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Research Article

Exploration of computational thinking ability in limit concept of algebraic function with interactive multimedia

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ABSTRACT

The difficulty of students in solving computational thinking (CT) problems related to the limit material of algebraic functions is that students do not understand the existing problems, difficulties regarding how the problem-solving pattern, difficulties when asked how to solve the problem, and difficulties when deciding and concluding from the problem. To overcome these difficulties, interactive multimedia is used, which is very important in modern education, it allows students to learn in a more interesting and interactive way, which can strengthen students' computational thinking skills. The purpose of this study was to determine the Exploration of Computational Thinking ability in the concept of Limit algebraic function with interactive multimedia and to determine the student's response to the use of interactive multimedia on the computational thinking ability of students in the material limit algebraic function in the department of Tadris Mathematics IAIN Lhokseumawe. The method used in this research is pre-experimental method, with the research design used is One Group Pretest-Posttest (Initial Test-Final Test on a single group. The study subjects were 1st semester students majoring in Tadris Methematics IAIN Lhokseumawe academic year 2023/2024. The research results obtained 1) From the calculation of the t test obtained the results of Tcount amounting to 2.583 and T_{table} 1.684 ($T_{test} > T_{table}$) or the probability value Sig 2 tailed < α (0.000 < 0.05), then the hypothesis decision can be stated Ho rejected and Ha accepted. Thus, there is a significant difference in the exploration of computational thinking ability in the concept of limit function algebra with interactive multimedia. 2) the average percentage of very good categories obtained a value of 86%, good 13%, less 1%. The difference from the results of student responses with good to very good criteria is influenced by attitudes that show enthusiastic positive responses to interactive multimedia.

Keywords: Computational thinking; Limits of algebraic; Interactive multimedia; Teaching algebra

1. INTRODUCTION

The development of technology today cannot be doubted because every day it experiences a very rapid increase. This is because with the development of technology, humans will find it easier to do their work (Ngafifi, 2014) (Inge Kurnia Mardia, Lestyaningrum, AnitaTrisiana, Destyn Ayu Safitri, Supriyanti, Alfian Yuda Pratama, 2022). This technological development also has a significant impact on the world of education because, with sthe help of technology in the field of education, teachers will be easier to perform their duties more easily. The development of information and communication technology has changed the way we access, process and understand information. Increased Use of Technology in Learning in today's digital era, where the use of technology in learning is becoming increasingly important (Muh. Rizaldi Pratama, 2023).

Interactive multimedia is one form of this technology that can be used in mathematics education to enrich students' learning experience (Lilis Diah Kusumawati, Sugito, 2021). Mathematics is an important subject in education and has a significant role in the development of computational thinking. Computational thinking skills are becoming increasingly important in an increasingly connected and digitalized world (Christi & Rajiman, 2023). For this reason, information technology is needed for students to better understand the material to be learned. The use of interactive multimedia is important in modern education, it allows students to learn in a more interesting and interactive way, which can strengthen the understanding of mathematical concepts (Dian Novitasari, 2016).

An active learning approach where students are expected to be directly involved in the exploration and understanding of mathematical concepts, as well as the development of their computational thinking skills. They need to teach skills

relevant to the digital era, including strong mathematical understanding and computational thinking skills. In higher education, algebraic function limit material is one of the materials that play an important role as the basis for the development of several calculus concepts that will be studied in semester 1 in the differential calculus course. The concepts in calculus begin with the real number system, then proceed to the limit material, which will be useful in derivative and integral material. Limit material is also applied to economics, physics, biology and other courses. In economics courses, such as to help calculate marginal revenue functions, determine population comparisons and so on. While in physics courses such as determining the physical quantities of motion with speed and acceleration. So understanding the limit function material will certainly be very helpful for students in understanding other materials not only in their mathematics courses but in other subjects. According to Rahman (Alfiannor, 2016), the concept of limit function is an abstract concept and only provides the symbol $\mathrm{Lim}x\rightarrow c\ f(x) = L$, so it cannot be seen directly how the actual form and purpose of the concept of limit function. Based on the research result (Mahuda, 2022) the difficulties faced by students in solving inequality, function and limit function problems occur because: 1) students do not memorize the properties of inequalities; 2) students forget about the rules of absolute values; 3) students are less skilled in performing basic arithmetic operations; 4) students forget about the concept of the natural domain of a simple function; 5) students do not understand the concept of limit of indeterminate forms; 6) students are not skilled in performing fraction calculation operations; 7) students are not skilled in the process of factoring polynomials; 8) students are less careful/thorough in answering questions, The same thing was also stated by (Deby Erdriani, 2019). which causes students to be less able to follow calculus courses, especially in inequality material and limit functions, namely: 1) students' inability to perform mixed fraction operations, 2) students' inability to use theorems in inequality cases in absolute value 3) students' inability to find factorization in many terms, 4) students' inability to perform limit function operations in polynomial ruptures. The same thing was conveyed by (Retnowati, 2019) found that there are two types of errors: (1) procedural errors, including: errors in not writing Lim correctly when running limits, errors in substituting values into variables, errors in not simplifying the final result, or no effort: (2) conceptual errors, including: errors in solving fractions, errors in factoring, errors in rationalization.

