



Implementing the Geogebra Applet-Based Connecting, Organizing, Reflecting, Extending (CORE) Learning Model for Students' Critical Thinking Ability in Learning Styles

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| Article Info | Abstract |
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| Received July 3, 2022 | In the era of globalization, the 21st century requires learning integrated with technological developments and innovation. This study aims to analyze the implementation of the Connecting, Organizing, Reflecting, Extending (CORE) learning model based on the Geogebra Applet on students' critical thinking ability regarding learning styles. The design of this study is quasi-experimental. The samples in this study were students of class XI MIPA 1 and XI MIPA 2 SMA Negeri 2 Magelang who were selected by the cluster random sampling technique. The instruments used in this study were critical thinking ability tests and learning style questionnaires. Based on the results of the hypothesis test conducted with the ANOVA test of two unequal cell paths and the LSD (Least Significance Difference) follow-up test, results were obtained: (i) The Core learning model based on the Geogebra Applet produces students' critical thinking ability better than the direct learning model; (ii) There are differences in critical thinking ability between students and the learning styles of divergers, convergers, assimilators and accommodators; (iii) There is no interaction between the Geogebra Applet-based CORE learning model and the direct learning model with the student's learning style. |
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| Keywords | |
| Applet geogebra; CORE model; Critical thinking; Learning styles. | |

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INTRODUCTION

In the 21st century era of globalization, the rapid increase in science and technological innovation requires the role of educators with character. This condition results in a nation that is not ready to adapt and will fall into the enormity of changes in civilization and advances in science and innovation. This way, education must be improved (Kemendikbud, 2017). Commonly referred to as the 4C skills of the 21st century, schools teach children to think creative thinking, communication, critical thinking and problem solving, and collaboration.

As one of the talents of the 21st century, critical thinking or critical thinking abilities contain components often faced by students in their daily lives. Critical thinking is investigating and assessing information based on observation, application, reasoning, and communication results to determine whether the data should be trusted or ignored (Purwati, Hobri, & Fatahillah, 2016). Observation of a

person's behavior can realize the thinking process in critical thinking abilities. In daily life, a person cannot be separated from the use of essential thinking skills; that is, a person is not only influenced by information or issue but must be able to choose the information he obtains and present reasons and evidence logically and rationally. In line with (Ruggiero, 2012) opinion that critical thinking is assessing the ideas we have to make the best choice in solving problems or making logical conclusions. Then evaluate and refine the decision.

The impact that occurs when someone cannot think critically is that it is easy to make decisions without conducting an analysis first, resulting in decisions taken less in line with expectations. Someone who cannot think critically will be easily influenced by a problem and find it challenging to find ideas to solve it. Therefore, critical thinking abilities are essential for students (Agustina, 2019).

According to Facione (2011), critical thinking abilities have six primary skills, including (1) interpretation, understanding problems, (2) analysis, the process of analyzing the relationship between concepts and statements, (3) evaluation, applying correct strategies in solving problems, (4) Inference, making conclusions based on the previous step, (5) explanation and (6) self-regulation, where students describe what they have learned and how their work develops from beginning to end. According to discussions with teachers at SMA Negeri 2 Magelang, students are rarely given questions that require critical thinking. The initial test of essential thinking skills at SMA Negeri 2 Magelang resulted in 52.13 out of 100. This result was categorized as low because the category of critical thinking ability was <55 (Pertiwi, 2018).

One of the things that affect critical thinking abilities is the learning model (Hasibuan, Abubakar, & Harahap, 2018). A learning paradigm is needed that can involve students' necessary thinking skills. Observations at SMA Negeri 2 Magelang show that educators often adopt a teacher-centered learning paradigm. The learning model is still teacher-centered and has not changed. As a result of this condition, only a few children are active, so students' abilities are not emphasized in class.

