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Relationship between Formal Reasoning and Understanding of Physics Concepts for Eleventh Grade Students: A Case of SMAN 3 Wajo

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Abstract: This research is a correlational descriptive study that aims to describe formal reasoning and understanding of physics concepts and the relationship between the two. The population in this study were all students of class XI MIPA SMAN 3 Wajo, while the number of samples based on the Proportional Random Sampling technique was 135 students. The instrument research is in the form of formal reasoning test instruments and understanding of physics concepts. Instrument validation used the Gregori test and continued with empirical validation Data analysis techniques performed consisted of descriptive statistical analysis and inferential statistical analysis. Based on the descriptive statistical analysis, it was found that the students' formal reasoning and conceptual understanding were in the medium category. Meanwhile, based on inferential statistical analysis, the results of the product-moment correlation test obtained an r count of 0,584. The value of the r count which is positive indicates the relationship between variables is positive. The results of the significance test obtained 0,01<0,05 so it can be said that the relationship between formal reasoning and understanding of physics concepts is significant. So it can be concluded that the relationship between formal reasoning and conceptual understanding is positive and significant.

Keywords: physics learning, formal reasoning, conceptual understanding.

Abstrak: *Penelitian ini merupakan penelitian deskriptif korelasional yang bertujuan untuk mengetahui hubungan antara penalaran formal dengan pemahaman konsep fisika.Populasi dalam penelitian ini adalah seluruh peserta didik kelas XI MIPA SMAN 3 Wajo, sedangkan jumlah sampel berdasarkan teknik Proportional Random Sampling adalah 135 peserta didik.Instrumen penelitian berupa instrumen tes penalaran formal dan pemahaman konsep fisika. Validasi instrumen menggunakan uji gregori dan dilanjutkan dengan validasi empirik. Berdasarkan analisis statistik deskriptif diperoleh bahwa penalaran formal dengan pemahaman konsep peserta didik berada pada kategori sedang. Sedangkan berdasarkan analisis statistik inferensial, hasil uji korelasi product moment diperoleh nilai r hitung 0,584. Nilai r hitung yang bernilai positif menunjukkan hubungan antar variabel bernilai positif. Hasil pengujian signifikansi diperoleh 0,01 < 0,05 sehingga dapat dikatakan hubungan penalaran formal dengan pemahaman konsep fisika signifikan. Berdasarkan hasil penelitian dapat disimpulkan bahwa hubungan antara penalaran formal dengan pemahaman konsep fisika positif dan signifikan.*

Kata kunci: *pembelajaran fisika, penalaran formal, pemahaman konsep.*

▪ INTRODUCTION

The definition of education from a policy perspective as stated in Law Number 20 of 2003 concerning the National Education System, namely education, is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual power, self-control, personality, intelligence, noble character, as well as the skills needed for themselves, society, nation, and state. The ideal learning activity that is used as a standard is the

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active process of students and the presence of teachers as facilitators whose task is to develop the potential of their students. One of the subjects that can develop the self-potential of students is the subject of Physics.

Understanding concepts in physics learning is one of the important aspects needed by students in explaining natural phenomena that occur daily. Understanding concepts is indispensable for students who have already experienced the learning process. The understanding of concepts owned by students can be used to solve a problem that has something to do with the concept they have. In understanding concepts, students are not only limited to knowing but students must be able to connect one concept with another. Mastery of physics concepts concerns the ability of students to understand the concepts or physical meanings of concepts and apply concepts correctly. According to a student, it is (Kartal Taşoğlu & Bakaç, 2014) not enough just to identify and memorize the concepts in it to understand the concepts and relationships between them, it takes a learning environment that can provide a conceptual experience supported by good reasoning skills of the learner. The factors that cause the understanding of students' concepts to be low are, the lack of interest and motivation of students to repeat the material that has been studied, accustomed to interpreting formulas, not being able to manipulate equations containing three variables, and being less thorough in understanding the problem (Riwanto & Azis, 2019). The lack of understanding of this concept also causes learners to have difficulties in solving physics problems (Hung & Jonassen, 2006). If the ability to understand this concept decreases over time it will lead to poor performance(Simeon, Samsudin, & Yakob, 2022).One of the important initial steps taken to improve learning outcomes is to identify students' reasoning abilities (Bolat & Sözen, 2009)

