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Analysis of Understanding Physics Concepts in terms of Students' Learning Styles and Thinking Styles

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Abstract: There are three types of student learning styles used in the study, namely visual, auditory and kinesthetic and four types of thinking styles used in this study, namely Concrete Sequential, Abstract Sequential, Concrete Random, and Abstract Random. This study aims to analyze the level of understanding of physics concepts in terms of students' learning styles and thinking styles and examines learning styles and thinking styles that most influence the level of conceptual understanding. This study uses a quantitative approach, survey methods, and descriptive techniques. The population in this study were all students of SMAN 9 Banda Aceh, while the sample was 116 grade 2 students of SMA Negeri 9 Banda Aceh. Data analysis used descriptive statistical tests and data triangulation. The results of the analysis show that the level of understanding of students is at the second level, namely not understanding dominance compared to other levels of understanding concepts. Furthermore, it is obtained that a high kinesthetic learning style affects the level of understanding of concepts with a visual learning style. As for the thinking style, it was found that the concrete sequential thinking style was more dominant in influencing the level of conceptual understanding compared to other thinking styles.

Keywords: Level of understanding; Physics concepts; Learning styles; Thinking styles

Introduction

Understanding the concepts that students have is one of the most important things in the learning process where concept understanding is an ability that a person has to explain the knowledge he has gained so that other people understand what is being conveyed (Suraji, 2018). This is in line with Utami (2020) who state that conceptual understanding is the ability to construct concepts with specific rules to become more general so that they are easy to understand. Many factors influence students' understanding of concepts, one of which is learning style and thinking style.

Learning style is the preferred way of learning by students that can help understand the concept, so it is stated that if students learn according to their learning style it will increase the ability of these students (Jatikusumo, 2017) while Winulang & Subkhan (2015) state that learning style is the determination of a person's style to absorb, organize and manage information for problem solving in the learning process according to their abilities. There are three types of learning styles, (1) auditory learning styles, namely learning in the form of sound; (2) visual learning styles, namely learning with media in the form of writing, pictures, diagrams, graphics, and similar media; (3) kinesthetic learning style, namely learning in the form of activities or practices (Psycharis, 2014; Rhouma, 2016; Pekić, 2016).

Understanding of students' concepts during learning also depends on thinking styles so it can be said that students who have a high thinking style will be able to solve problems given by the teacher well and can improve their understanding of the concept (Halim, 2017). According to DePorter & Hernacki (2013), thinking style is the way a person organizes and processes information and there are four types of thinking styles, namely (1) concrete sequential, (2) abstract sequential, (3) concrete random, and (4) abstract random. Learning style or thinking style refers to the preferred way of individuals in processing information

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and describes a person's typical way of thinking, remembering, or solving problems (Abante, 2014).

Based on National Examination data obtained in the last 5 years, student scores in physics subjects at SMAN 9 Banda Aceh are low with details of the average score in 2017 of 24.72, in 2018 of 32.77, and in 2019 of 35.87 where the value is still relatively low when compared to the standard value of physics lessons nationally (Kemdikbud, 2019). This states that students' understanding of concepts is still not optimal, causing the learning outcomes obtained to be classified as low. The low student learning outcomes can be seen from the results of the final semester exams which show the same percentage of results. Based on observations at SMAN 9 Banda Aceh, it is known that students do not understand the concept because of the way students learn who pay less attention and rarely ask questions so that students lack curiosity about the concepts being taught, and the teacher does not know for sure the learning style and thinking style of each student.

Based on the results of previous studies, it was stated that learning styles were influential in the process of understanding students' concepts and that among the three learning styles, the kinesthetic learning style was better in understanding concepts compared with visual and auditory learning styles (Latisma, 2015; Ahmad, 2018). According to Yuniarti (2020) visual and auditory learning styles affect understanding of concepts in expressing repetition of concepts while kinesthetic learning styles affect understanding concepts in the form of examples.

