

IMPLEMENTATION OF ETHNO-STEM-BASED TRAIT TREATMENT INTERACTION (TTI) MODEL: RUMAH GADANG ARCHITECTURE TO STUDENTS' CRITICAL AND CREATIVE THINKING SKILLS

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Articel Received: 20/09/2023; Accepted: 10/10/2023

ABSTRACT

Ethno-STEM (Ethnoscience, Science, Technology, Engineering, Mathematics) is a learning approach that integrates local wisdom into STEM education. STEM involves connecting and integrating two or more STEM subjects to explore real-world problems. When real-life issues are combined with local wisdom/culture around students, it's termed Ethno-STEM, an integration of ethnoscience into STEM-based learning. The aim of this research is to investigate the implementation of the Trait Treatment Interaction (TTI) Model Based on Ethno-STEM: The Architecture of Gadang House for students with fast and slow learning abilities regarding their Critical and Creative Thinking Skills in SMAN 1 Banuhampu Grade XI. The study took place in SMAN 1 Banuhampu, Nagari Pakan Sinayan, Banuhampu District, Agam Regency. The population included all XI-grade classes, with a sample of 68 students selected through cluster random sampling. The research instrument was validated by three validator reprehensions. The hypothesis was tested using ANCOVA after passing normality, homogeneity, and mean equality tests. The results indicate an improvement in students' physics critical and creative thinking skills, with averages rising from 82.8 to 86.5 and 85.0 in XI IPA 1 class, and from 81.7 to 86.1 and 83.3 in XI IPA 2 class.

Keywords: Ethno-STEM, TTI, Critical Thinking , Creative Thinking .

INTRODUCTION

The development of science and technology in education requires maximum attention in order to achieve effective and efficient goals. With the advancement of education, it will affect the process of human maturation, especially students. Therefore, the contribution of science and technology has a great impact on the educational process.(Herawati et al., t.t.) Good education management has been givenby the government, one of which is through 21st century learning. (Shaturaev, t.t.)This 21st century learning includes: creativity and innovation, critical thinking and problem solving and communication and collaboration in the context of higher-order thinking.

Higher order thinking is the embodiment of critical, creative, and problem-solving thinking. In this study, researchers focused on critical thinking and creative thinking. (Astutik et al., 2020).

The ability to think, both critical thinking and creative thinking is an important ability for students to have so that students can solve problems faced in an ever-changing world. However, creative and critical thinking has not been specially trained for students in Indonesia. (Yulianti et al., 2020) (Rihayati et al., 2021) The critical and creative thinking ability of students will definitely not develop by itself. (Suntusia et al., 2021) (Maharani Sastra et al., 2022) It will develop well if educators deliberately encourage learners' thinking potential, and manage it in a planned manner with good lesson planning. (Prasadi et al., 2020) Learning activities allow students to develop creativity in solving problems. (Saefullah et al., 2021) (Surya & Wahyudi, 2018) (Almuharomah et al., 2019) These activities include connecting different ideas, developing and formulating ideas to solve certain problems. (Hamdani et al., 2020) As a result, students' skills in formulating ideas to solve problems, providing original new ideas, (Arisanti et al., 2017) developing ideas and being able to make decisions about situations related to science will increase. (Fatmawati et al., 2019) (Oktavia & Ridlo, 2020).

With regard to the above problems, the need for efforts to guide students to think critically and creatively, namely paying attention to local culture, especially those closely related to scientific concepts, needs to be emphasized. (Adlin, 2022) Because these two aspects, namely creative and critical thinking, can be honed by learning by including local culture, so that students feel more interested in the learning process that is different than usual. (Sumarni & Kadarwati, 2020) (Armadi & Sihabuddin, 2021) (Azalia et al., 2020) (Priyani & Nawawi, 2020) Learning by combining local wisdom can be integrated with the Ethno-STEM-based learning process. STEM is a concentration on connecting and integrating, exploring, combining two or more STEM subjects into learning based on real-world problems. (Zakiyah, 2022) (Reffiane et al., 2020) If problems in life/the real world are combined with local wisdom/local culture around students, then this learning is called the integration of ethnosience in learning STEM or Ethno-STEM approaches. (Ariyatun, 2021).