Based on the results of some of the above explanations, it can be concluded that difficulties in Limit material are lack of skill in performing basic arithmetic operations, lack of understanding of the concept of limit of indeterminate form, unskilled in performing fraction calculation operations, unskilled in the factoring process, lack of care/thoroughness in answering questions, lack of ability to find factorization in many terms, lack of ability to perform limit function operations in polynomial ruptures. Procedural errors, namely errors in not writing the limit correctly when running limits, errors in substituting values into variables, errors in not simplifying the final result, or no effort, and conceptual errors, namely errors in solving fractions, errors in factoring, errors in rationalization. Based on the above explanation, that students and college students still have difficulty in solving the limit of algebraic functions .

Computational thinking is a concept and approach in problem-solving that is relevant in the digital world which is a ministry program where students are expected to have computational thinking skills, for that before we plant computational thinking skills in students, it is necessary to train students as future teachers to be able to create problems and solve computational thinking problems. Computational thinking skills are needed by humans in facing the industrial era 4.0 (Cakir, 2019). According to (Glaucio Messias, 2018), the abilities needed to live in the industrial era 4.0 are found in 21st century learning, such as leadership, cooperation, creativity, digital literacy, effective communication, emotional intelligence, entrepreneurship, global citizen, problem-solving, and teamwork. According to (McCauley, 2016) Computational thinking has been recognized by a number of computer science experts and education authorities as 21st century literacy. (Buckley, 2012) computational thinking is a new method of problem-solving using computer science techniques. Furthermore, Wing added that computational thinking is a fundamental ability needed for all humans. Computational thinking is also needed to improve children's analytical, reading, counting, and writing skills. The domain of computer skills and abilities applied to understand the content of mathematical fields is referred to as computational thinking in mathematics. (Barcelos, 2013) Computational thinking in mathematics is needed as a way to solve problems in everyday life. This ability needs to be owned and developed by students at school through the mathematics learning curriculum to improve the ability to systemize problems and their solutions. According to Yahya, there are four cores of computational thinking skills, namely (Tabesh, 2017): (1) Decomposition, analyzing a problem to break it down into smaller parts. (2) Pattern Recognition, observing patterns, trends, and regularities in data. (3) Abstraction, identifying the underlying principles that generate patterns. (4) Algorithm, developing step-by-step instructions to solve the problem.

The results of observations and interviews with IAIN Lhokseumawe students found that students have difficulty in solving computational thinking (CT) ability questions related to limit material of algebraic functions. Students have difficulty when expressing what information is in the given problem, this is because students do not understand the existing problems, students also have difficulty regarding how the pattern of solving the problem, students also have

difficulty when asked how to solve the problem, and students also have difficulty when deciding and concluding from the problem.

The goal of improving computational thinking. Awareness of the importance of improving computational thinking skills, namely the ability to solve problems with logical thinking and use computational tools. This ability is becoming relevant in an increasingly digitized world. The material of the concept of limit of algebraic functions in mathematics is a topic that often requires critical thinking and computational approaches in its understanding, through understanding this concept, students can understand the basics of calculus. For this reason, the importance of measuring Computational Thinking: The ability of computational thinking is very important in today's digital era. Students need to be able to identify, analyze, and solve problems using a computational thinking approach. The development of digital learning modules with a focus on computational thinking can help students develop these skills. It is important to remember that computational thinking skills can be developed through practice, experience, and continuous learning. Based on the explanation that the researcher has conveyed above, the purpose of this study is to determine the Exploration of Computational Thinking ability in the concept of Limit algebraic function with interactive multimedia and to find out the student's response to the use of interactive multimedia on the computational thinking ability of students in the limit material of algebraic functions in the department of Tadris Mathematics IAIN Lhokseumawe.

