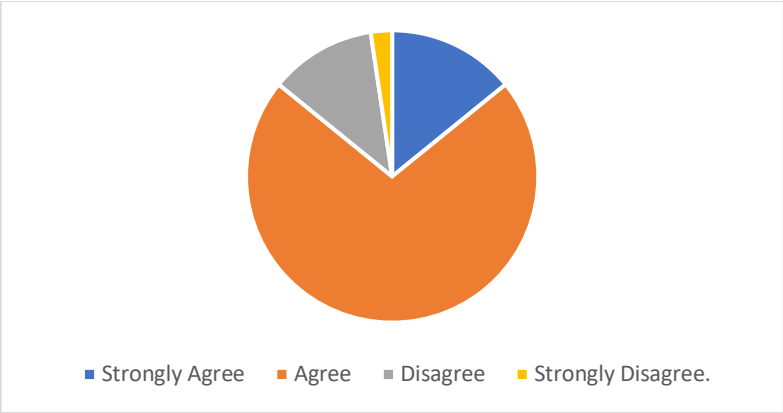

Figure 4. Student Responses to UbD-Based Learning

Based on Figure 4, as many as 14.15% filled in strongly agree, 71.70% filled in agree, 11.79% filled in disagree, and 2.36% filled in strongly disagree. The average score of student responses after the implementation of UbD-based learning was 74.41 with a good category. Student responses to understanding science concepts through UbD learning, overall received a positive response as seen in Figure 5.

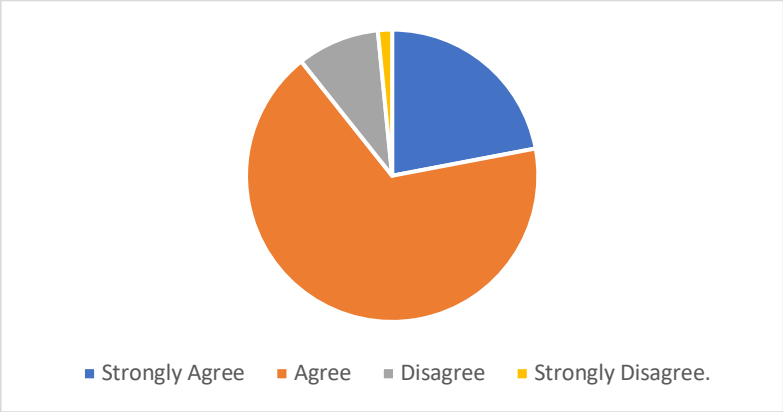

Figure 5. Student Responses to Understanding Science Material through UbD-Based Learning

Based on Figure 5, as many as 22.01% filled in strongly agree, 67.30% filled in agree, 9.12% filled in disagree, and 1.57% filled in strongly disagree. The average value of student responses to UbD-based learning on science material is 77.44 with a good category.

Discussion

Positive responses from teachers and students to UbD-based learning can be seen in the results of the research that has been carried out. In line with the results of previous studies which stated that the results of responses from teachers and students showed that science learning with the Understanding by Design (UbD) framework that was developed received a positive response (Fradina et al., 2022).

Teacher Response

This can happen because by implementing UbD-based learning, teachers find it easier to design learning tools. This is also supported by the results of interviews which state that by implementing UbD-based learning, teachers find it easier to design learning tools because teachers have determined their goals from the start and the assessments they will use. So, teachers focus on compiling learning steps to achieve these goals by using the assessments that have been determined. In addition, the problem of limited time owned by teachers is also resolved through the implementation of UbD because by determining learning objectives at the beginning, teachers become focused on designing learning and the time used is more effective. This is following other studies, namely that UbD-based learning can make it easier for teachers to plan learning because previously teachers had formulated learning objectives explicitly which would be an effective guide for teachers to plan learning (Fointuna et al., 2024).

Through UbD-based learning, teachers are also more enthusiastic about implementing learning. Based on the results of the interview, this can happen because teachers focus on learning objectives by implementing innovative and varied learning and applying teaching styles that have never been done before. This makes teachers more challenged and enthusiastic in implementing learning. In addition, through UbD-based learning, it becomes easier for teachers to achieve learning objectives. This is explained in more detail in the interview session, namely that teachers have become more focused on the objectives to be achieved and then determine the things needed to achieve these objectives. This is in line with other studies that state that UbD-based learning makes teachers prepare structured learning plans that focus on the learning objectives to be achieved (Fatmawati et al., 2023). Teachers also gave a positive response to the suitability of UbD learning to be applied to elementary school students. This is confirmed by the results of the interview which stated that the material at the elementary school level is very much, but the

learning time is very short which makes a lot of material missed or delivered in a hurry and results in learning objectives not being achieved. However, by implementing UbD-based learning, teachers will be more focused on delivering material that follows the learning objectives to be achieved. The time used also becomes more effective and efficient in implementing learning and learning objectives can be achieved properly. In line with previous research which states that UbD learning makes learning more effective and learning activities are well structured (Siregar et al., 2024).