Ethnosience is an activity to transform / reconstruct community knowledge that has been going on for generations into scientific knowledge. The knowledge of society that can be observed includes customs, customs, behavior, art, religion, language, myths, and symbols. The stages of ethnosience in STEM learning include (Azalia et al., 2020) (Rihayati et al., 2021) Observing the community about community knowledge and transforming it into scientific knowledge, (Sudarmin et al., 2020) Based on the results of the reconstruction, chemical concepts contained in general knowledge will be known, and based on the results of identification, ethnosience integration into the basic competencies of the selected topic will be carried out, then formulate learning target indicators and lesson plans. (Patricia et al., t.t.) One of the functions of local wisdom is

to preserve cultural values into character education.(Reffiane et al., 2020) (Azis & Yulkifli, 2021) The application of Ethnoscience and Ethno-STEM-based learning can effectively improve students' science literacy), scientific skills, learning outcomes, entrepreneurship, science process skills, scientific nature, critical thinking skills, and creative.(Rizki et al., 2022).

One of the local wisdom that is still preserved today in the field of architecture / development is the gadang house in West Sumatra. Rumah Gadang has a building architecture that is closely related to the physical material of rotational dynamics, balance of rigid objects and static fluids. The architecture in Rumah Gadang can be related to physics learning so that students still know and do not forget the local wisdom around them and can get references about the application of physics concepts in life that is close to them. (Oktavia & Ridlo, 2020) The diversity possessed in the region should be able to be utilized in learning to produce students who easily respond to events in the surrounding environment so that learning becomes more meaningful. The use of local cultures, traditions, practices, beliefs and native languages can improve learners' attitudes towards science.(Trisnawan & Rifqih, 2018) Ethno-STEM-based learning with local wisdom of Rumah Gadang's architecture helps students to master concepts from physics learning. In addition to the STEM approach, combining learning with local wisdom is beneficial for students to be able to learn about science, technology of making gadang houses, engineering and mathematics and can reflect Minangkabau cultural values and preserve the nation's culture so that the cultures in Indonesia, especially in West Sumatra, do not fade and disappear.(Parno et al., 2019) (Aswirna et al., 2022).

Educators in teaching give equal treatment to students. Student interaction and seriousness are lacking in learning. It is clear that when learning begins, students are actively involved, only a few people are dominated by smart students. Other students just watched without participating properly. The opportunity to ask questions and give opinions is also taken by only active students. Students who are inactive when given the opportunity tend not to want to because they feel someone is smarter than them.(Aswirna & Harahap, 2019) In the implementation of learning, educators give equal treatment to students, but only a few people show seriousness in following learning. Inaction and seriousness in students is lacking, this is seen by when learning begins, only a few people are actively involved, this is dominant with students who have high abilities. Other students just listen without participating properly. The opportunity to ask questions and give opinions given to students is only taken by active students. Students who are not active when given the opportunity they tend not to want to feel that someone is smarter than them, so in this case there is no achievement of critical and creative thinking skills in students. In the past educational institutions usually forced students to do and accept what educators say. Learning methods are more dominant than conventional methods. So that learning is more predominantly

teacher-centered. In fact, the author sees that educators in a class face a large number of students (between 20-35 people).

Individuals who are born twins and even identical in the sense of being physically similar, are still autonomous individuals, where they are two individuals who each have different bodies and souls. Individual differences owned by students require educators to pay attention to these differences in the learning process. Paying attention and considering the different characteristics of students in teaching and learning activities can meet the needs of students who will learn with methods that meet the needs of individual differences, where children must be treated like humans, must be educated according to their needs, and learn something useful for themselves.(Aswirna et al., 2020) (Aswirna, 2018) Seeing differences in individual abilities in learning requires a learning model that considers differences in individual abilities. One of the learning models that is expected to accommodate and appreciate these problems is the Trait Treatment Interaction (TTI) learning model. The TTI (Trait Treatment Interaction) model is an effective learning model used for certain individuals according to the abilities of students. The trait treatment interaction model is a suitable model used to explain that students have different learning abilities.(Aswirna & Rahmadani, 2020) (Aswirna, Yulianti, et al., 2020).