The CORE learning model is one of the learning models that can improve students' ability to think critically (Ayudia & Mariani, 2022). Connecting, organizing, reflecting, and extending is part of the CORE learning model (Miller & Calfee, 2004), where each step cannot be completed without completing or leaving the previous one. In the linking stage, students activate prior knowledge (Curwen et al., 2010) and relate it to newly acquired information (Dymock, 2005). In the organizing step, students are directed to organize the knowledge they have developed in the previous stage (Miller & Calfee, 2004) so that the principles learned by students are clearly defined (Dymock, 2005). In the reflecting stage, students re-examine the organizational structure that has been formed (Curwen et al., 2010), and explain or criticize the information structure that has been made previously (Dymock, 2005), while in the extending stage, students develop or expand knowledge (Dymock, 2005).

Previous research has shown that CORE learning benefits critical thinking abilities (Ningsih et al., 2020; Udayani, Gita, & Suryawan, 2019; Wati et al., 2019). Using the CORE paradigm, students learn how to relate and organize their accumulated knowledge. When using the CORE learning model, students are more involved in the educational process.

The supporting factor in the learning model is the learning media. Learning media is very helpful in delivering and understanding the material. One of the learning media that helps to learn and can explore students' critical thinking abilities is Geogebra (Andriani et al., 2022; Batubara, 2019).

Geogebra is an innovative mathematics program that integrates calculus, algebra, and geometry (Hohenwarter et al., 2008). This program is used for mathematics education. Students who use Geogebra are expected to learn freely, even without explicit instruction. In addition, this curriculum allows students to strengthen their talents. According to (Hohenwarter et al., 2008), Geogebra learning media can provide several benefits, such as helping the process of demonstrating and visualizing specific mathematical ideas to minimize the amount of mathematical abstraction. This media can also be used as a building tool for several mathematical topics. Geogebra can also be applied as a discovery tool, enabling students to discover specific mathematical ideas.

Geogebra can be a medium of learning in helping students understand one of them in learning mathematics at school. The output created in Geogebra is called a Geogebra applet. The derivative of the algebraic function is one of the materials that must be visualized through learning media. The derivative of algebraic functions is a complex topic because it requires a high level of abstraction. In understanding this fairly complex material, teaching aids are needed in the learning process. The Geogebra applet can be applied to material derived from algebraic functions. This material requires visualization in the concept of derivatives of algebraic functions. Students have difficulty imagining derivatives of algebraic functions because they cannot interact directly with relevant images and observe content without much curiosity (Pradhana, 2020).

The CORE learning model can take advantage of the Geogebra Applet learning media. Besides being able to help students understand and create more exciting and interactive learning, the use of the Geogebra Applet is also in line with the use of developments in science and technology. 21st-century learning must be integrated with technological developments (Kemendikbud, 2017). Therefore, students must be given the knowledge by the development of civilization to fulfill 21st-century skills.

Besides being influenced by the learning model, other factors affect students' ability to think critically, namely learning styles (Karim, 2014). A person's learning style is an individual's way of obtaining, processing, and manifesting information in daily behavior (Rambe & Yarni, 2019). Kolb & Kolb (2005) divides learning styles into four categories: (1) divergers, individuals who are adept at observing concrete situations from multiple perspectives, (2) convergers, individuals who are adept at finding practical applications for ideas and theories, (3) assimilators, individuals who have the ability to processing diverse information and pouring it into a logical and definite form, and (4) accommodator, individuals who have advantages can learn from direct experience.

Every student has a unique learning style. Therefore, every student in the learning process needs a separate way to understand the subject matter simply (Rahmi & Samsudi, 2020). Because of this variation, each student's understanding and absorption of information during learning differs, as are his abilities.

RESEARCH METHODS

This research is a type of quantitative research with quasi-experimental methods. In this study, there were two free variables and one bound variable. The free variables in this study are learning models, namely learning models and learning styles. The learning model used is the Geogebra Applet-based CORE (P_1) and the direct (P_2) learning models. Then the learning style used is a Kolb-type learning style, namely the learning style of diverger (Q_1), converger (Q_2), assimilator (Q_3), and accommodator (Q_4). At the same time, the bound variable used in this study is the ability to think critically. So the two-track experimental design of this study is shown in the following table.