Scientific reasoning is a necessary part of the 21st century to develop critical thinking, problem-solving, and decision-making skills (Bao & Koenig, 2019). The ability of scientific reasoning is a major factor in the success of the learning process and the process of technology transfer (Silaban & Pardede, 2021). This is also in line with the opinion of Sahin (2010), which posits that it is important for a teacher to consider the student's reasoning process. Because of this process of reasoning, students can influence their conceptual understanding. According to Ding (2014) students who are experts, tend to solve problems using previously owned concepts. An important opinion expressed by Piaget is regarding the stages of cognitive development of the child. This stage of cognitive development must be considered by the teacher in planning and implementing and evaluating the learning process for which he is responsible. Specifically, this cognitive development is divided based on the age of the child and if it is attributed to high school students (equivalent) then it should theoretically be at the formal operational stage. At this stage, the child is already able to think abstractly and master reasoning.

Based on a preliminary study conducted by the author by interviewing teachers of physics subjects class XI SMA 3 Wajo with the aim of consulting and obtaining information about the state of students in the learning process. At SMA 3 Wajo conducts ability selection for all new students in determining majors. This selection aims to determine the personality condition, and intelligence level (IQ), along with the strengths and weaknesses of students. In addition, the results of this selection will be used as a basis for class division. Based on this, the author wants to know how the formal reasoning picture and understanding of the concepts of class XI MIPA students at SMAN 3 Wajo. Furthermore, researchers also want to know how the relationship between formal reasoning and understanding the concepts of class XI MIPA students of SMAN 3 Wajo.

That source of human knowledge is the ratio. That ratio is on the subject. Then the origin of knowledge must be sought on the subject. That ratio thinks. It is this thinking that shapes knowledge. Since only human beings think, then only human beings are knowledgeable. Man as a being capable of thinking ((Muslih, 2016) homo rationale), carries out reasoning activities to obtain clarity and truth. So that when a man acts, he has a clear and correct understanding to be used as a basis for making decisions to act to realize what he wants (Rides, 2016). Reasoning according to the Kamus Besar Bahasa Indonesia (KBBI) (Depdiknas: 2008) is a way (regarding) using reason, thinking, or a logical way of thinking; the range of thought; the thing of developing or controlling something by reason and not by feelings or experiences; mental processes and developing the mind from some fact or principle. Based on the statements above, it can be concluded that reasoning is a thought process based on facts or statements of an assumption that is considered correct leading to a conclusion. According to Lawson, there are five characteristics of formal reasoning, namely the identification and control of variables, the ability to think combinatorially, the ability to think correlational, the ability to think probabilities, and the ability to think proportionally. Piaget further explained that there are indicators in each of these reasoning abilities, including a person said to have the ability to think the probability is when he can distinguish certain things and things that may happen. A person is said to have the ability to think correlational when able to identify using relationships or causation. Furthermore, a person is said to have the ability to think combinatorially when he can solve a problem by using all combinations or factors that have something to do with a particular problem.

Formal reasoning ability is a part of basic abilities such as talents possessed by each individual that allows them to achieve a specific proficiency, knowledge, and skill. The ability of reasoning greatly affects the understanding of physics concepts which are generally unreal that require formal reasoning to understand. A student who can think logically, especially in learning and understanding physics concepts, and where the student can learn the structure of science itself, then the student will not be left behind in learning. Thus interpreting that the formal reasoning ability possessed by students plays an important role in mastering physics concepts optimally. Based on the description above, the formal reasoning ability referred to in this study is the ability of students to reason physics learning materials based on correct, precise, and reasonable (logical) considerations. Further related to the description of the types of formal reasoning that can support the learning process of physics includes correlational reasoning, combinatorial reasoning, and probabilistic reasoning

Comprehension is when students are faced with communication, they are expected to know what is being communicated and be able to use the ideas contained in said communication (Benjamin Bloom, 1956). Such communication can be in the form of oral or written examinations, either verbal or symbolic. According to to Handoko (2014), comprehension is a systematic way of interpreting, interpreting, translating, or stating something in its way after it has been known and remembered. Comprehension can be interpreted as the ability of students to explain and reuse the knowledge they already have. An understanding person means that he not only memorizes verbality but understands the concept of the problem or fact in question. Some indicators are used as a reference in the process of understanding concepts, namely: students can distinguish, change, prepare, present, organize, interpret, explain, demonstrate, exemplify, estimate, determine, and make decisions based on the knowledge they have (Salma, 2015).