Based on the background above, researchers experimented with products that have been developed by Siska Rahmadani in 2021 where the products produced are valid in terms of material, media and language with an average value of 91.85% with nvery valid categories, the practicality of this product with an average value of 87.15% with a very practical category, and effectiveness using questionnaires and tests obtained an average value of 80% with a very effective category. Therefore, the researcher conducted a researchentitled the application of the Ethno-STEM-based trait treatment interaction (TTI) model: gadang house architecture to critical and creative thinking skills of students of SMAN 1 Banuhampu Class XI.

METHODOLOGY

This research is an experimental research with aquasi-experimental method (Quasi Experiment Methode) conducted at SMAN 1 Banuhampu in the odd semester of the 2021/2022 academic year, precisely in October-November 2022 with a population of all grade XI SMAN 1 Banuhampu. The sampling technique uses cluster random sampling with the results of sample selection set to class XI Science 1 with 34 students as experimental class I and class XI Science 2 as many as 34 people as experimental class II. The variables of the study were Ethno-STEM based physics learning with trait treatment interaction model (TTI): self-learning and regular learning + additional learning (regular teaching + tutorial) as independent variables, critical and creative thinking skills as dependent andIQ tests as moderator variables.

Table 1. Factorial Design 2 X 2 X 2

Treatment		Variable	
Group/Class	Treatment	Covariate (X)	Bound (Y)
Class XI IPA 1	Self Learning	X1	Y1
	Regular Learning + Additional Learning (Regular Teaching + Tutorial)	X2	Y2
Class XI IPA 2	Self Learning	X1	Y2
	Regular Learning + Additional Learning (Regular Teaching + Tutorial)	X1	Y2

Data collection was carried out using students' physics learning test instruments. The test of critical and creative thinking skills results from 10 essay questions that have been validated by validator lecturers and have been tested first. Data analysis uses anestes for problem analysis and SPSS programs for data processing. Data were analyzed using Pearson correlation statistics and factorial covariance analysis technique (ANACOVA) 2x2x2

RESULT AND DISCUSSION

Learning as a process of interaction in the learning environment between Didi K participants, educators, and learning resources. Students are required to master the main purpose of mastering the skills and concepts taught. Because of the interrelationship between the results of students' skills and the environment in which they learn, each student receives material differently. Even learners who are born twins or even identical in the sense of physical similarity, who remain autonomous individuals because they are two individuals with different bodies and souls, have different variants. (Deno, 2015) Everyone has a unique sensitivity to learning styles. People are special. The uniqueness then forces us to think about how learning can be adjusted to account for personal differences. (Snow, 1991).

The individual characteristics of students, such as intelligence, talent, skills, mindset, and so on, which result in group differences, are influenced by environmental factors as well as heredity and environmental factors. (Koenig et al., 2005) The learning characteristics of each person are unique. Even when solving a problem, it shows traits of varying degrees of worry and depression. (H.-A. Min & lee, 2012) Educators must first be able to identify the traits possessed by each learner. It's important to see which cognitive operations mediate individual differences because recognition is a complex talent that is not the result of a unified process. (K. E. Stanovich, 1982) Each individual is

physically and genetically completely unique from each other, even in the case of twins, providing additional evidence for this. These individual differences become more noticeable with age, from childhood to old age. (Fujii et al., 2020) (Harrison & Rainer, 1992) This fits with the idea that adults are not only much more complicated than children, but also increasingly different from each other as they age. Of course, different people apply this temporal orientation to different degrees, and each orientation may lead to the best choice in certain circumstances. (Zimbardo & Boyd, 2015).

