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Research Article

Identifying Student Prior-Knowledge and Conceptual Changes Profile on Newton Law Using by using POE (Predict, Observe, and Explain) as Probing Understanding Strategy

Hisbulloh Als Mustofa[1], Evelyn Sandanadas[2], Lilia Ellany Mohtar[3*] and Rangga Alif Faresta,[4]

[1]Physics Education Study Program, Faculty of Teacher Training and Educations, University of Mataram, Mataram 634918, Nusa Tenggara Barat, Indonesia
[2]Department of Biology, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, Tanjong Malim 35900 Perak, Malaysia
[3]Department of Physics, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, Tanjong Malim 35900 Perak, Malaysia
[4]Department of Digital Learning, Faculty of Education, Monash University, Clayton VIC 3800, Australia
*Corresponding author: lilia@fsmt.upsi.edu.my

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ABSTRACT

Newton's law is an important topic and a key concept that students need to understand to proceed to the next step of physics learning, but students can have wrong conceptions in learning, knowing students' conceptions of newton's law is important for teachers. This study aimed to identify students' prior knowledge and conceptual changes in Newton's Laws using the Predict-Observe-Explain (POE) strategy. This case study used a qualitative approach involving observation, document analysis, and interview. This qualitative method allows one to understand the phenomenon under study by directly examining the context and experiences involved. Profile of student prior knowledge categorized as student has Scientific Conception, Lack of Knowledge, Misconceptions, and has No Conception at all. The conceptual change level is categorized into Construction, Revision, Static, and Disorientation. Complementation Participants in this study consisted of 15 respondents with four students. The analysis reveals that a significant percentage 40% of respondents entered the study with misconceptions about Newton's law. A substantial percentage 53.33% of respondents demonstrated a lack of knowledge as their prior understanding. The pattern of conceptual changes shows that almost all students have experienced an increase in their conception of the third law of Newton's motion. This can be seen from the changes that occur a lot at the revision level even with some changes at the static level. Hence, POE probing as an understanding strategy can be used to identify the student's initial knowledge and conceptual changes.

Keywords: Prior-Knowledge, Conceptual Changes, POE (Predict, Observe, and Explain), Newton Law, Probing Understanding Strategy

1. INTRODUCTION

The essence of learning physics lies in the student's active process of creating conditions and opportunities to construct knowledge, develop process skills, and foster scientific attitudes through interactions with the environment and other individuals. Furthermore, physics education places significant value on a student's prior knowledge (Muna et al., 2016). Initial knowledge, in this context, refers to the foundational concepts already present in a student's mind even before formal learning begins. These concepts are shaped by the student's interpretations of their experiences and interactions with their surroundings. For students to accurately grasp scientific principles, it is essential that they acquire a solid understanding of scientific concepts. However, during the learning process, there is no guarantee that these concepts will align with the established scientific consensus (scientific conception). These disparities in understanding are commonly referred to as misconceptions. A misconception can be defined as an individual's understanding that deviates from the scientifically accepted concepts recognized by experts (Sholihat et al., 2017).

Newton’s Law is an important topic in physics. It is the main concept that students need to have an adequate understanding of to move to the next steps of the physics study. Almost all other physics topics, such as vibration and waves, optics, and thermodynamics depend, for example, on displacement, speed, distance, velocity, force, momentum, and energy as concepts in Newtonian mechanics (Syuhendri, 2021) . The mechanics of Newtonian are usually studied at the beginning of the physics syllabus from junior high school to university. It has been found that many students have serious problems with their conceptions of the mechanic's area. Students, for example, can calculate quickly the time needed by a stone to reach the ground in free fall motion, but unfortunately, they give the wrong answer when they are asked which one of the two different weight objects will get to the ground first if these two objects are dropped from the same height (Syuhendri, 2021). Students usually think that the heavier one will arrive on the ground faster than the lighter one.