Understanding can be divided into three aspects, namely translational understanding, interpretation, and extrapolation. Translational comprehension (the ability to translate) is the ability to understand an idea expressed in another way than the initial statement known earlier. The ability to translate is a diversion from the language of concepts into one's language or a transfer from abstract concepts to a model or symbol that can make it easier for people to learn them. If a person can interpret part of a communication in different terms or contexts, he will be able to engage in a more complex way of thinking (Benjamin Bloom, 1956). Understanding interpretation (the ability to interpret) is the ability to understand material or ideas that are recorded, altered, or arranged in another form. For example, in the form of graphs, concept maps, tables, symbols, and vice versa. If the ability to translate contains the notion of changing part by section, the ability to interpret includes unification and realignment. In other words, connecting the previous parts with the next known parts.

The comprehension ability of this type of extrapolation is different from the other two types of understanding and has a higher level. The ability to understand this type of extrapolation demands higher intellectual abilities, such as making a study of what possibilities will apply. The understanding of extrapolation (the ability to foresee) is the ability to foresee existing tendencies according to certain data by expressing consequences and implications that are in line with the conditions described. Based on the description above, the understanding of the concepts referred to in this study is the ability of students to understand physics concepts which include translational understanding, interpretation, and extrapolation.

▪ METHOD

Research Design

The type of research used by researchers is a type of ex post facto research, namely research that obtains data by not giving treatment to the sample studied and only taking data from a symptom that has occurred. The design used for this study is a single correlation (simple correlation) and is a type of research that takes the form of a relationship between free variables and non-free variables

Participants

The population is the entire object that is the target of a study where the population of this study is students of class XI MIPA SMAN 3 Wajo.

Table 1 Research population

NO	Class	Sum
1	XI MIPA 1	36
2	XI MIPA 2	36
3	XI MIPA 3	35
4	XI MIPA 4	35

5	XI MIPA 5	36
	Jumlah	178

A sample is part of the number and characteristics possessed by that population. When the population is large, researchers can't study everything in the population, for example, due to limited funds, energy, and time, then researchers can use samples from that population. What is learned from that sample, the conclusion will be enforceable for the population. For this reason, the sample taken from the population must be truly representative/representative (Sugiyono, 2019).

The determination of sampling errors depends on the level of accuracy or sampling error tolerated by the researcher. The error rate commonly used in research is 5% (0,05). Based on the Slovin Formula, the sample size of the study population was 123 people. The sampling technique used is Proportional Random Sampling, which is a sampling technique where all members have the same opportunity to be sampled according to their proportions, many or few populations (Sugiyono, 2019). Based on the results of the sample calculation, a sample of 25 people was obtained from each class. To avoid the possibility of missing samples, a maximum sample of 135 students were drawn. So, for each class, 27 people were selected as representatives.

Research Instruments

A research instrument is a tool used to measure observed natural as well as social phenomena (Sugiyono, 2019). The research instruments used to collect data in this study are as follows:

Formal Reasoning Test

The aspects measured in the formal reasoning test include three aspects, namely probabilistic reasoning, correlational reasoning, and combinatorial reasoning. The tests are arranged according to the formulation of indicators for each aspect of formal reasoning. In this study, formal reasoning instruments were used to determine the formal reasoning picture of class XI students of SMAN 3 Wajo. The Formal Reasoning Test is structured in the form of multiple answer choices and each question item comes with 5 answer choices. One of the 5 answer choices is the answer key, while the other answer choice is a wrong or deceptive answer. Each question item has a score of 1 if the answer is correct and a score of 0 if the answer is wrong. After the preparation of the instrument, a validity test is then carried out in the form of instrument testing by experts or known as the Gregory test, and empirical validation. The Gregory test is carried out by two experts in their fields, where the test results will then be cross-tabulation and analyzed to determine the level of reliability of the instrument. While empirical validation consists of two steps, namely the validity test and the reliability test.

The results of the Gregory test of formal reasoning instruments obtain a value of relevance equal to 1, or it can be written as Rcount. 0,75 so that it can be stated that each item of the instrument can be used for the next stage. Meanwhile, empirical validation was carried out by distributing 40 questions to 24 students. The results of the validity test showed that as many as 17 questions were declared "INVALID" with details of 4 points of correlational reasoning questions, 8 points of probabilistic reasoning questions, and 5 points of combinatorial reasoning questions. The formal reasoning questions that are declared "VALID" are 23 questions with details of 8 points of correlational reasoning questions, 6 points of probabilistic reasoning questions, and 8 points of combinatorial reasoning questions. The reliability test results stated that the formal reasoning instrument was declared reliable with a value of 0,93.