The needs of students to learn with methods that meet the needs of individual differences in a learning process where children must be treated like humans, must be educated according to their needs, and must learn something useful for themselves can be met by paying attention to and by paying attention to the differences in the characteristics of students in teaching and learning activities. Genetics and environment have an impact on individual differences in student traits, such as intelligence, aptitude, skills, mindset, and so on, resulting in group differences. (Aswirna, Sabri, et al., 2020) (Aspinwall & Taylor, 1992) High-ability students can learn on their own, while low-ability students usually learn structured, guided, and guided and require further learning (tutorials) from their classmates. Therefore, a model is needed that considers the unique characteristics of each learner. (Aswirna, 2018).

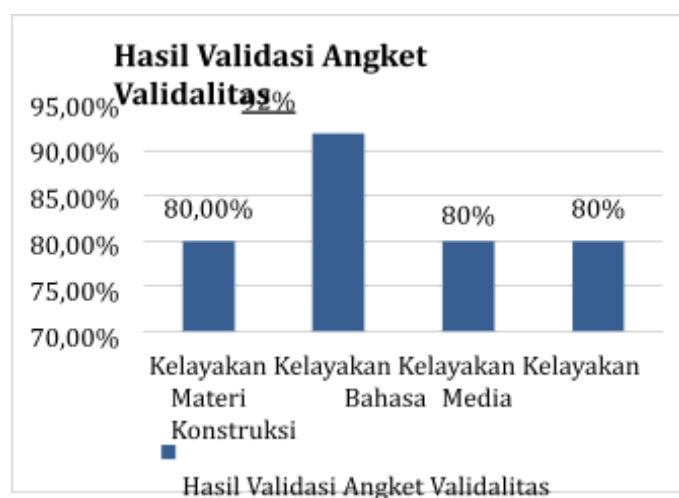
Trait Treatment Interaction (TTI), the new name for the correlational approach to the aptitude treatment interaction paradigm, measures individual differences as a basis for generalizations about relationships between individual traits. (Vesta, 1975) Studies of the impact of individual differences on learning must account for more than just test results collected from individuals at any given time. To ensure the aptitude of each student, the test in question can be an IQ test. High-ability students receive treatment in the form of self-directed learning, while medium-skilled and low-skilled students are combined in one group and receive regular teaching and tutorials. (Nuridin, 2001) The Trait Treatment Interaction (TTI) model according to Aswirna's research can help students develop their critical thinking skills and creativity to recognize and appreciate individual differences. Research conducted by Aswirna shows that model trait treatment interaction can improve the academic performance ability of chemical science students. From the research above, it can be concluded that the trait treatment interaction (TTI) learning model is very closely related to students' critical thinking and creative thinking skills. The TTI model can improve the ability of academic performance, make learning more effective and increase understanding so that it affects the results of participants' critical and creative thinking skills. (J.-A. Min et al., 2012).

Ethno-STEM is the basis of the TTI trait treatment interaction learning model used in this work by combining learning with local wisdom. (Damsar & Indrayani, 2018) A comprehensive presentation, including sample questions, evaluations, quizzes, and IQ tests, is how Rumah Gadang Architecture is laid out. Siska Rahmadani's research shows that using teaching resources based on Ethno-STEM: Rumah Gadang Architecture can help participants develop their critical and creative thinking skills. High-ability learners

can self-learn using the Ethno-STEM approach: Rumah Gadang Architecture, where after completing one unit, students can continue to study the next unit, helping them master the material faster. High-ability learners can learn independently in a variety of learning environments and prefer less organized learning methods such as conversation and experimentation. While this is going on, low-ability learners will be more successful if they get regular teaching using the Ethno-STEM: Rumah Gadang Architecture, with the help of educators. Low-ability learners need a controlled learning environment with educator direction and lecture-style teaching methods as well as explanatory assistance from fast campmates. (Rihayati et al., 2021) (Anwar, 2021).

Students who do not understand will be given tutorials from high-ability students, educators direct groups of students who have high abilities to provide explanations (tutorials) to groups of low-ability students. The results of students' critical thinking skills in experimental class I and experiment II increased after being given treatment in the form of a trait treatment interaction (TTI) model with learning media teaching materials based on Ethno-STEM: Rumah Gadang Architecture. Learning media based on Ethno-STEM: Rumah Gadang Architecture in this study was designed in PDF form containing theoretical material on rotational dynamics and to the balance of rigid objects and static fluids. (Altinay et al., 2020) Learning media for Ethno-STEM-based teaching materials: Rumah Gadang architecture was previously created by Siska Rahmadani in 2020.