Understanding the concept of Newton's law needs to be had by students so that they can apply and reason the concept correctly so that they can understand natural conditions. Earning an understanding of concepts becomes a very challenging thing because in the process students often experience misunderstandings of concepts (Eaton et al., 2005). Students experience many misconceptions about basic physics concepts because both texts and teachers are inadequate in dealing with their misconceptions and personal experiences also influence student conceptions. The possibility of the emergence of misconceptions in students should be a concern for teachers because once a misunderstanding has formed, it will continue and it is difficult to change it (Fuadi et al., 2020). So, teachers need to use instructional models that can change student conceptions. When students get their learning, there will certainly be changes in their understanding. One learning strategy that can overcome misconceptions is applying the POE strategy. POE strategies can be used to correct misunderstandings of concepts to improve students' understanding of concepts in the learning process (Hsu et al., 2011; Kibirige et al., 2014). This strategy is applied in the science learning process because science learning is a direct activity that requires students to be involved in the scientific process through practice. However, in addition to this function, this strategy can also be an assessment strategy to be able to describe the level of student knowledge and changes in student understanding (Ipek et al., 2010). In accordance with White & Gunstone (2014), POE as probing understanding strategy. Prediction, Observation, and Explanation (POE), which has long been known as an instructional strategy, can bring out students' understanding.

This study aims to identify students' prior knowledge, profiles and conceptual changes using the developed POE instrument based on Newton's law. Therefore, the current study was conducted to answer the research question regarding: (i) What is the student prior knowledge held by students about Newton's Laws? and (ii) What is the student conceptual changes held by students about Newton's Law?.

Jean Piaget's constructivism theory is based on the idea that learners construct their own understanding of the world based on their experiences and interactions with the environment. According to Piaget in (Brau, 2020) humans create knowledge through the interaction between their experiences and ideas. His view of constructivism is the inspiration for radical constructivism due to his idea that the individual is at the center of the knowledge creation and acquisition process. Two of the key components that create the construction of an individual's new knowledge are accommodation and assimilation (Perry, 1999). Assimilation causes an individual to incorporate new experiences into the old experiences, while accommodation causes an individual to adjust their old experiences to fit in the new experiences. Piaget's theory of cognitive development identifies four stages of cognitive development, and he proposed that cognitive development occurs as people's minds are physically developed. The four stages of cognitive development are the sensorimotor stage, preoperational stage, concrete operational stage, and formal operational stage (Piaget, 1968). In Piaget's view, people are increasingly able to mentally organize their experiences and construct new knowledge as they grow and develop.

Based on that view, constructivism can be defined as a learning theory that emphasizes the active role of learners in building their own understanding based on their prior knowledge and new knowledge. According to this theory, learners construct knowledge rather than just passively take in information. As people experience the world and reflect upon those experiences, they build their own representations and incorporate new information into their prior knowledge (schemas) (Gupta, 2011).This promotes deeper learning and understanding. Constructivism is based on the idea that people actively construct or make their own knowledge, and that reality is determined by the experiences of the learner (Bada, 2015). Learners use their previous knowledge as a foundation and build on it with new things that they learn. So, everyone's individual experiences make their learning unique to them.

POE is a strategy based on constructivist learning theory. This strategy involves three steps: predicting what will happen, observing what happens, and explaining why it happened (Mamun et al., 2020). In the first step, students make predictions about what they think will happen in each situation. In the second step, they observe what happens. In the third step, they explain why what happened did happen (Ozcan & Uyanık, 2022). This strategy encourages students to actively engage in the learning experience, to reflect on their experiences, and to construct their own knowledge (White & Gunstone, 1992). It also promotes deeper learning and understanding by encouraging students to think critically and to make connections between their prior knowledge and new information. The POE strategy is often used in science and works best with demonstrations or experiments that allow immediate observation. It can be used to determine students' initial ideas, provide teachers with information about students' thinking, generate discussion, motivate students to want to explore the concept, and generate investigations (White & Gunstone, 1992). The POE strategy is a powerful tool for promoting deeper learning and understanding by encouraging students to construct their own knowledge through active engagement with the learning experience. The POE strategy aligns with the principles of constructivist learning theory in several ways (White & Gunstone, 1992). Here are some of the ways in which the POE strategy aligns with constructivist learning theory:

1. Active engagement: The POE strategy encourages students to actively engage in the learning process by making predictions, observing what happens, and explaining why it happened. This aligns with constructivist learning theory, which emphasizes the active role of learners in building their own understanding.
2. Prior knowledge: The POE strategy encourages students to use their prior knowledge and experience to make predictions and to think critically about what they already know. This

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aligns with constructivist learning theory, which emphasizes the importance of prior knowledge in the learning process.

3. Constructing knowledge: The POE strategy promotes deeper learning and understanding by encouraging students to construct their own knowledge through active engagement with the learning experience. This aligns with constructivist learning theory, which emphasizes the idea that learners construct knowledge rather than just passively take in information.

Reflection: The POE strategy encourages students to reflect on their experiences and to make connections between their prior knowledge and new information. This aligns with constructivist learning theory, which emphasizes the importance of reflection in the learning process.

2. METHODS

2.1. Research Design

This research uses case studies as a research design and a qualitative research approach involving observation, document analysis, and interviews. This qualitative approach allows us to understand the phenomenon under study by directly examining the context and experiences involved. In the study, the researcher has done purposive sampling because this method can help researchers obtain information and data from respondents. Sample selection was justified based on the similarity of the learning stages and the similarity of the cognitive stages of students where the research was conducted. Participants in this study consisted of 15 respondents with four students. They are individuals of form 4 Physics students. The instrument used for this research was the Force Concept POE Work Sheet adapted from the worksheet developed by (Haysom & Bowen, 2010). Respondents were given the work sheet for the topic of Force and Motion. In this study, the instruments worked individually to probe students' conceptions and students' misconceptions. Data collection is based on the activities based on POE stages, which are detailed as follows:

a) **Prediction (P):** In this step, students were being asked to make predictions about the contextual phenomenon based on their existing understanding of Newton's Laws. They were given scenarios and situations that required them to apply the concepts of Newton's Laws and make guesses about what will happen. This step aims to elicit students' initial thoughts and misconceptions related to the topic. Moreover, in this activity, the interview was carried out to know the specific reason for the predictions.

b) **Observation (O):** In this step, students carried out an experiment that allowed them to observe and collect data on the actual outcomes or behaviour of objects or systems in accordance with Newton's Laws. Then, they compared their predictions from the previous step with the real observations and record any discrepancies or inconsistencies. This step aims to provide students with concrete evidence that challenges their misconceptions.

c) **Explanation (E):** After the observation phase, students were prompted to explain the observed outcomes using the principles and concepts of Newton's Laws. They will be encouraged to reflect on their initial predictions, compare them to the observed results, and identify any gaps or misconceptions in their understanding. Through this process, students developed a more accurate and comprehensive explanation of the phenomena based on the correct application of Newton's Laws.

2.2. Profile of Students' Prior Knowledge

Based on the data obtained from observing the stages of prediction from students, through the answers given to the worksheet question accompanied by interviews conducted with students, students' prior knowledge can be determined. To determine the stages of conception determined by the adopted Keleş & Demirel (2010) conception category in Table 1.