Physics Concept Comprehension Test

The aspects measured in the concept comprehension test include three aspects, namely translation, extrapolation, and interpretation. In this study, a concept understanding instrument was used to find out an overview of the conceptual understanding of class XI students of SMAN 3 Wajo. The Concept Comprehension Test is arranged in the form of multiple answer choices and each question item is equipped with 5 answer choices. One of the 5 answer choices is the answer key, while the other answer choice is a wrong or deceptive answer. Each question item has a score of 1 if the answer is correct and a score of 0 if the answer is wrong. After the preparation of the instrument, a validity test is then carried out in the form of instrument testing by experts or known as the Gregory test, and empirical validation. The Gregory test is carried out by two experts in their fields, where the test results will then be cross-tabulation and analyzed to determine the level of reliability of the instrument. While empirical validation consists of two steps, namely the validity test and the reliability test.

The results of the Gregory test of the concept understanding instrument obtained a relevance value equal to 0,975, or it can be written Rcount > 0,75 so that it can be stated that each item of the instrument can be used for the next stage. Meanwhile, empirical validation was carried out by distributing 40 questions to 24 students. The validity test results showed that as many as 18 question items were declared "INVALID" with details of 4 translational questions, 6 interpretation questions, and 8 extrapolation questions. The points about understanding the concept that is declared "VALID" are 22 questions with details of 7 points of translation, 8 points of extrapolation questions, and 7 points of interpretation questions. The reliability test results state that the concept understanding instrument is declared reliable with a value of 0,92.

Data Analysis

This research is quantitative research that processes data in the form of numbers to answer the formulation of problems in research. The two types of statistics used in this study are descriptive statistics and inferential statistics. Descriptive statistics describe or give an overview of the object under study through sample or population data as it is, without conducting analysis and making conclusions that apply to the public (Sugiyono, 2019).

The inferential statistics carried out in this study are normality tests, and linearity tests as prerequisite tests before the Pearson product-moment test are carried out. The overall statistical analysis in this study was carried out by researchers using the SPSS Statistical 24 For Windows application. Normality testing is carried out to determine whether the distribution of data used is normal. The test criterion is that if the significance value is greater than 0,05 then the distributed data is normal. Linearity tests are carried out to find out whether the data on understanding physics concepts and formal reasoning obtained are linear in a pattern or not. The test criterion is that if the significance value is greater than 0,05 then the data is linearly patterned.

After prerequisite test calculations, the data proved to be normally distributed and linearly patterned. So the analysis continues with the testing of the proposed hypothesis.

In this study, the hypothesis was tested using Pearson Product Moment (PPM) correlation analysis. Pearson Product Moment correlation is used to look for the relationship of a free variable (X) with a bound variable (Y) and data in the form of intervals and ratios. The results of testing this hypothesis are based on the output results of the SPSS Statistic 24 For Windows program. The prerequisite test in statistical decision-making is that if the r count is greater than the r table (r h > rt) then H0 is rejected and H1 is accepted.

The degree of association between free variables and bound variables can be known by conducting a coefficient of determination test. The coefficient of determination or also known as r squared (R2) is used to measure the extent to which a free variable can explain or describe a bound variable. If the value of the correlation coefficient is known, then the coefficient of determination can be obtained by squaring it. The value of the coefficient of determination is expressed in percent.

▪ RESULT AND DISSCUSSION

Formal Reasoning

Data from formal reasoning results were obtained from the answers of students (respondents) to 22 questions in the instruments that had been shared. The clustered data were then analyzed using descriptive analysis to show the characteristics of the formal reasoning variables. Based on this, it was obtained from the 135 respondents studied, the highest score was 20 and the lowest score was 3 out of 22 scores that might be achieved with an average score (mean) of 11,38. The standard deviation obtained is 4,23 so the variance value is 17,29. In this study, students' formal reasoning was analyzed based on three indicators described by Lawson, namely correlational thinking ability, probabilistic thinking ability, and combinatorial thinking ability. This formal reasoning score was obtained from a test instrument that was distributed as many as 22 items in the form of multiple choice.