Based on the findings of previous research about concept understanding when viewed from students' thinking styles, it is said that there are differences in learning outcomes for understanding concepts when viewed from different thinking styles (Purwowidodo, 2016). Bancong's research (2014) obtained similar results which stated that there was an influence of the type of thinking style on solving Physics problems where the type of abstract random thinking style was more creative in planning and solving Physics. Increased understanding of concepts influenced by thinking styles dominated by AA thinkers with an achievement percentage of 7.33% compared to other thinking styles (Halim, 2017). Based on several previous research results, it can be said that it is very important to study in-depth to find out more about the relationship between students' level of understanding of physics concepts when viewed from learning styles and thinking styles.

Method

Approach and Type of Research

This study aims to analyze the relationship between the level of understanding of the concept of learning styles and the thinking styles of students in Physics lessons. This study uses a quantitative approach to the type of survey research. Survey research is procedures in quantitive research in which investigator administer a survey a population or sample to describe the attitudes, opinions, behaviors or characteristics of the population with this research because it aims to find or clarify the relationship between two variables, namely: Level of understanding of the concept in Physics lesson (as variable X), learning styles and thinking styles of student (as variable Y).

Population and Sample

The population used in this research was students in grade XI/MIA at SMAN 9 Banda Aceh for the academic year 2021/2022 as 116 students. The sample of this research was taken by total sampling technique.

Collection of Data

1. Level of understanding of physics concept.

The data instrument used in this study was a test of the level of understanding of the concept of Physics which was adopted from Saglam and Devecioglu (2010) to analyze the level of understanding of students' physics which consisted of 16 questions open-ended. In the question, part A has presented examples of physics cases in everyday life, students are asked to explain why this phenomenon can occur, while in part B students are asked to mention the laws or concepts of physics that follow the answers given in part A. Furthermore, in part C, asked to provide another example of the law mentioned in part B, and part D students were asked to define the law or concept of physics mentioned in the previous section.

This istrument has been validated by expert in their respective field and uses a statistical validation by test using a proanal test application. Researcher completed the data collection during introductory physics courses. Students were given 45 minute to complete the test and they were encouraged to freely express their thoughts. They were assured that it was not an examination and their answers were not to be used in order to evaluate their academic levels.

2. Learning Styles.

The learning style questionnaire aims to determine learning styles guided by the Chislett & Chapman (2005) learning style questionnaire which consists of 30 simple questions equipped with 3 answer choices that have been adapted to students' learning abilities and this instrument has been validated by experts in their respective fields and is accepted globally for use as a learning style test. The learning style questionnaire before being used was validated by experts and the validation process was carried out by examining aspects of the content and use of grammar.

3. Thinking Styles.

Thinking style questionnaire to determine the type of thinking style of each student in learning is adopted based on a questionnaire developed by John Le Tellier as a result of the adaptation of Anthony Gregorc which consists of 15-word groups where one group consists of 4 words reflecting their respective personalities and this instrument has been validated by a psychologist (DePorter and Hernacki, 2013). Thinking style questionnaire before being used is validated by experts.

Data Analysis

1. Test form.

The data obtained were tested statistically and analyzed in descriptive form. The data on the level of understanding of the concept will first be tested for normality to see whether the data obtained by the researchers in this study are normally distributed or not through the Kolmogorov-Smirnov test with the help of SPSS, the data is said to be normal if the value is significantly greater than 0.05 at (P>0.05) (Sugiyono, 2013). Then the results of the data from the concept understanding level test refer to the assessment rubric adapted from Saglam and Devecioglu (2010) which refers to the research rubric developed by Abraham (1992) as shown in Table 1.