Table 1. Responses Interpretations

Categories	Explain about category
Scientific Conception	Explanations that can be accepted completely and scientifically correct
Lack of Knowledge	The explanation is correct but incomplete with respect to the expected one
Misconceptions	Explanations that include statements that are wrong scientifically
Have No Conception	No response or wrong answer and no explanation

2.3. Profile of Students' Prior Knowledge

The pattern of student conceptual change is based on the answers given to the work sheet question after doing the observations accompanied by interviews conducted with students. The changes in student conceptions can be determined by an adopted table of patterns of change in students' conceptions based on those formulated by (Anam et al., 2019). The students' conceptions were categorized into six levels (Anam et al., 2019), namely: Scientific Conception (SC), Almost Scientific Conception (ASC), Lack of Confidence (LC) Lack of Knowledge (LK) Misconception (MSC) and Have No Conception (HNC) (Anam et al., 2019)

Table 2. Patterns of Change in Students' Conceptions

Change of response		Level of changes	Descriptions
Predictions	Explanations		
Have No Conception	LC ASC SC	Constructions	There is an understanding of construction
Misconception	LK LC ASC SC	Revision	There is a revision to the initial understanding
Lack of Knowledge	LC ASC SC		
No Change		Static	Cannot Change Understanding
Backward Change		Disorientation	Decrease in Understanding
Almost Scientific Conception	SC	Complementation	An improvement in understanding becomes scientific understanding

Source (Anam et al., 2019)

3. RESULTS

3.1. Students' prior knowledge Identification

The research findings according to Table 3 give insights into the profiles of students' prior knowledge regarding Newton's third law, based on the data collected from the 15 participants. The analysis revealed diverse profiles that can be categorized into distinct groups. One group consisted of Students 1, 2, 4, 5, and 6, who exhibited misconceptions as their prior knowledge. These students held inaccurate or incomplete understandings of Newton's laws as we know based on the interview with students, suggesting the need for conceptual correction and improvement to establish a solid foundation of accurate knowledge.

Table 3. Student Prior Knowledge Category Based on Prediction Stages

Participant	Predictions	Reason	Predictions category
Student 1	The same	The same weight hung on both sides	Misconceptions
Student 2	The same	The same weight hung on both sides	Misconceptions
Student 3	The same	Will remain the same	Have no conceptions
Student 4	The same	Weight same on both sides	Misconceptions
Student 5	The same	The length will be the same as the weight hung on both sides	Misconceptions
Student 6	The same	The length will be the same as the weight hanging on both sides	Misconceptions
Student 7	More	Stretch	Lack of knowledge
Student 8	More	Stretch	Lack of knowledge
Student 9	More	Will stretch	Lack of knowledge
Student 10	More	Will stretch	Lack of knowledge
Student 11	More	Will stretch after placing the weight	Lack of knowledge
Student 12	More	Unsure	Lack of knowledge
Student 13	More	Rubber bands always stretched longer	Misconceptions
Student 14	More	The elastic band will stretch because of the weight	Lack of knowledge
Student 15	More	Unsure	Lack of knowledge

Another group includes Student 3, who entered the study with no prior conceptions related to Newton's laws. This student had a blank slate regarding the topic, indicating a lack of previous exposure or understanding. They would require foundational instruction to build a conceptual framework. Students 7, 8, 9, 10, 11, 12, 14, and 15 formed a group characterized by a lack of knowledge as their prior understanding. These students had limited or insufficient knowledge about Newton's third law, indicating the necessity for comprehensive instruction and guidance to develop a foundational understanding. Lastly, Student 13 shared similarities with the first group, displaying misconceptions in their prior knowledge. Like Students 1, 2, 4, 5, and 6, this student held incorrect or incomplete understandings of Newton's laws that needed to be addressed through targeted interventions and conceptual correction. Based on interviews conducted with students, it was found that the misconception stemmed from an error in understanding the concept of the resultant style in previous learning. Students assume that the resultant force that occurs on both objects of the same mass or with the same force of the same magnitude and different directions will produce the resultant force of zero.