UbD-based learning is also suitable for application to the characteristics of elementary school students. Explained in more detail during the interview, namely that UbD-based learning is implemented more effectively and efficiently and focuses on learning objectives which makes the explanation of the material taught more focused and shorter in time. Following the length of student concentration which is only effective for around 15-18 minutes allows students to focus on material that is following the learning objectives to be achieved. UbD-based learning is also suitable for application to material at the elementary school level. Following the results of the interview, the teacher said that the large amount of material sometimes makes teachers confused about how to convey it, especially for elementary school students, but by implementing UbD learning, teachers can focus on delivering material that is relevant to the goals that have been set. In line with the main focus in UbD-based learning, namely the transfer of understanding and learning resulting from authentic student performance (Natala et al., 2023).

Science learning using UbD also received positive responses from teachers. Based on the interview results, teachers stated that complex science material problems that were considered difficult by students could be solved by implementing UbD-based learning because science learning became more structured and focused on the goals to be achieved. It does not expand on material that lacks essence in science learning. This makes it easier for students to learn science. This opinion is in line with other studies, namely the application of the PBL model accompanied by UbD shows an increase in students' understanding of food chain material (Wadi et al., 2024).

The application of UbD-based learning in science learning also has a positive impact on the ease of achieving science learning objectives in elementary schools. This was conveyed more clearly by the teacher in the interview session, namely in determining media, models, compiling assessments, and arranging learning stages, teachers are more in line with the objectives, and during implementation, they will be more focused on these objectives. This makes the application of UbD easier for teachers to achieve the science learning objectives that have been formulated. In addition, UbD-based learning also makes science learning more interesting because, in UbD learning itself, teachers are required to utilize technology, media, models, and various learning resources that make learning interesting for students and motivate them to learn during UbD-based learning activities. It is hoped that this can take place continuously and students can continue to be motivated during long-term learning activities. This opinion is in line with other studies that state that learning with the UbD approach not only able to improves students' conceptual understanding but also makes students motivated to learn (Banu, 2024).

Based on questionnaire and interview data, UbD learning also has a less than good response from teachers, namely related to the time in the process of preparing learning designs. This is explained in more detail in the interview, namely that teachers still need to adapt when designing UbD-based learning because the compilation system applies backward design. This is in line with Banu's research (2024), namely that time constraints in preparing UbD-based RPP are the main obstacle. UbD learning which requires the application of innovative learning methods also requires teachers to be more creative and spend more time because they are not used to it. In addition, UbD learning also sometimes implements learning unpleasant. This can happen because teachers are too focused on learning objectives so that they are achieved and the impression is that they force students to understand a material with repeated explanations to achieve these learning objectives.

UbD learning itself requires teachers to apply innovative learning, but this can backfire on learning itself. This can happen because sometimes teachers feel that the creativity and innovation that have been applied previously are suitable for the characteristics of students and run smoothly when applied in the class. This makes teachers continuously use the learning style in several meetings which makes learning non-innovative. Teachers also do not develop other innovative learning because they feel safe and comfortable with the teaching style. Teachers feel that they have implemented enough innovative learning with the teaching style and feel that they no longer need to develop other innovative learning. Based on the results of the interview, this can happen because teachers are afraid of developing other innovative learning, but it turns out that it is not suitable to be applied to students in their class. Teachers feel that it is a waste of time and energy to do this. This also makes teachers unmotivated to develop other innovative learning.

Student Response

A positive response to UbD-based learning was also given by students. This can happen because UbD-based learning makes learning more interesting because. After all, interesting and varied learning media are used in learning. This is what makes students interested in the material presented or studied that day because the teacher not only explains it directly but also uses learning videos and concrete learning media. This is in line with the opinions of other researchers, namely that UbD learning by paying attention to media and learning resources can attract students' interest in the material being taught (Namus et al., 2024).

In UbD learning focuses on objectives when learning activities are carried out, which makes the material presented focused on objectives and not much time is wasted on other things, the teacher has time to do ice breaking during learning activities which makes learning not monotonous and enjoyable. Students become more focused, don't chat much, and don't get sleepy when learning is carried out. Based on the results of the interview, students also said that they felt that their learning was very enjoyable when UbD-based learning was implemented. In addition to being able to make learning focused on goals, UbD-based learning also makes learning innovative. In line with the statement from Sutanto (2024) which states that in implementing UbD-based learning, learning will use various strategies. Based on the results of the interview, students also stated that when teachers implement UbD-based learning, the learning does not only use media that is often used, but teachers look for other innovative learning media. This follows the principle of implementing UbD, namely, teachers are required to be more creative and innovative and implement student-centered learning (Sariyanti et al., 2024). An example of innovative learning applied to students in this study, namely in learning evaluation, teachers do not only use paper to carry out quizzes, but teachers use quiziz as an innovation for students.