2. RESEARCH METHOD

The method used in this research is the pre-experimental method, which is a method for obtaining accurate data from the data to be studied, namely by conducting direct experiments on the object under study (Sugiyono, 2015). This study was only conducted using an experimental class without a control class. The research design used is One Group Pretest-Posttest (Initial Test-Final Test on a single group), where the sample group is given treatment (independent variable) but the sample's initial ability is known in advance through an initial test, after the treatment is given, the results of the study are observed by giving a final test. The research subject is a source that provides information about data or things needed by researchers on the research being conducted. In this study, the research subjects were 1st semester students majoring in Tadris Mathematics IAIN Lhokseumawe academic year 2023/2024 using 1 class, namely the experimental class, the class was homogeneous in the sense that the students had never received the learning provided by the lecturer. Validity and Reliability Test of Instruments This research was conducted using instruments that have not been standardized, so it is necessary to test the instruments to avoid incorrect data results. Before the research instrument is used to obtain data, the instrument needs to be tested using expert validation, item validity test, item difficulty test, differentiation test, and reliability test.

Data Collection Techniques are procedures in research that are very important to collect data correctly and precisely. The use of appropriate data collection techniques will obtain objective data. Data collection techniques in this study were carried out using the following techniques: 1) Tests to measure the presence or absence of computational thinking skills by using interactive multimedia. The form of the test that will be given to students is an essay totaling 2 items that will be done twice, the test is in the form of: The initial test (pre-test) and the final test (post- test). 2) Interview to find the problem to be studied. In this study, the authors conducted initial interviews during observations to obtain clear and accurate information, which came from students. 3) Questionnaires data collection techniques used to measure understanding of the material on students' computational thinking skills by using interactive multimedia. Student response questionnaires to the use of interactive multimedia are carried out using a Likert scale. The results of the questionnaire can be in the form of student attitudes that support (positive statements) or reject (negative statements). Data Analysis Techniques Research needs to be measured using an appropriate method and instrument in order to obtain relevant data. The use of appropriate data collection techniques can obtain objective data. The data that has been obtained comes from the cognitive value of students' computational thinking ability in the form of initial ability test scores and students' final ability on the limit material of algebraic functions, which is analyzed using inferential statistics, namely the t-test. The t-test can be done using the help of SPSS 25 for windows software. The following stages must be done for data analysis include: normality test, homogeneous test, hypothesis testing, N-Gain test. Following this, the N-Gain formula used is:

$$\text{N-Gain} = \frac{\text{Posttest Score} - \text{pretest score}}{\text{Maximum Score} - \text{pretest score}}$$

Table 1. N-Gain Value Criteria

N-Gain Value	Criteria
N-Gain ≥ 0,70	High
0,30 ≤ N-Gain < 0,70	Medium
N-Gain ≤ 0,30	Low

3. RESULTS AND DISCUSSION

Results

This research was conducted at the Tadris Mathematics IAIN Lhokseumawe on September 19-26, 2023. The type of approach in this research is a quantitative approach, which means that data processing is carried out using statistical analysis by taking purposive sampling techniques. Based on the results of the normality test using SPSS 25 for windows, obtained 0.322 from the calculation of the normality test is normally distributed. This can be proven by the results of the significance value or Sig (2-tailed) > 0.05. So at the value of the output it can be concluded that the data used is declared normally distributed. Based on the calculation of the homogeneity test using SPSS 25 for windows is 0.706 The sample criteria can be said to be homogeneous if the significance level is > 0.05. So that the results obtained are 0.706 > 0.05, it can be concluded that the samples used in this study are homogeneous. After the data is carried out a prerequisite test which shows the results are normally distributed and homogeneous, then the t test or hypothesis test is next. From the results of the calculation of SPSS 25, the T_{test} value is 2.583 and T_{table} 1.684 ($T_{test} > T_{table}$) and sig. (2-tailed) of 0.000. In the hypothesis testing criteria, if sig (2-tailed) < 0.05 or 0.000 < 0.05, the hypothesis result Ho is rejected and Ha is accepted. So, it can be concluded that the results of the t-test analysis show a significant difference in the value of the results of students' computational thinking abilities before and after using interactive multimedia.