Based on the results of descriptive statistical analysis, formal reasoning students of class XI MIPA SMAN 3 Wajo are in the category of moderate formal reasoning. Referring to Piaget's theory of the mental development of children aged 12 years and over is in the formal operational stages. At this stage, the child can use his concrete operations to form more complex operations(Farooq Joubish & Ashraf Khurram, 2011). Reasoning is a general concept that refers to one thought process to conclude a new statement of several other known statements(Effendy & Yuliant, 2018).

Based on the results obtained in this study, learners are at the initial formal operational stage. This means that there is a mismatch between age and the child's developmental ability, especially in formal reasoning ability. Then it is further explained that this formal reasoning is not something fixed from birth but rather several factors influence it(Effendy & Yuliant, 2018). This discrepancy can occur because each learner's reasoning ability is influenced by various factors such as motivation, educator attitudes, environment, and learning media. Menurut, Nawi (2012)in a study entitled "The Influence of Learning Strategies and Formal Reasoning Ability on Mathematics Learning Outcomes of Al Ulum Medan High School (Private) Students" stated that this is very flexible because there are still students who have graduated at the high school level never reaching the formal operational stage.

Based on the results of the study, it was obtained that out of a total of 135 students of class XI MIPA SMAN 3 Wajo, 36% of students had correlational reasoning, 34% had probabilistic reasoning, and 29% had combinatorial reasoning. These results show that the dominant formal reasoning of learners is correlational. So it can be said that students can analyze problems using causal relationships. This is also in line with the opinion (Effendy & Yuliant, 2018) that formal reasoning patterns include theoretical reasoning, combinatorial reasoning, proportional reasoning, probabilistic reasoning, and correlational reasoning.

Understanding Physics Concepts

Data from understanding concepts are obtained from the answers of students (respondents) to 22 questions in the instruments that have been shared. The data is then analyzed using descriptive analysis to show the characteristics of the concept of understanding variables. Based on this, it was obtained from the 135 respondents studied obtained the highest score of 21 and the lowest score of 3 out of 22 scores that might be achieved with an average score (mean) of 13,01. The standard deviation obtained is 4,18 so the variance value is 17,54. In this study, students understanding of concepts were analyzed based on three indicators, namely translation, interpretation, and extrapolation. The score of understanding this concept was obtained from a test instrument with elasticity material distributed as many as 22 items in the form of multiple choice.

Based on the results of descriptive statistical analysis, the understanding of the concept of class XI MIPA students of SMAN 3 Wajo is in the moderate category. This is also following the opinion expressed that the learning process in terms of good mastery of concepts is influenced by four factors, including the provision of examples, attributes, feedback in the form of information, and finally individual differences. Each student will have a different level of mastery of concepts because it depends on their age, intelligence, language skills, training, and experience. Boldy (2013), Then another opinion was put forward by Arafah (2020), that the understanding of this concept influenced the teacher's teaching method.

On the other hand, there are still 4,4% of students with a very low level of understanding and 9,6% of students with a low level of understanding. The understanding of concepts is one of the most difficult things to teach in the concept of science. The learning process requires improvements(Suharto & Csapó, 2021) such as giving exercises about understanding concepts both individually and in groups. These activities are useful for honing students' abilities in understanding the concept of the material that has been taught. In addition, it is inseparable from the difference in initial abilities possessed by students. Where in the formation of concepts between individuals another can be different, depending on the level of age, intelligence, language ability, training, or, experience of each.(Suharto & Csapó, 2022)

Based on the results of the study, it was obtained that out of a total of 135 students of class XI MIPA SMAN 3 Wajo, 38% of students have translational understanding, 35% of students have interpretation understanding, and 27% of students have extrapolation understanding. This shows that the level of translational understanding dominates the abilities of learners. This is also in line with the opinion that a deep understanding of the concepts will be achieved if students can relate relevant knowledge to make comparisons, translations, and judgments. Conceptual understanding is also shown by the recognition and creation of relationships between existing concepts(Vachliotis et al., 2021).