Table 1. Experimental Research Design

| Learning model (P_i) | Learning style (Q_i) | | | |
|--------------------------|--------------------------|----------|----------|----------|
| | Q_1 | Q_2 | Q_3 | Q_4 |
| P_1 | P_1Q_1 | P_1Q_2 | P_1Q_3 | P_1Q_4 |
| P_2 | P_2Q_1 | P_2Q_2 | P_2Q_3 | P_2Q_4 |

This research was conducted at SMA Negeri 2 Magelang in the 2022/2023 school year. The population in this study was all students of class XI MIPA, with a total of 179 students. This study used class XI MIPA 1 as the experimental class and class XI MIPA 2 as the control class. The number of students in each class amounted to 36 children, so the total number of the sample was 72 students. The sampling technique used in this study was random cluster sampling. This technique is used if the sample to be studied is substantial.

The instruments used in this study were learning style questionnaire instruments and critical thinking ability test instruments. The learning style questionnaire used in this study was David Kolb's learning style questionnaire. This questionnaire is a standard questionnaire sourced from Miami University. Because David Kolb's learning style questionnaire is a standard questionnaire, this questionnaire is suitable for use without having to be validated and tested. David Kolb's learning style lifting instruments are given in practical and control classes to determine the characteristics of students' learning styles. Meanwhile, the test instruments in this study must be validated and tested. Validation of the critical thinking ability test is carried out to determine the validation of the contents of the test instrument. The content validators on the critical thinking ability test instrument are based on the assessment by the three validators, five questions were stated to be content worthy of testing. The following Table 2 is presented a summary of the results of the analysis of the trial item of the critical thinking ability test instrument.

Table 2. Summary of Instrument Calibration Analysis Results

| No. | Validity | Reliability | Difficulty index | Discriminatory power | Conclusion |
|-----|-----------|-------------|------------------|----------------------|------------|
| 1 | Very Good | Good | Keep | Enough | Proper |
| 2 | Very Good | | Keep | Good | Proper |
| 3 | Very Good | | Keep | Enough | Proper |
| 4 | Very Good | | Difficult | Enough | Proper |
| 5 | Very Good | | Difficult | Enough | Proper |

Based on Table 2 of the analysis on the instrument item, the critical thinking ability test instrument is worth using.

The collection techniques carried out in this study were observation, interviews, tests and questionnaires. The test instrument is used to determine the student's critical thinking ability, while the questionnaire instrument is used to determine the student's learning style.

The data analysis techniques used in this study were ANOVA, two unequal cell paths and LSD follow-up tests. However, before conducting the test, conduct a pre-requisite test, namely the normality test and the homogeneity test. The normality test in this study used the Lilliefors test, while the homogeneity test carried out in this study used the Barlett test.

RESULTS AND DISCUSSION

Pre-Requisite Test

The pre-requisite tests carried out in this study are normality tests and homogeneity tests. The normality test aims to find out whether the sample is from a normally distributed population or not. The normality test used in the pre-condition test uses the Lilliefors test. Normality tests in the final data analysis were carried out in practical classes, control classes, diverger learning styles, converger learning styles, assimilator learning styles and accommodator learning styles. The following is a summary of the normality test results presented in table 3.

Table 3. Summary of Normality Test Results

| Kategori | L_{obs} | L_{critic} | Conclusion |
|----------|-----------|--------------|---------------------------|
| P_1 | 0,110 | 0,148 | Normally distributed data |
| P_2 | 0,069 | 0,148 | Normally distributed data |
| Q_1 | 0,089 | 0,173 | Normally distributed data |
| Q_2 | 0,122 | 0,227 | Normally distributed data |
| Q_3 | 0,111 | 0,173 | Normally distributed data |
| Q_4 | 0,227 | 0,234 | Normally distributed data |

The conclusion of the Lilliefors normality test is if the observation value of L less than the critical value of L ($L_{obs} \leq L_{critic}$), then the sample is usually distributed. Based on Table 3, known values $L_{obs} \leq L_{critic}$. To meet the conclusion of the normality test that the sample used is from a normally distributed population.