N-Gain is the difference in student ability to the results of computational thinking ability. The calculation of the value is obtained from the ability of computational thinking material that has been understood by students after the learning process, seen from the pretest and posttest scores on essay questions. Based on the acquisition of these data will be sought to what extent the improvement of computational thinking ability with the N-Gain formula. The following data are presented the results of the N-gain test analysis, which can be seen in **Table 2**.

Table 2. N-Gain Test Analysis Results

Criteria	N-Gain	Pretest	Posttest
High	0,84	30	88,75

The student response questionnaire was given after working on the posttest questions filled in by 15 1st semester students. The questionnaire is used to measure student responses or responses to learning by using interactive multimedia on the limit material of algebraic functions. The data obtained from the student response questionnaire will be analyzed by calculating the percentage of questions answered positively or negatively by students. The following presents the percentage results of student responses to the use of interactive multimedia, which can be seen in **Figure 1**.

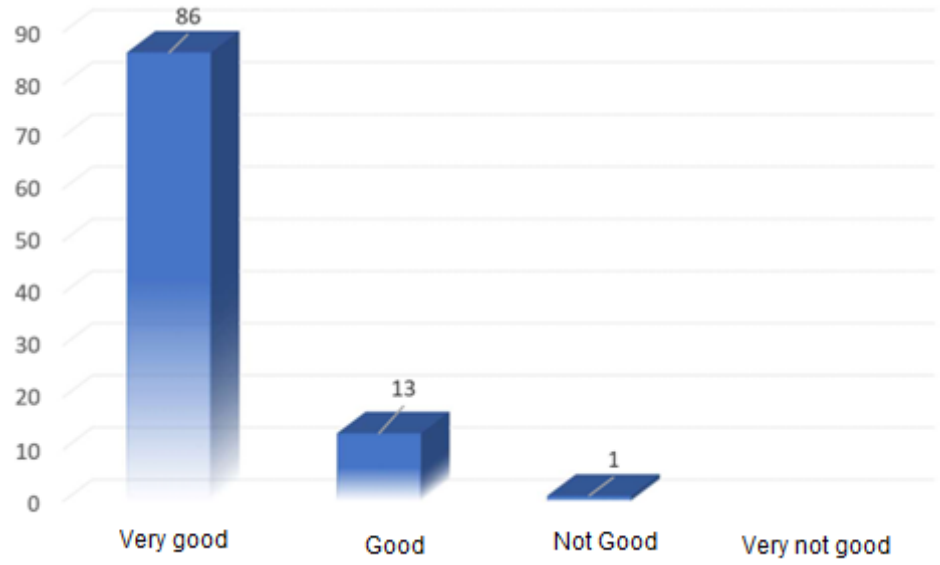

Figure 1. Percentage data of student response

Based on **Figure 1**, it is known that the total percentage of student responses produces a value, namely those who answered very well was 86%, those who answered well was 13%, those who answered less was 1%. From the percentage results, it can be concluded that the student response to learning by using interactive multimedia has a very good category, namely with a value of 86%. This shows that students are very interested in learning to use interactive multimedia.

Discussion

Exploration of Computational Thinking ability in the concept of Limit algebraic functions with interactive multimedia in the department of tadris Mathematics IAIN Lhokseumawe. Based on previous research by (Retnowati, 2019), it was found that there were two types of errors: (1) procedural errors, including: errors in not writing Lim correctly when running limits, errors in substituting values into variables, errors in not simplifying the final result, or no effort: (2) conceptual errors, including: errors in solving fractions, errors in factoring, errors in rationalization. For this reason, the author is interested in learning by utilizing interactive multimedia in which there is a fairly detailed and clear explanation of the material with an attractive design to make students not feel bored and more focused during learning.