It is further explained that students tend to understand concepts based on their interpretations. This ability is very important because, without a proper understanding, it becomes impossible to solve small problems well. This is also in line with the opinion of Bao and Kathleen (2019) who explained that new concepts must be integrated into learners of existing knowledge structures by connecting new knowledge to concepts that are already understood. (Maknun, 2020)

The Relationship between Formal Reasoning and Concept Understanding

The main purpose of this study is to determine the relationship between formal reasoning as variable X and understanding the concept of physics as variable Y for students of class XI MIPA SMAN 3 Wajo. To find out the relationship between the two variables, a Pearson Product Moment correlation test was carried out. However, before conducting a prerequisite test, first named the normality and linearity test. Normality tests are performed to determine whether the distributed data is normal or not. Based on normality tests conducted with the help of SPSS Statistic 24 For Windows. The criterion used is if the significance value is greater than 0,05 then the data is normally distributed. Based on the analysis, a significance value of 0,499 for formal reasoning and 0,251 for concept understanding was obtained. Thus it can be concluded that the distributed data is normal

The next test is a linearity test to find out whether the data is linear patterned or not. Based on normality tests conducted with the help of SPSS Statistic 24 For Windows. The criterion used is if the significance value is greater than 0,05 then the data is linearly patterned. After the linearity test was carried out, a Deviation from the Linearity value of 0,236 was obtained where this value showed a sig value of > 0,05 which means that formal reasoning data with an understanding of the concept are linear patterned.

Hypothesis testing uses simple correlation analysis and simple linear regression using the SPSS Statistical 24 For Windows application based on decision making, namely if the probability value (ρ) < 0,05 then H0 is rejected and H1 is accepted. Based on the results of the SPSS program output above, it resulted in a correlation between formal reasoning and concept understanding of 0,584. In addition, a significance value of 0,00 was obtained. The value obtained is smaller than the significance value of α of 0,05. Because the sig value (2-tailed) < the sig.α value (0,00 < 0,05) it can be concluded that there is a significant relationship between formal reasoning and the understanding of physics concepts of class XI students of SMAN 3 Wajo.

The next analysis is a simple linear regression analysis using the SPSS Statistical 24 For Windows application. Based on this analysis, a correlation value of 0,935 was obtained. In addition, the value of R square or the coefficient of determination (KD) is obtained, which shows how well the regression model formed by the interaction of free variables and bound variables is. The KD value obtained is 34,1% which can be interpreted to mean that the free variable X1 has a contribution influence of 34,1% to the variable Y and the other 65,9% is influenced by other factors outside the variable X. The other factors are self-efficacy and prior knowledge (Acar et al., 2015).

The Product Moment correlation test and the Determinant Coefficient showed that the relationship in the category there was interactive (mutual influence) between formal reasoning and students' understanding of physics concepts, namely the calculated r value of 0,584. The strength of the relationship between formal reasoning and understanding of physics concepts in class XI of SMAN 3 Wajo is in the moderate category. Formal reasoning has a relationship with the understanding of the concept this is in line with the opinion that scientific reasoning is closely related to intellectual development where one of the forms is the ability to understand the concepts of students Sriyansyah & Saepuzaman (2017),

The results of this study show that there is a positive and significant relationship between formal reasoning and understanding of physics concepts in Class XI students of SMAN 3 Wajo. This is also in line with research (Jamaa Bok, Ambrose, & Maikudi, 2022) that states that formal reasoning is proven to be a strong predictor of student success. Furthermore, it is mentioned that reasoning abilities have an important role in the process of conceptual change that the learner has(Linnenbrink & Pintrich, 2002). This is also in line with the research conducted (Kuo, Hull, Gupta, & Elby, 2013) that student reasoning plays a role in the formation of student conceptual schemes.

For students to solve various kinds of physical science problems that are not clearly stated need to use formal reasoning skills, it is clear that a person who wants to succeed in a certain lesson or wants to obtain good concept understanding results, of course, must have certain abilities, especially formal reasoning abilities. (Syihab Ikbal, Ali, Setianingsih, & Alauddin Makassar, 2016) It is also in line with the opinion of Luo et al. (2021), that the understanding of concepts requires good reasoning skills. Based on this, the higher the formal reasoning ability of students, the easier it will be for students to understand the concepts contained in the material they are studying.

▪ CONCLUSION

Based on the results of research that researchers have conducted at SMAN 3 Wajo about the relationship between formal reasoning and understanding of physics concepts for class XI MIPA students, researchers can conclude that formal reasoning ability and understanding of physics concepts are in the moderate category. Furthermore, based on the analysis carried out, it was found that there was a positive and significant relationship between formal reasoning and understanding of physics concepts for class XI MIPA students of SMAN 3 Wajo.

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