Furthermore, a homogeneity test is carried out. The homogeneity test carried out in this study used the Bartlett test. The homogeneity test in the final data analysis was carried out in both classes, namely the experimental class and the control class. Then the homogeneity test was also carried out on the diverger learning style, converger learning style, assimilator learning style and accommodator learning style. The following will describe the results of the homogeneity test in the pre-condition test in Table 4.

Table 4. Summary of Homogeneity Test Results

| Category | χ^2_{obs} | χ^2_{critic} | Conclusion |
|----------|----------------|-------------------|------------|
| P_i | 3,60 | 3,84 | Homogene |
| Q_i | 4,13 | 7,82 | Homogene |

Based on Table 4, in learning model category obtained values of $\chi^2_{\text{obs}} = 3.60$ dan $\chi^2_{\text{critic}} = 3.84$. This means that these categories are expressed homogeneously between the experimental and the control class ($\chi^2_{\text{obs}} \leq \chi^2_{\text{critic}}$). Then the learning style categories obtained values of $\chi^2_{\text{obs}} = 4.13$ dan $\chi^2_{\text{critic}} = 7.82$. This means that these categories are expressed homogeneously ($\chi^2_{\text{obs}} \leq \chi^2_{\text{critic}}$) between the forth category of learning style.

Variance Analysis of Two Unequal Cell Paths

The results of the analysis of the variance of two unequal cell paths are presented in Table 5 as follows.

| Source | <i>JK</i> | <i>dk</i> | <i>RK</i> | <i>F_{obs}</i> | <i>F_{critic}</i> | Conclusion |
|-------------|-----------|-----------|-----------|------------------------|---------------------------|-----------------|
| Line | 5105 | 1 | 5105 | 28,99 | 3,99 | Significant |
| Column | 1938 | 3 | 646 | 3,66 | 2,75 | Significant |
| Interaction | 354 | 4 | 118 | 0,66 | 2,75 | Not significant |
| Error | 11295 | 64 | 176 | | | |
| Total | 18692 | 71 | | | | |

The criteria for the ANOVA test is that if the observation value of F less than the critical value of F ($F_{\text{obs}} \leq F_{\text{critic}}$), it means that there is no significant difference, and while if it is $F_{\text{obs}} > F_{\text{critic}}$ so that means there is significant difference one of other(s). Based on Table 5, it can be concluded as follows: (i) because of $F_{\text{obs}} = 28.99 > 3.99 = F_{\text{critic}}$, so that based on the criteria of the ANOVA test, the conclusion was there are difference achievement between students who have been implemented the Geogebra Applet-based CORE and direct learning model for critical thinking abilities, (ii) because of $F_{\text{obs}} = 3.66 > 2.75 = F_{\text{critic}}$, so based on the criteria of the ANOVA test, the conclusion was there are difference between students with diverger, converger, assimilator, and accommodator learning styles with critical thinking abilities, (iii) because of $F_{\text{obs}} = 0.66 < 2.75 = F_{\text{critic}}$ so that based on the criteria of the ANOVA test, the conclusion was there is no interaction effect between models and learning styles toward students' critical thinking abilities.

Advanced Test Post-Analysis of Variance of Two Unequal Cell Paths

Further tests after analysing the variance of two unequal cell paths in this study used the LSD (Least Significance Difference) double comparison test. Follow-up tests are essential, considering that the results of the two-way ANOVA test show some analysis result was in significant different. A summary of marginal averages is presented in Table 6 as follows.

Based on the ANOVA test, two unequal cell paths that have been carried out, it is stated that H_{0A} was rejected, which means that there is a difference in critical thinking abilities between students who obtained the Geogebra Applet-based CORE learning model and students who obtained the direct learning model. Then to find out a better learning model, there is no need to do an LSD follow-up test because it is enough to look at the marginal average between the two learning models. Sourced

from Table 6, it is known that the marginal mean value for the Geogebra Applet-based CORE learning model is 79, and the marginal average value for the direct learning model is 60. Based on the differences in marginal averages between the two learning models, it can be concluded that the Core learning model based on the Geogebra Applet is better than the direct learning model for critical thinking abilities.