Table 1. Level of Understanding and the Assessment Rubric

Score	Level of Understanding	Criteria for Scoring
0	No Response (NR)	- Leaving blank - Answering "I don't know" - Answering "I don't understand"
1	No Understanding (NU)	- Complete repetition - Irrelevant answer - Vague answer
2	Incorrect Understanding (IU)	- Insesible information - Incorrect information
3	Partial Understanding (PU)	- Answers that include only one aspect but not all aspects of a valid answer - Answer that include some aspects of a valid answer and some misunderstandings
4	Sound Understanding (SU)	- Answers that include all aspects of a valid answer

Testing the level of understanding of the concept in this study uses the percentage adapted from Saglam and Devecioglu (2010) which refers to the research rubric developed by Abraham (1992) which contains five types of scoring in it. Participants' answers to four questions about each concept were analyzed collectively to determine the characteristics of each understanding. The research data in the form of a conceptual understanding level test were grouped based on the concept understanding level rubric adopted from Saglam, then linked to each learning style and thinking style.

2. Questionnaires.

Learning style questionnaires and thinking styles were analyzed using descriptive statistics of percentages (Sudijono, 2005), then the learning style data that had been obtained from the questionnaire were analyzed descriptively based on the Chislett & Chapman (2005) learning style questionnaire, namely by adding up each choice. Answers that have been selected by the sample. If most of the samples choose option A then the sample has a visual learning style, if most of the samples choose option B then the sample has an auditory learning style while if most of the samples choose option C then the sample has a kinesthetic learning style while the thinking style data that has been obtained from the questionnaire analyzed using a scoring technique guided by the thinking style test questionnaire developed by Gregorc in (DePorter & Hernacki, 2013) by adding up all the answers in the four columns and then multiplying each column by 4 so that the column with the largest number describes the thinking style that is often used to process the information after completing the analysis of the thinking style test data then map the results on the thinking style graph to see which thinking style is more dominant.

Result and Discussion

This study looks at the understanding of students' concepts that students have after learning ends. The test data were analyzed using Microsoft Office Excel 2010, from the results of the data analysis it can be seen how far the level of understanding of students' learning concepts. The results of the test analysis show that overall there are differences in the level of understanding of students' concepts in terms of learning styles and students' thinking styles.

Analysis of Students' Concept Understanding Level

The level of conceptual understanding is the level or level of a person's ability to understand a material where students not only know but can explain the material obtained using their sentences. The concept of tested in this study is the concept of waves because the concept of waves is a basic concept that students get from junior high and high school. Data analysis was carried out with the following criteria: score [0]: No Response (NR); score [1]: No Understanding physics (NU); score [2]: Incorrect Understanding (IU); score [3]: Partial Understanding (PU); and score [4]: Sound Understanding (SU). From the results of data analysis, it

is known that only a few students have the highest level of conceptual understanding.

The level of understanding of the concept on the question of rope waves showed that as many as 14.00% of students who were included in the criteria did not answer, 43.00% of students included in the criteria did not understand, 23.00% understood incorrectly, 7.00% understood partially, and 13.00% understood completely. The question regarding the spring movement in a baby swing found that 23.00% did not answer, 35.00% did not understand, 10.00% understood it wrongly, 18.00% understood partly, and there were 14.00% of students understood it completely. Furthermore, the question about water waves was obtained as many as 19.00% did not answer, 42.00% did not understand, 16.00% understood incorrectly, 14.00% understood partially and 9.00% of all students fully understood. Problems related to one of the properties of waves, namely wave refraction, obtained 29.00% did not answer, 42.00% did not understand, 10.00% understood incorrectly, 13.00% understood some of the material and as many as 6.00% of all students understood the material in its entirety.

Based on the explanation above, it can be concluded that the level of understanding of students' physics concepts for all students of SMAN 9 Banda Aceh is at level (1) no understanding by 34.00% of 116 students.

Analysis of Learning Styles and Level of Concept Understanding

The level of understanding of the concept in this study was obtained from the test questions given to students who had studied the material of mechanical waves. In this study, an analysis of the level of understanding of the concept was carried out in terms of student learning styles. Based on the results of the learning style questionnaire answers and students' conceptual understanding level tests, the data obtained for each learning style and the average level of concept understanding were obtained as follows.