Table 4. Student Answer Based on POE Work Sheet

Participants	Predictions	Explanations	Observations		Explain	Explanations
			Rubber Band Length Before	Rubber Band Length After		
Student 1	The Same	The same Weight Hung on Both Sides	7,2	8,2	Stretch More	The Band stretches a Bit as Forces Are Equal On The Both Side
Student 2	The Same	The same Weight Hung on Both Sides	7,2	7,2	Stretch More	The Force Is Applied by Putting The Weight. The Band stretches and The Balances Are Equal
Student 3	The Same	Will Remain the Same	6,1	7,2	Stretch More	The Force Is Applied by Putting The Weight. The Band

						Stretched, The Balances Are Equal
Student 4	The Same	Weight Same on Both Sides	5	7,2	Not State	Maybe The Force (Pulling) Is the Same
Student 5	The Same	The Length Will Be Same as Weight Hanged on The Both Side	6,1	10,2	Not State	Both Sides Might the Same
Student 6	The Same	The Length Will Be Same as Weight Hanged On The Both Side	6,1	10,2	Not State	Both Side Weight the Same
Student 7	More	Stretch	6,1	7,2	Stretch More	The Both Stretched After Putting the Weight
Student 8	More	Stretch	6,1	7,2	Stretch More	The Band Stretched Longer
Student 9	More	Will Stretch	6,1	7,2	Stretch More	Stretched After the Weight Placed
Student 10	More	Will Stretch	6,1	7,2	Stretch More	The Band Stretched Longer After Putting the Weight
Student 11	More	Will Stretch After Placing the Weight	6,1	7,2	Stretch More	The Band stretch and The Balancing Are Equal
Student 12	More	Unsure	5,3	8,2	Stretch More	Maybe The Weight Pulls the Band
Student 13	More	Rubber Band Always Stretched Longer	5,3	6,2	None	None
Student 14	More	The Elastic Band Will Stretch To The Weight	6,1	8,2	Stretch More	When the Weight Hung the Length Of The Band stretched Longer Than The Original Length
Student 15	More	Unsure	6,1	8,2	Stretch More	Both Side Weight the Same

3.2. Students' Conceptual Changes

Based on the prediction phase, we perform a simple experiment using a rubber band and two masses. The instrument of this assessment can be seen in Figure 1. In Figure 1, after making predictions, students are given the opportunity to test the experiment. Then students are asked to explain the results of their findings at the explained stage. This change in conception is then interpreted based on Table 2. The results of students' answers are contained in Table 3 and then analysed with the results that can be seen in Table 6. In the Prediction phase, Students 1, 2, 4, 5, and 6 exhibited misconceptions, while Students 3, 11, 12, and 13 showed a lack of knowledge. Students 7, 8, 9, 10, 14, and 15 displayed a static level of conceptual understanding, indicating no significant changes during the process. During the explanation phase, Students 1 and 2 progressed to the Almost Scientific category, suggesting a revision in their understanding. Student 3, who initially had no conceptions, showed progress and moved into the Almost Scientific category, indicating a construction of new knowledge. Students 4, 5, and 6, who had misconceptions in the prediction phase, changed to the category of lack of knowledge, also