Table 6. Marginal Average Summary

| Learning model | Learning Styles | | | | Average Marginal |
|-----------------------------|-----------------|-------|-------|-------|------------------|
| | Q_1 | Q_2 | Q_3 | Q_4 | |
| CORE Based Geogebra Applets | 83 | 83 | 78 | 68 | 79 |
| Direct Learning | 62 | 69 | 55 | 56 | 60 |
| Average Marginal | 72,43 | 76,94 | 64,91 | 62,51 | |

Sourced in Table 5 regarding the summary of ANOVA results of two unequal cell paths, it can be seen that H_{0B} is rejected; it can be concluded that there are differences between learning styles. Multiple comparative tests need to be performed to analyze the differences in each group. A summary of the double comparison test between columns is presented in Table 7 as follows.

Table 7. Summary of Double Comparative Test Results

| No. | Interaction | $ \mu_i - \mu_j $ | LSD | Conclusion |
|-----|-----------------------------|-------------------|-------|-----------------|
| 1 | $(\mu_1 \text{ vs } \mu_2)$ | 4,51 | 9,06 | Not significant |
| 2 | $(\mu_1 \text{ vs } \mu_3)$ | 6,52 | 7,90 | Not significant |
| 3 | $(\mu_1 \text{ vs } \mu_4)$ | 9,92 | 9,27 | Significant |
| 4 | $(\mu_2 \text{ vs } \mu_3)$ | 11,03 | 8,98 | Significant |
| 5 | $(\mu_2 \text{ vs } \mu_4)$ | 14,43 | 10,21 | Significant |
| 6 | $(\mu_3 \text{ vs } \mu_4)$ | 3,40 | 9,20 | Not significant |

Based on Table 7, it can be concluded as follows:

1. Test result $(\mu_1 \text{ vs } \mu_2)$, $|\mu_i - \mu_j| = 4,51 < \text{LSD} = 9,06$ so that there is no significant difference between students with diverger learning styles and students with converger learning styles.
2. Test result $(\mu_1 \text{ vs } \mu_3)$, $|\mu_i - \mu_j| = 6,52 < \text{LSD} = 7,90$ so that there is no significant difference between students with diverger learning styles and students with assimilator learning styles.
3. Test result $(\mu_1 \text{ vs } \mu_4)$, $|\mu_i - \mu_j| = 9,92 > \text{LSD} = 9,27$ so this means significant differences exist between students with diverger learning styles and students with accommodator learning styles.
4. Test result $(\mu_2 \text{ vs } \mu_3)$, $|\mu_i - \mu_j| = 11,03 > \text{LSD} = 8,98$ so that there are significant differences between students with converger learning styles and students with assimilator learning styles.
5. Test result $(\mu_2 \text{ vs } \mu_4)$, $|\mu_i - \mu_j| = 14,43 > \text{LSD} = 10,21$ so that means significant differences exist between students with converger learning styles and students with accommodator learning styles.

6. Test result (μ_3 vs μ_4), $|\mu_i - \mu_j| = 3,40 < \text{LSD} = 9,20$ so that there is no significant difference between students with assimilator learning styles and students with accommodator learning styles.

Discussion of the First Hypothesis

Based on the results of the first hypothesis testing, learning that uses the Core learning model based on the Geogebra Applet is better than learning with a direct learning model regarding students' critical thinking ability.