The resulting learning media has gone through a process of validation of content, media, and language. The media has also gone through tests of validity, practicality and effectiveness. The assessment of the media has met the valid, practical, and effective requirements so that it is suitable for use in learning. The average validity test results were 80%, effectiveness was 76.66%, and practicality was 78.57%. (Rahmadani, t.t.).



Graph 1. Validation Results of Questionnaire Validity

Individual differences in students are not only influenced by environmental factors but also the influence of genetics and environment, such as intelligence, talent,

skills, mental and so on giving rise to groups of differences. (Permana et al., 2019) (Novaliendry et al., 2021) Dobzhansky also supports the fact that everyone is biologically and genetically completely different from each other, even in the case of twins. These individual differences are evident as we age from childhood to old age, in line with the opinion that adults are not only much more complex than children, but they are more different from each other, and differences will increase with the shift from young to old age. (K. Stanovich, 198M).

Individual differences that cause students not always match all learning conditions and environments. (Ediyani et al., 2020) (Mashami & Gunawan, 2018) Independent learning can be done by students with high abilities, while students who have low abilities tend to learn in a structured, accompanied, guided manner and require additional learning (tutorials) from their peers. So a model is needed that accommodates the differences of individual learners. (H.-A. Min & Lee, 2012) (Halpern & Dunn, 2021).

The TTI learning model is suitable for learning according to the potential of students. The TTI learning model divides students into high-ability groups, medium-ability groups, and low-ability groups. (Aswirna, 2022) However, here researchers only divide students into high and low groups, each of which is given different treatment. (Kimonis et al., 2019) Students who have high abilities are given treatment in the form of self-learning and for students with medium and low abilities combined in a group by providing ordinary learning coupled with additional learning (regular teaching + tutorial). (Lee, 2013).

Table 2. Results of Calculation and Critical Thinking Test Sample Hypothesis Using Anacova Test

Tests of Between-Subjects Effects					
Dependent Variable: Critical Thinking					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	929,354a	4	232.339	24.147	.000
Intercept	2084.123	1	2084.123	216.604	.000
IQ	67.782	1	67.782	7.045	.010
Class	.836	1	.836	.087	.769
VarietyLearning	86.418	1	86.418	8.981	.004
Classes *	124.133	1	124.133	12.901	.001
VarietyLearning					
Error	606.175	63	9.622		
Total	508600.000	68			
Corrected Total	1535.529	67			

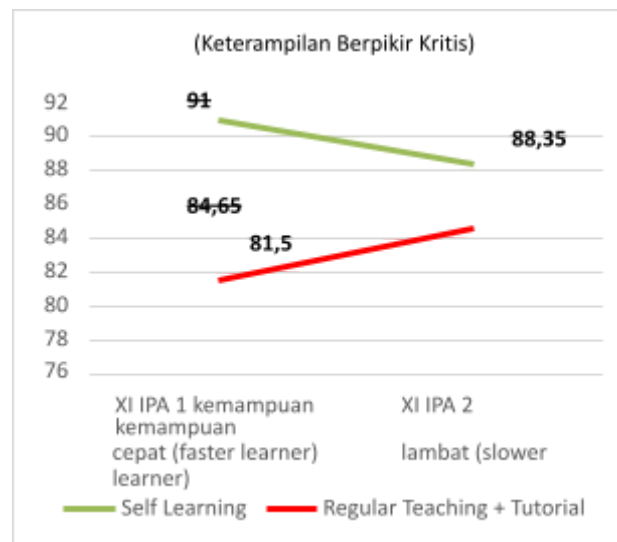
a. R Squared = .605 (Adjusted R Squared = .580)

Table 2 presents the analysis of the Ancova test on student learning outcomes on the material Dynamics of rotation and balance of rigid bodies. From the output above, it

can be seen that the significance figures for the IQ test modifiers Sig. $0.010 < 0.05$ then H_0 is rejected and H_a is accepted. with critical thinking obtained by learners. This means that at a 95% confidence level, it can be said that there is a linear relationship between IQ tests, so that IQ tests have an effect on students' critical thinking. This statement indicates that the assumption of anacova has been fulfilled.