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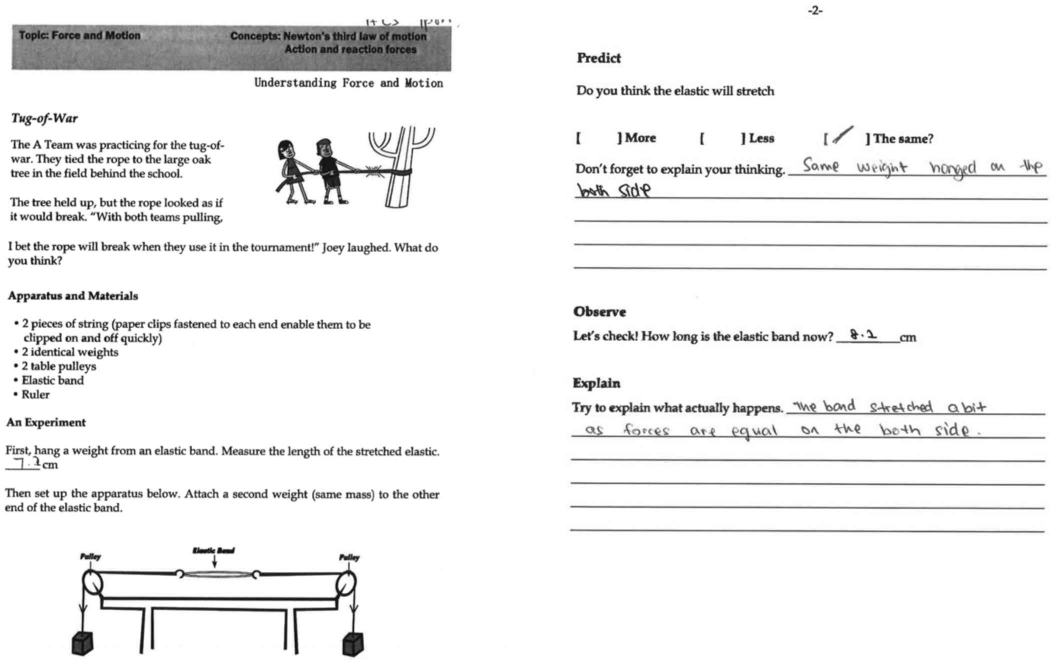
indicating a revision. On the other hand, Students 7, 8, 9, 10, 14, and 15 remained static throughout the process, maintaining their initial lack of knowledge. Student 11 experienced a revision from a lack of knowledge to the Almost Scientific category, while Student 12 changed to the lack of confidence category, indicating a revision in conceptual understanding. Student 13 exhibited a unique pattern of conceptual change, experiencing misconceptions in the prediction phase and backward changes during the explanation phase, resulting in disorientation.

Table 5. Student Level Conceptual Change

Participant	Changes		Level of conceptual changes
	Predictions category	Explanations category	
Student 1	Misconception	Almost scientific	Revision
Student 2	Misconceptions	Almost scientific	Revision
Student 3	Have no conceptions	Almost scientific	Constructions
Student 4	Misconceptions	Lack of Knowledge	Revision
Student 5	Misconceptions	Lack of Knowledge	Revision
Student 6	Misconceptions	Lack of Knowledge	Revision
Student 7	Lack of knowledge	No changes	Static
Student 8	Lack of knowledge	No changes	Static
Student 9	Lack of knowledge	No changes	Static
Student 10	Lack of knowledge	No changes	Static
Student 11	Lack of knowledge	Almost scientific	Revision
Student 12	Lack of knowledge	Lack of Confidence	Revision
Student 13	Misconceptions	Backward change	Disorientation
Student 14	Lack of knowledge	Lack of Knowledge	Static
Student 15	Lack of knowledge	Lack of Knowledge	Static


Topic: Force and Motion
Concepts: Newton's third law of motion
Action and reaction forces

Understanding Force and Motion

Tug-of-War

The A Team was practicing for the tug-of-war. They tied the rope to the large oak tree in the field behind the school.

The tree held up, but the rope looked as if it would break. "With both teams pulling, I bet the rope will break when they use it in the tournament!" Joey laughed. What do you think?

Apparatus and Materials

- 2 pieces of string (paper clips fastened to each end enable them to be clipped on and off quickly)
- 2 identical weights
- 2 table pulleys
- Elastic band
- Ruler

An Experiment

First, hang a weight from an elastic band. Measure the length of the stretched elastic. 7.2 cm

Then set up the apparatus below. Attach a second weight (same mass) to the other end of the elastic band.

-2-

Predict

Do you think the elastic will stretch

[ ] More [ ] Less [✓] The same?

Don't forget to explain your thinking. Same weight honged on the both side

Observe

Let's check! How long is the elastic band now? 8.2 cm

Explain

Try to explain what actually happens. The band stretched a bit as forces are equal on the both side.