The learning process in the experimental class begins with the connecting step (connecting the material already learned by the student with the material to be studied). In this step, students are directed to relate the material of straight-line equations (gradients of secant lines) and the limits of functions to find the concept of derived definitions of algebraic functions. The process of connecting can involve students' critical thinking abilities. Because in this step students are directed to find the concept of definition of the derivative of an algebraic function using the material that has been studied, namely the material of the straight line equation (gradient of the secant line) and the limit of the algebraic function. In line with Ausubel's theory of meaningful learning (Lestari & Yudhanegara, 2017), meaningful learning is the process of relating new information to relevant concepts in a person's cognitive processes. Sourced from Ausubel's theory, in assisting in instilling new knowledge, it is necessary to have early concepts of students related to the concepts to be studied.

The next step is organizing (dividing students into groups). The students, totalling 36 children, were divided into nine groups in the experimental class. Each group has four students. The formation of groups aims to involve the active role of all students due to the division of tasks for each group. In addition, discussions with one group that takes place during the learning process can help passive students to be able to understand the material. This is because passive students lack the courage to convey questions and express their incomprehension to the teacher in class; they tend to be more comfortable asking and discussing with their group. At the organizing stage, students who have been divided into several groups are directed to discuss in, explore and understand the material during learning.

This is because passive students lack the courage to convey questions and express their incomprehension to the teacher in class; they tend to be more comfortable asking and discussing with their group. At the organizing stage, students who have been divided into several groups are directed to discuss in, explore and understand the material during learning.

The final stage is extending (expanding knowledge). Students are given practice questions and evaluations to expand their knowledge at this stage. The questions given contain the ability to think critically. At the organizing stage, reflecting and extending align with Bruner's learning theory (Lestari & Yudhanegara, 2017). In learning theory, Bruner students are directed to have active involvement by constructing their knowledge by discussing groups, presenting and doing practice questions.

The CORE learning model in this study is also supported by the Geogebra Applet learning media. This medium can help students visually understand abstract mathematical material. In the learning process, the Geogebra Applet can help students find the concept of the derivation of algebraic functions through the

material of gradients of secant lines and limits of algebraic functions. Then the Geogebra Applet also helps to understand the concept of graphics in more detail with a varied and attractive appearance. The Geogebra Applet learning media can be more interactive because students can interact directly with images.

Geogebra Applet-based CORE learning is better than the direct learning model of critical thinking ability. This is because, in the Core learning model based on the Geogebra Applet, students are directed to find new material concepts by relating their understanding to the learning material that has been learned. Then students can actively discuss in groups and present the results of their discussions with other groups. In this final stage of learning, students are directed to expand their knowledge by working on practice questions and evaluations. The questions given contain the ability to think critically. This learning is also supported by the Geogebra Applet learning media which can help students visually understand abstract concepts. Applet Geogebra learning media can increase students' curiosity about learning materials because they are more interactive and varied. Learning with the Core learning model based on the Geogebra Applet is students centred. This means that student involvement in learning is more dominant. This learning is also supported by the Geogebra Applet learning media which can help students visually understand abstract concepts. Applet Geogebra learning media can increase students' curiosity about learning materials because they are more interactive and varied. Learning with the Core learning model based on the Geogebra Applet is students centred. This means that student involvement in learning is more dominant.

Meanwhile, learning in control classes that use the student's direct learning model only obtains material from the teacher. During learning, students listen only to lectures from the teacher. This results in students not being actively involved during learning. Students have difficulty understanding the derived material of algebraic functions because they cannot interact directly with images resulting in weak student curiosity towards learning. At the end of the lesson, the teacher will give students the opportunity to ask questions if there are things that are not yet understood. However, no student dared to ask questions or express his incomprehension to the Master. Then, when given the practice questions, students do it in groups, which means there are still students who do not understand the material and cannot do the practice questions independently.

This result is in line with (Rahman, 2018) under the title "Application of The Connecting, Organizing, Reflecting, Extending (CORE) Learning Model in Mathematics Learning to Improve Mathematical Critical thinking abilities of Class X Science Students at SMA N 1 Sungayang". The result of this study is that the CORE learning model positively affects students' mathematical critical thinking ability.