Furthermore, testing was carried out to determine the effect of learning variations on student learning outcomes. The results output obtained learning variation modifiers Sig. $0.004 < 0.05$, so it was concluded that H_0 was rejected and H_a was accepted. This means that there is an influence of learning variations on students' critical thinking. The calculation of class significance is $0.769 > 0.05$, so the variable doesnot affect the critical thinking skills of students because the value of sig is greater. Classes from the level of sig. 0.05.

The application of IQ tests and student learning variations to learning outcomes can also be seen from the significance in the Corrected Model section. It can be seen that the Sig number $0.00 < 0.05$ and far below the value of Sig. 0.05 then H_0 is rejected and H_a is accepted.(Ben-Eliyahu, 2017) So that simultaneously there is an influence of IQ tests and learning variations on student learning outcomes. Comparison of learning outcomes of students who are given treatment in the form of self-learning for high- ability students and reteching+tutorial for medium and low-ability students can be seen in graph 2.



Graph 2. Comparison of the average value of critical thinking skills Students use the Ethno-Stem- based TTI model on the material Dynamics of rotation and balance of rigid bodies.

Graph 2. shows that the application of learning variations to students' critical thinking. In the lecture learner, students who were taught with self-learning had an average score of critical thinking skills of 91.00, while those who were retaught had an average value of critical thinking skills of 81.50 In the slower learn er class, students who were taught with self learning had an average score of critical thinking skills of 88.35,

while those who were retaught had an average value of critical thinking skills of 84.65. So that the comparison of the results of students' critical thinking performance between the faster learner class and the slower learner class in self-learning averaged and 88.35. While the results of students' critical thinking skills between the faster learner class and the slower learner class in reteaching + tutorial learning were 81.50 and 84.65. From the results of critical thinking skills, it can be concluded that students who have high abilities are more suitable for independent learning (self learning) and students who have medium and low abilities are more suitable for learning with ordinary learning + additional learning (regular teaching + tutorials).

Table 3. Results of Creative Thinking Calculations Test the Sample Hypothesis Using the Anacova Test.

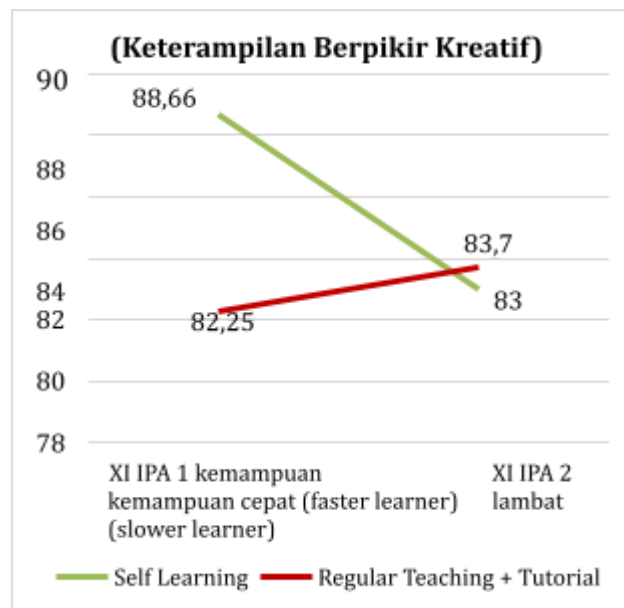
Tests of Between-Subjects Effects					
Dependent Variable: Creative Thinking					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	528,333a	4	132.083	15.737	.000
Intercept	1751.919	1	1751.919	208.726	.000
IQ	110.834	1	110.834	13.205	.001
Class	64.313	1	64.313	7.662	.007
VarietyLearning	43.262	1	43.262	5.154	.027
Classes *	339.400	1	339.400	40.437	.000
VarietyLearning					
Error	528.785	63	8.393		
Total	483220.000	68			
Corrected Total	1057.118	67			

a. R Squared = .500 (Adjusted R Squared = .468)