Figure 1. Example of Students' POE Worksheet Answers.

Based on observations and interviews conducted as part of the research, it was found that students who experienced a conceptual change in the form of "revision" had a specific misconception related to Newton's 3rd law. This misconception was evident in their understanding of the tug-of-war phenomenon during an experiment involving two equal masses connected by a rope with a rubber in the middle. This finding is in accordance with Kariotoglou et al., (2009); Zhou et al., (2015) statement that many alternative conceptions arise regarding the mass of objects with force. Initially, these students believed that if two forces of the same magnitude but in different directions were applied, the resultant force would be zero. This misconception stemmed from their incorrect interpretation of Newton's 3rd law. However, through the process of conceptual change, they came to realize their error. During the explanation phase of the POE technique, these students began to understand that according to Newton's 3rd law, there is an equal amount of action and reaction force. This realization led them to recognize that the rubber in the experiment would elongate due to the forces acting in opposite directions, rather than producing a zero resultant force. The experiments conducted with these students provided valuable insights into their thought processes and conceptual shifts. Through the POE technique, the students were able to confront their misconceptions and engage in a reflective process that facilitated the revision of their understanding

4. DISCUSSIONS

4.1. Profile of Students' Prior Knowledge

When introducing scientific topics to students for the first time, it's crucial for the teacher to recognize that students already have some pre-existing knowledge or ideas about these subjects (Taber, 2017). This prior understanding is developed through everyday experiences and can significantly impact the learning process. Students may have varying perceptions of scientific topics, with some aligning with scientific concepts while others may not entirely align (Bayraktar, 2009). It's common for students to have interpretations of natural phenomena that differ from scientifically accepted viewpoints. The POE instrument depicted in Figure 1 includes a phenomenon, associated questions, and experiments designed to elicit and challenge students' initial conceptions. It aims to uncover the initial understanding held by the student and then provides an opportunity for the student to make predictions. This prediction phase serves as a crucial initial diagnostic stage in the learning process, aligning with the approach advocated by Lazarowitz & Lieb (2006). By utilizing an initial diagnostic test, researchers can gain precise insights into both the comprehension and misconceptions related to the topic they intend to address.

At this testing stage, the results of the diagnosis, based on the data in Table 5, allow us to categorize students' initial knowledge using the criteria provided in Table 1. The analysis reveals that a significant portion, 40% of students, entered the study with misconceptions about Newton's laws. Specifically, Students 1, 2, 4, 5, and 6 displayed misconceptions as their prior knowledge. Furthermore, a substantial percentage, 53.33% of students, demonstrated a lack of knowledge as their prior understanding. This category includes Students 7, 8, 9, 10, 11, 12, 14, and 15. The data suggests that a significant number of students initially hold conceptions that fall under the category of misconceptions, wherein their responses do not align with scientific concepts. Based on the findings and interview, this misconception is evident and often experienced in their understanding of the phenomenon of attraction during an experiment involving two equal masses connected by a rope with a rubber in the middle. Based on the students' answers, they predict that there is no change in the length of the rubber because the mass hangings are the same, this is in accordance with the students' statements during the interview. *"I feel that the same mass will produce a resultant force of zero, so there is no force there, however I still feel unsure about this answer"*

Additionally, when asked about their confidence in their answers, students exhibit a high level of certainty. Many sources contribute to these misunderstandings, including personal experiences, influences from family and friends, analogies, media, teachers, and textbooks

(Bayraktar, 2009; Moodley & Gaigher, 2019). Student misunderstandings can significantly impact their ability to learn new scientific knowledge, serving as a barrier to acquiring accurate understanding (Ozmen, 2004). Moreover, based on the data in Table 5, it's evident that there are still students who lack the concept of Newton's third law. Understanding the state of students' initial conceptions enables teachers to design more effective learning experiences that build upon and correct students' existing ideas (Kala et al., 2013; Malleus et al., 2017).