Discussion of the Second Hypothesis

Based on the results of the second hypothesis test, diverger, converger, assimilator and accommodator learning styles were obtained to have different critical thinking abilities. This is in line with (Nanda, Maharani, & Ubaidah, 2019) research that students with diverger, converger, assimilator and accommodator learning styles have different critical thinking abilities. Then to see a significant difference, it is necessary to conduct a double comparison test between columns using the LSD

(Least Significance Difference) test or the BNT (Smallest Real Difference) test. Based on the results of the double comparison test between columns, which can be seen in Table 7, 6 comparisons of learning styles were obtained as follows.

Comparison of students with diverger learning styles and students with converger learning styles obtained grades $|\mu_i - \mu_j| = 4,51 < \text{LSD} = 9,06$. This means that there is no significant difference between students with diverger learning styles and students with learning styles converging on critical thinking abilities. Students with a diverger learning style have an excellent ability to see situations from different points of view. This learning style can perform better when finding ideas to solve problems. Students with diverging learning styles prefer to study in groups to discuss openly and receive feedback. Meanwhile, students with a converger learning style have the best ability to find practicality using ideas and theories. This learning style can solve problems and make decisions based on solution discovery. Based on the description above, it can be concluded that the critical thinking ability of students with a diverger learning style is as good as a converger learning style. This is because both of them can find ideas to solve problems. Then these two learning styles also like learning that is carried out in groups so that they can discuss openly to find solutions to problems.

Comparison of students with diverger learning styles and students with assimilator learning styles obtained grades $|\mu_i - \mu_j| = 6,52 < \text{LSD} = 7,90$. This means there is no significant difference between students with diverger learning styles and students with assimilator learning styles towards critical thinking abilities. Students with an assimilator learning style can understand various information best. This learning style prefers to think independently or less focused on the crowd. The learning style of assimilators is more interested in abstract concepts. Assimilator learning and diverger learning styles have similarities in terms of seeing situations and processing information from different points of view. Both are very fond of examining a problem and then putting it into a logical form. Thus it can be concluded that the critical thinking ability of students with diverger learning styles is as good as students with assimilator learning styles.

Furthermore, comparing students with diverger learning styles and accommodator learning styles obtained scores $|\mu_i - \mu_j| = 9,92 > \text{LSD} = 9,27$. This means that there are significant differences between students with diverger learning styles and students with accommodator learning styles to critical thinking abilities. Students with accommodator learning styles can learn from direct experience. This tendency of learning styles acts on feelings of kindness, not logical analysis. Accommodator's learning style relies heavily on people to solve problems rather than self-analysis. In contrast to the diverger learning style, which can find ideas to solve problems and see concrete situations of problems. Based on the preceding, it can be concluded that the diverger learning style has a better critical thinking ability than students with an accommodator learning style. This is because the accommodator's learning style is lazier if the emotional condition is not good and still depends on others.

Then the comparison of students with converger learning styles and assimilator learning styles obtained scores $|\mu_i - \mu_j| = 11,03 > \text{LSD} = 8,98$. This means that there is a significant difference between students with converger learning styles and students with assimilator learning styles towards critical thinking abilities. The

difference lies in how to process information and solve a problem. The converger learning style can find practicality in using ideas and theories. This learning style can process information into concrete forms, and there is an element of practicality in solving a problem. Meanwhile, the learning style of assimilators can process various information into a form that is still abstract. This learning style is still not meticulous in terms of solving a problem because too much is observed and is still abstract. Thus it can be concluded that the critical thinking ability of students with converger learning styles is better than students with assimilator learning styles.

Following Comparison of students with converger learning style and accommodator learning style obtained value $|\mu_i - \mu_j| = 14,43 < LSD = 10,21$. This means that there are significant differences between students with converger learning styles and students with accommodator learning styles to critical thinking abilities. The difference between students with converger learning styles and accommodator learning styles is that converger learning styles are superior in finding practical ideas to solve problems. Meanwhile, the accommodator's learning style still depends on others to find ideas for solving problems. Accommodation's learning style is also lazier when the atmosphere is not good enough. Based on the description above, it can be concluded that the critical thinking ability of students with a converger learning style is better than students with an accommodator learning style.