Table 3 presents the analysis of the Ancova test on student learning outcomes on the material Dynamics of rotation and balance of rigid bodies. From the output above, it can be seen that the significance figures for the IQ test modifiers Sig. $0.010 < 0.05$ then H_0 is rejected and H_a is accepted. with critical thinking acquired by learners. This means that at a 95% confidence level, it can be said that there is a linear relationship between IQ tests, so it is concluded that IQ tests have an effect on students' critical thinking. This statement indicates that the assumption of anacova has been fulfilled.

Furthermore, testing was carried out to determine the effect of learning variations on student learning outcomes. The output results obtained learning variation modifiers Sig. $0.004 < 0.05$, so it was concluded that H_0 was rejected and H_a was accepted. This means that there is an influence of learning variations on students' critical thinking. The calculation of class significance is $0.769 > 0.05$, then the class variable does not affect the critical thinking skills of learners because it is greater sig score. Classes from the level of sig. 0.05.

The application of IQ tests and student learning variations to learning outcomes can also be seen from the significance in the Corrected Model section. It can be seen that the Sig number of $0.00 < 0.05$ and far below the value of Sig. 0.05 maka H_0 is rejected and H_a is accepted. So that simultaneously there is an influence of IQ tests and learning variations on student learning outcomes. Comparison of learning outcomes of students who are given treatment in the form of self-learning for students with high abilities and reteching + tutorials for medium and low ability students can be seen in graph 5.



Graph 3. Comparison graph of the average value of creative thinking skills Students use the TTI a model based on Ethno-Stem materi Dynamics of rotation and balance of rigid bodies.

Graph 3 shows that the application of learning variations to students' creative thinking. In faster learners, students who are taught with self learning have an average score of creative thinking skills of 88.66, while those who are taught reteaching have an average value of creative thinking skills of 83 In the slower learner class, students who are taught with self learning have an average value of thinking skills krEatif 82.25 while those who were retaught had an average score of creative thinking skills of 83.7. So that the comparison of the results of students' creative thinking skills between the faster learner class and the slower learner class inself-learning learning averages 88.66 and 83. While the results of students' creative thinking skills between the faster learner class and the slower learner class in reteaching + tutorial learning were 82.25 and 83.7. From the results of creative thinking skills , it can be concluded that students who have high abilities are more suitable for independent learning (self learning) and students who have medium and low abilities are more suitable for learning with ordinary learning + added learning (regular teaching + tutorials).

The results of this study are also supported by research conducted by (Aswirna, 2018) Trait Treatment Interaction (TTI) model according to Aswirna's research can help students develop their critical thinking skills and creativity to recognize and appreciate individual differences. Research conducted by Aswirna shows that the trait treatment interaction model can improve the academic performance ability of chemistry students. From the research above, it can be concluded that the trait treatment interaction (TTI) learning model is very closely related to students' critical thinking and creative thinking skills. The TTI model can improve academic performance abilities, become more effective learning and increase understanding so that it affects the results of students' critical and creative thinking skills. (Aswirna & Harahap, 2019).

KESIMPULAN/CONCLUSION

Results The critical thinking ability of students who have faster learners using self-learning with an average score of 88.7 is higher than ordinary learning with additional learning (regular teaching + tutorials) and an average of 80.9. The learning outcomes of slower learners who used regular learning plus additional learning (regular teaching + tutorial) were higher with an average score of 87.0 compared to self-study (self learning) with an average score of 81.7 on each learning material.

Results The ability to think creatively of students who have the ability to quickly (faster learner) using independent learning (self learning) with an average score of 88.6 higher than ordinary teaching furniture with additional learning (regular teaching + tutorials) average score of 83.0. The learning outcomes of slower learners who use regular learning plus additional learning (regular teaching + tutorial) are higher with an average score of 83.7 compared to self-learning (self-learning) with an average score of 82.2 on each learning material.

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