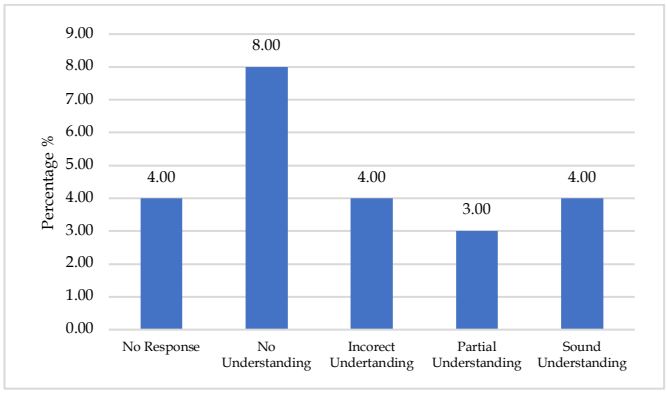

Figure 1. The Level of Understanding of Physics Concepts in terms of Visual Learning Styles

Students with visual learning styles have a way of learning by seeing directly what they are going to learn. In this study, students were more likely to enjoy learning by watching videos, phenomena, and experimental results being studied. When taught about waves, the teacher provides media such as videos related to the material so that students can see firsthand what they are learning. Based on interviews with several randomly selected students, students stated that when they learn by viewing videos and pictures, they tend to be more enthusiastic about learning and easier to remember the lessons learned so that they gain maximum understanding of concepts.

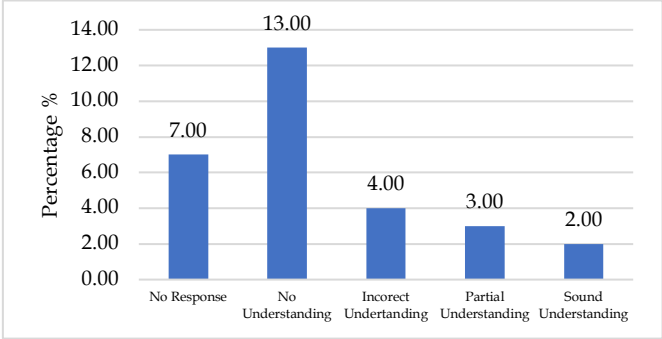

Figure 2. Level of Understanding of The Concept of Physics in terms of Auditory Learning Style

Students with an auditory learning style in the learning process have a way of learning by listening to what is learned. Based on interviews with several students, they are happy to learn if the teacher first explains in detail and detail about the lessons to be delivered, so that students are easier to remember and understand learning and get good learning outcomes. Students with auditory learning styles are also not disturbed when learning is accompanied by music. According to Deporter (2013), students with an auditory learning style find it easier to absorb information to think when they learn from sounds, dialogue, read aloud, and tell others what they have just heard and learned.

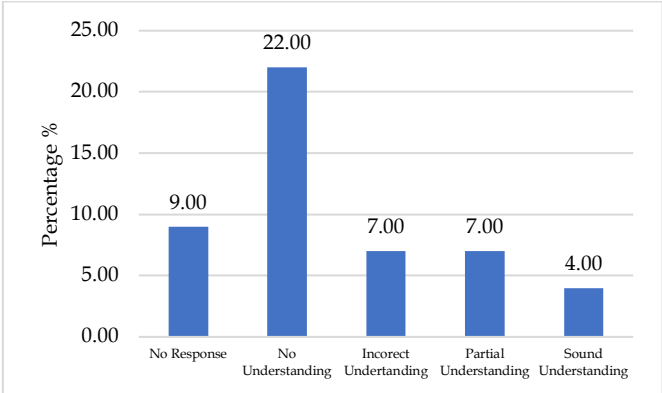

Figure 3. Level of Understanding of Physics Concepts in terms of Kinesthetic Learning Style

Students with a kinesthetic learning style have a way of learning by doing movements that are directly involved in the learning process. In this study, students experimented with the material being studied. Based on interviews with several students, they like to learn by doing experiments, because they can move freely and can remember easily what they learn. Students with a kinesthetic learning style usually cannot sit still in the learning process, they will move their limbs such as shaking their legs, or playing with a pen while studying. According to Halim (2017) students with their kinesthetic learning style move more, touch, and do so it is difficult to sit still for a long time because the desire to be active and explore is so strong.