Comparison of students with assimilator learning style and students with accommodator learning style obtained value $|\mu_i - \mu_j| = 3,40 < LSD = 9,20$. This means there is nothing significant between students with assimilator learning styles and students with accommodator learning styles towards critical thinking abilities. These two learning styles have something in common: it is still not suitable for determining ideas in solving a problem. Thus, it can be concluded that the critical thinking ability of students with an assimilator learning style is as good as that of students with an accommodator learning style. This is in line with the theory teaching Piaget (Lestari & Yudhanegara, 2017) that the development of individuals in receiving and processing different information results in different critical thinking abilities that they have are also different.

Discussion of the Third Hypothesis

Based on the results of the third hypothesis, there was no interaction between the learning model and the student's learning style on the ability to think critically. The absence of this interaction means that students with diverger, converger, assimilator and accommodator learning styles who obtain learning with the Geogebra Applet-based CORE learning model have better critical thinking abilities than students with diverger, converger, assimilator and accommodator styles who obtain learning with a direct learning model. This is not in line with the third research hypothesis, so the third research hypothesis has not been fulfilled.

There is no interaction between the learning model and student learning styles because the Core learning model based on the Geogebra Applet has fulfilled all four student learning styles. The Core learning model based on the Geogebra Applet involves students in critical thinking abilities, which include connecting (linking), organizing (in groups), reviewing (presenting) and expanding knowledge (doing practice questions and evaluations). In addition, the CORE learning model is also

supported by the Geogebra Applet learning media which can help students visually find abstract mathematical concepts.

Then in the Core learning model based on the Geogebra Applet, students with a diverger learning style can use their skills in seeing problem situations concretely because this learning uses GeoGebra learning media that helps students find abstract concepts to be visually concrete, Students whose learning style is converger can apply their ability to find the practicality of using ideas and theories because this learning involves the ability to think critically to find solutions to problems; students whose learning styles are assimilators can use their skills in processing information abstractly to find ideas because this learning uses connecting steps (connecting new knowledge with the knowledge that students already have) and students whose learning style accommodators can use their expertise in learning with direct experience because this learning is assisted by the Learning Media Applet Geogebra which can be used with direct actions and interactions (Kolb & Kolb, 2005).

Meanwhile, these four learning styles feel limited in learning with a direct learning model because they are only teacher-centred. Students feel bored and saturated during learning which results in weak student curiosity. In the direct learning model, students are allowed to ask questions, trying to practice questions. However, it has not been able to encourage students in critical thinking abilities because, in reality, students are just silent and do not ask questions. In this condition, the teacher will not necessarily be able to recognize whether the student understands the material or not. This has resulted in these four learning styles' critical thinking ability developing less well. Thus, whatever learning style students have (diverge, converger, assimilator and accommodator) who obtain learning with the Core learning model based on the Geogebra Applet have better critical thinking abilities than students who obtain learning with a direct learning model.

CONCLUSION

Based on the results and discussion above, it can be concluded that 1) students who obtain learning with the Geogebra Applet-based CORE learning model have better critical thinking abilities than students who obtain learning with a direct learning model; 2) students with a diverger learning style have the same good critical thinking ability as students with converger learning styles, students with diverger learning styles have critical thinking abilities that are as good as assimilator learning styles, and students with diverger learning styles have better critical thinking abilities than students with accommodator learning styles, students with converger learning styles have better abilities than students with learning styles assimilators and accommodators and students with assimilator learning styles have the same good critical thinking ability as students with accommodator learning styles; 3) there is no interaction between the learning model and the student's learning style on critical thinking ability, namely students with diverger, converger, assimilator and accomodator learning styles who obtain learning with the Geogebra Applet-based CORE learning model have better critical thinking abilities than students with diverger, converger, assimilator and accomodator learning styles who obtain learning with a direct learning model. The results of this study can be used as a

reference for teachers in using learning models and adjusting to student learning styles.

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