4.2. Student Ability to Predict

The ability of students to predict the concept of Newton's third law is situated at levels characterized by misconceptions and a lack of knowledge. The dominant level is that of a lack of knowledge, indicating that students' understanding of Newton's third law is deficient, making them less capable of anticipating the outcomes of experiments. Furthermore, there are students who fall into the "Have No Conception" level, signifying that their predictions do not align with the underlying concept. Table 5 reveals instances where students provided answers based on guesswork, possibly due to repetition of the questions. The ability to make accurate predictions stems from the initial conceptions held by students. Justification at the prediction stage offers students opportunities to categorize and rationalize their preexisting notions (Hsu et al., 2011). This knowledge is crucial as it equips teachers with insights into students' challenges in grasping new concepts, enabling them to formulate effective strategies for assisting students in overcoming difficulties (Yang et al., 2014).

4.3. Patterns of Students' Conceptions Changes

Prior to the commencement of formal education, students already possess their own preliminary comprehension and perception of various natural phenomena (Yamtinah et al., 2019). This understanding is acquired through their interactions with nature, people, and the sources they have read. When confronted with new information, students may either retain their initial conception, mostly unchanged, or modify it in response to inconsistencies (Hewson, 1981). Based on Table 6, almost all students have experienced an increase in their conception of the third law of Newton's motions. This can be seen from the changes that occur a lot at the revision level even with some changes at the static level. The third Newton law is a concept that is close to the daily lives of students. The third law of Newton is important for students. This law is important for students to understand because it helps explain how objects move and interact with each other. By understanding this law, students can predict how objects will behave in different situations and can design experiments to test their predictions. Additionally, the third law is essential for understanding the concept of momentum, which is a fundamental concept in physics. Momentum is conserved in a closed system, meaning that the total momentum of the system remains constant unless acted upon by an external force. This principle is used in many areas of physics, including mechanics, thermodynamics, and electromagnetism. Overall, the third law of Newton is an important concept for students to understand because it helps explain the fundamental principles of motion and is essential for many areas of physics (Brown, 1989).

POE strategies can be used to correct misunderstandings of concepts to improve students' understanding of concepts in the learning process (Hsu et al., 2011; Kibirige et al., 2014). In its implementation, the teacher's role is to explore students' understanding by asking them to carry out three main tasks, namely, predicting, observing, and explaining. The advantage of this POE strategy is that students are invited to make predictions about a concept to be learned and students are actively involved in the search for scientific truth through experimental activities.

This research shows that direct experiments can help students understand the concept of air pressure in an easy way.

5. CONCLUSION

It is crucial for students to acquire a solid grasp of scientific concepts as it empowers them to devise solutions for real-life challenges, whether through ideas or practical work. The implementation of the POE (Predict-Observe-Explain) strategy in the intervention yielded promising outcomes, particularly in enhancing students' understanding of Newton's third law. This strategy proved effective in assessing students' prior knowledge and minimizing misconceptions. During the teaching process, students exhibited a sharp interest in experiment-based learning, allowing teachers to observe the transformation of students' conceptual understanding before and after engaging in learning activities. The classroom became a space where natural phenomena from the outside world could be observed and explored. The positive outcomes obtained from this study suggest that the POE strategy can be applied to facilitate students' comprehension of other scientific concepts. The analysis reveals that 40% of respondents entered the study with misconceptions about Newton's laws, while 53.33% demonstrated a lack of knowledge based on their prior understanding. However, after the learning activity, the pattern of conceptual changes shows that almost all students experienced an increase in their understanding of Newton's third law of motion. These changes were most prominent at the revision level, with some changes at the static level. This research aims to contribute to the advancement of science education by advocating for the implementation of the POE strategy as a foundational approach for future educational practices. Therefore, POE, as a probing understanding strategy, can be used to identify students' initial knowledge and track their conceptual changes.

Declaration of Interest
I declare that there is no conflict of interest.

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