In this study, the level of understanding of physics concepts in terms of the three students' learning styles was found that as many as 20.00% of students who were included in the criteria did not answer, 42.00% of students included in the criteria did not understand, 15.00% understood incorrectly, 13.00% understood partially and 10.00% understood completely and this study, researchers analyzed the level of understanding of the concept in which the material being taught was waved. The level of conceptual understanding that students get is different in each learning style, where the wave material taught by the kinesthetic learning style gets a very good level of conceptual understanding compared to students with visual and kinesthetic learning styles.

Analysis of Thinking Style and Level of Concept Understanding

The level of understanding of concepts in this study was obtained the same as the level of understanding of concepts for learning styles, namely as many as 16 multiple-choice questions. In this study, an analysis of thinking styles and levels of concept understanding was carried out. Based on the results of the thinking style questionnaire answers and students' level of conceptual understanding tests, data were obtained for each thinking style and the average value of learning outcomes as in each of the following images.

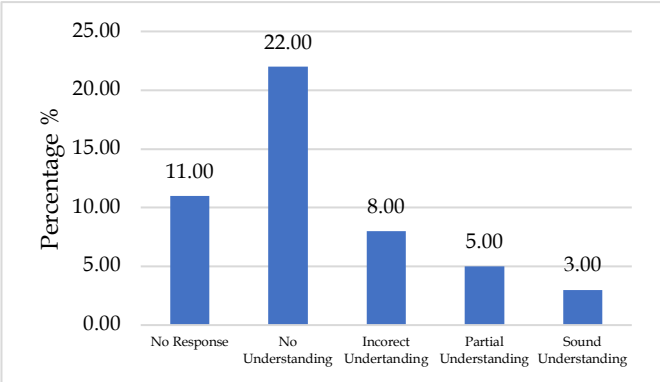

Figure 4. Levels of Understanding of Physics Concepts from a Concrete Sequential Thinking Style

Students with a concrete sequential thinking style can remember information, and formulas easily, causing students with this thinking style to have excellent learning outcomes according to the research of Sutriningsih (2015) which states that sequential students have a logical and rational way of thinking.

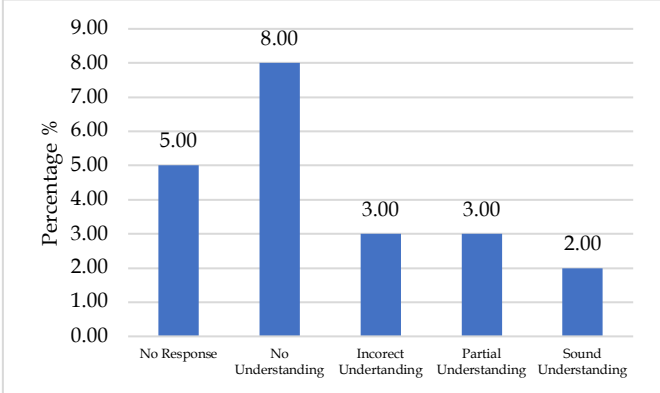

Figure 5. Level of Understanding of Physics Concepts in terms of Abstract Sequential Thinking Style

Students with abstract sequential thinking styles easily receive information by reasoning and analyzing concepts. Abstract sequential students are dominated by the left brain and they will think regularly, so they should be able to answer the questions well. Students with abstract sequential thinking styles are intelligent people, in analyzing problems they tend to do it completely and sequentially (Muliana, 2017).