The learning media used besides quiziz, teachers also make LKPD that does not use ordinary paper, but e-LKPD assisted by liveworksheets which makes students interested and enthusiastic to fill it out. However, based on the interview results, some students felt bored because during the 10 learning meetings using UbD, the teacher consecutively in several meetings used quizzes and liveworksheets which made students bored and no longer enthusiastic. In line with the interview results, namely the teacher felt safe and comfortable using the learning media because it was considered suitable and produced good learning outcomes, but it turned out that some students felt bored.

The use of innovative learning media that makes students more interested and enjoyable turns out to have a less good impact on this UbD-based learning. Based on the interview results, in addition to students feeling bored because of its continuous use, students also initially found it difficult with the learning media used because it was something new to them. This caused learning to take longer because students still needed to adjust to using the learning media. However, as the learning progressed, students were able and fluent in using the learning media and the implementation of learning returned to normal.

The application of UbD-based learning in science learning also received a positive response because students found it easier to understand the science material due to the application of varied learning and students played an active role during the learning activities. In addition, the material presented was not broad and was focused on learning objectives that made science learning clearer for students. The learning evaluation carried out was also focused on learning objectives that were in line with the material presented. This makes it easy for students to understand the material and learning outcomes are good as expected. Other studies also state similar things, namely the application of the backward design system in UbD learning makes learning more focused and increases the effectiveness of the learning process that affects learning outcomes (Sariyanti et al., 2024).

UbD-based learning is also very suitable to be applied to science material because the principle of science learning, especially at the elementary school level, is learning that can provide sufficient space for students to develop their abilities and skills through various learning strategies that vary and are centered on students (Wahyuni, 2022). This is in line with the principle of UbD learning, namely learning that uses various strategies and is centered on students (Sutanto, 2024). This is proven by other studies that state that science learning using UbD shows an increase from pre-test to post-test scores after implementing UbD learning in elementary school science material (Fradina et al., 2022). Based on the results of the study, both student responses and teacher responses as well as interview results regarding UbD-based learning, received positive responses because UbD-based learning itself has several advantages, namely it can help teachers focus on conceptual understanding and critical thinking skills that can be implemented in various contexts, UbD also provides simple and practical tools and procedures for designing structured learning. In addition, the desired learning outcomes are the main focus and can help teachers minimize excess learning content and focus on important concepts for easy understanding and facilitate the achievement of predetermined learning objectives (Sutanto, 2024).

Through UbD-based learning, there is also an increase in students' conceptual understanding. This can be seen when the question and answer process with the teacher is carried out, students can explain the science concepts that have been learned in their language, such as carnivorous animals are animals that eat meat, while herbivorous animals are animals that eat vegetables. Students can also solve problems that occur in the school environment by applying the concepts that have been learned. In addition, students can group objects based on their type, such as tigers and lions are carnivorous animals, while rabbits and goats are herbivorous animals. This follows the indicators of conceptual understanding, namely being able to restate concepts using their language, being able to classify objects based on their concepts, and being able to apply concepts to solve problems in everyday life (Murtiyasa et al., 2022).

The implementation of UbD learning has several advantages when compared to other learning models or methods, one of which is the Problem-Based Learning (PBL) learning model. The PBL learning model has weaknesses, namely that its implementation takes a long time and not all subjects are suitable for this model, while UbD learning makes learning time more effective and efficient and can be used in all subjects (Rahmatilah, 2024). Other models such as Project Based Learning (PJBL) also require more costs because they are required to be project-based, while UbD learning can be adjusted to the needs of teachers and students (Widiyaningsih et al., 2024). Based on the interview results, it is also undeniable that UbD-based learning also has several weaknesses, such as teachers who still need time to prepare UbD-based learning devices because they are not used to it, teachers also still find it difficult to apply innovative learning in the classroom, in implementing UbD-based learning, teachers still need adjustments. Students, also still need adjustments in innovative learning with various learning media that they have never used.

CONCLUSION

Learning using the UbD model received a positive response from teachers. The average teacher response score for UbD-based learning was 73.33, which is included in the good category. For UbD-based learning for elementary school students, the average teacher response score was 77.78, which is also in the good category, while for UbD-based learning on science material in elementary school, the average teacher response score reached 78.75, which is included in the good category. UbD-based learning also received a positive response from students, with an average response score of 74.41 in the good category, and for science material, the average student response score was 77.44, which is also included in the good category. Through the UbD model, teachers find it easier to design learning tools, and learning is more effective and well-structured. On the other hand, UbD-based learning makes students more motivated to learn, easier to understand science material, and learning becomes more focused on goals, which ultimately increases the effectiveness of the learning process and has a positive impact on student learning outcomes.

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