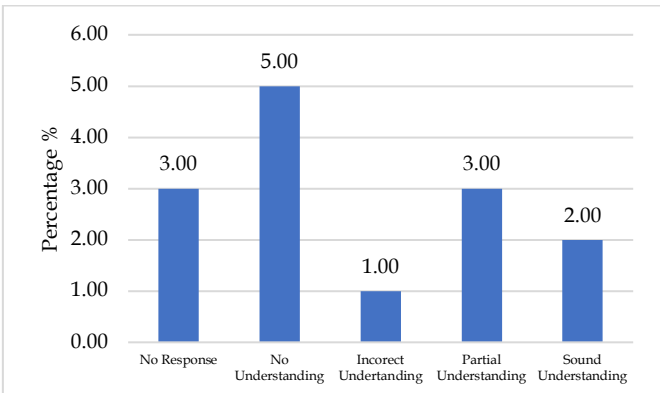

Figure 6. Level of Understanding of Physics Concepts in terms of Concrete Random Thinking Style

Students with a concrete random thinking style have a great curiosity in the learning process and have a strong drive in finding solutions in learning and answering questions on learning outcomes tests. This causes students to get good learning outcomes. Students with a concrete random learning style like to carry out the learning process by conducting experiments.

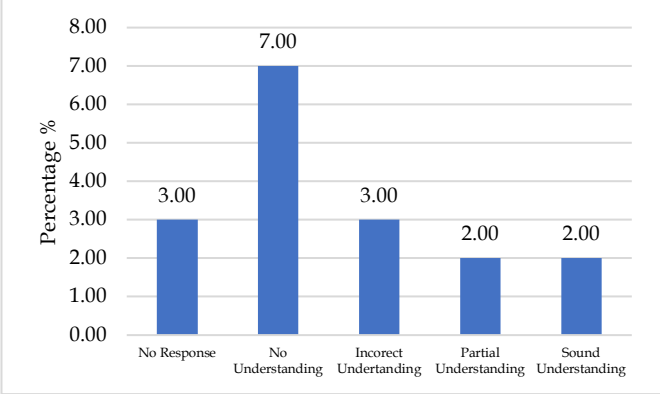

Figure 7. Level of Understanding of Physics Concepts in terms of Abstract Random Thinking Style

Students with abstract random thinking styles have a way of thinking or processing information by being dominated by the right brain. Students with an abstract random thinking style will easily process information if they see directly with their eyes what they are going to learn, not by listening. Some students with abstract random thinking styles take a long time to process information and process information irregularly, research conducted by Bancong (2014) stated that students with abstract random thinking styles tend to capture learning information less regularly.

In this study, the level of understanding of physics concepts in terms of the four students' thinking styles was found that as many as 21.00% of students who were included in the criteria did not answer, 42.00% of students included in the criteria did not understand, 15.00% understood incorrectly, 13.00% understood partially and 9.00% understood completely and the researchers analyzed the level of understanding of the concepts that students obtained were different in each thinking style, where the wave material taught by the concrete sequential thinking style got very good learning outcomes compared to students with other thinking styles. In addition to students' thinking styles, this is also due to several other factors such as learning styles, thinking styles, interests, class conditions, environment, and other factors that also influence student learning outcomes. Based on the table explanation regarding the analysis of the level of understanding of Physics concepts in terms of each type of student's thinking style, it can be concluded that the percentage level of understanding of Physics concepts of students is at the second level, namely not understanding dominance compared to other levels of understanding concepts.

Conclusion

Based on the objectives and analysis of research results related to the analysis of the level of understanding of Physics concepts when viewed from the learning styles and thinking styles of students, it was found that the level of understanding of Physics concepts of SMAN 9 Banda Aceh students is still relatively low because they are still at level one, which is not understanding concepts that dominate more than level one another understanding. At SMAN 9, it was also found that students with kinesthetic learning styles and concrete sequential thinking styles were more dominant than other types of learning styles and thinking styles.

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