Starting from the validation stage carried out by expert validators which aims to evaluate both the material, questions and interactive multimedia that will be given to students. Validation is very important because the author can find out the quality in terms of material and learning multimedia so that it can be used in research. At the validation stage there are expert validators who will evaluate the validation sheet including material experts and media experts. Material expert validation was carried out using a Likert scale and obtained an average percentage value of 84.6% with decent criteria. Then media expert validation is carried out to evaluate learning videos which get an average percentage value of 86.3% with very feasible criteria. From the assessment of the material and media expert validators, the value is obtained with decent to very decent criteria. The assessment is based on rational thinking by the validators. In addition, the validators also evaluated the validation sheet based on several aspects, including material, construction, completeness, appearance, operation, and presentation aspects. The question items that have gone through the validation stage from the validator will then be analyzed using statistical formulas. Essay-shaped question data which will later be used as student evaluation material, namely pretest and posttest. From the validity test, it was found that in three essay questions that were declared valid there were only two items, while there was one invalid item. Of the two items taken to be used as pretest and posttest questions. Furthermore, the prerequisite tests of normality test and homogeneity test were carried out. This normality test using the One-Sample Kolmogorov-Smirnov formula obtained a result of 0.322. These results are greater than the 0.05 significance level, meaning that the data used is normally distributed. Then proceed to the homogeneity test, which is carried out using the One Way Anova formula. The value obtained is 0.706 with a significance level greater than 0.05. From this value, it indicates that the data groups originating from the population have the same variance, in other words, they are not much different in diversity. Based on the prerequisite tests that have been carried out, it is stated that the data is normally distributed. The data obtained from the analysis of the students' final tests were then tested using the t test. From the calculation of the t test, the results of Ttest were 2.583 and T_{table} 1.684 (Ttest > T_{table}) or the probability value of Sig 2 tailed < α (0.000 < 0.05), then the hypothesis decision can be stated Ho is rejected and Ha is accepted. Thus, there is a significant difference in the ability of computational thinking of students in the department of tadris mathematics on the material Limit Algebraic functions carried out by applying interactive multimedia. Meanwhile, other results are also shown in the N-gain value, namely the difference in student pretest-posttest scores before and after being given interactive multimedia. From the calculation results obtained, pretest results obtained before interactive multimedia is given is an average of 30 with the lowest value of the pretest is 19 while the highest value is 41. In contrast to the posttest value done after students are given interactive multimedia, the results obtained with significant changes are an average of 88.75 with the lowest value of the posttest is 75 and the highest value is 94. The difference in the results of the pretest and posttest scores was influenced by the interactive multimedia provided because the interactive multimedia not only contains written material but there is an animation that explains the limit of algebraic functions. It can be proven that when students are given pretest questions, most of them are more likely to be indifferent and lazy to do the questions because there is no explanation of the material, then after interactive multimedia is given there is a change in posttest scores due to the enthusiasm of students who are very concerned about interactive multimedia when it is displayed. Interactive multimedia can reflect the absorption of information more effectively through the senses of sight and hearing, to increase knowledge in the material compared to using only the sense of sight. The use of interactive multimedia is very important in the learning process because it involves the five senses more than teaching aids. Through interactive multimedia viewing, students use more of the sense of vision about 77%, the sense of hearing 18%, and other senses about 5% during the learning process. The delivery of material outlined in interactive multimedia presentations is able to make students' brains think faster in capturing learning material so that it greatly affects the results of student pretests and posttests. This is in accordance with the results of research that has been conducted that when students begin to watch interactive multimedia there is a change in attitude shown by students. The enthusiastic attitude towards interactive multimedia makes students earnest in understanding the material and focus faster so that when given posttest questions, students can answer questions easily and get high scores. It is different when students are immediately given pretest questions without being based on introductory material, making students feel confused about the questions, resulting in low pretest scores. It can be seen that most students prefer interesting and fun learning rather than just reading and doing questions. In addition to

affecting the value of students' computational thinking ability, interactive multimedia can help and train the brain intelligence of Verbal (linguistic), Visual (spatial), and Music (rhythmic).

Student responses to the use of interactive multimedia on computational thinking skills on limit material of algebraic functions in the Department of Mathematics, IAIN Lhokseumawe. The use of interactive multimedia is one solution to make students easier to understand the material during learning. When viewed based on the results of the response of students majoring in tadris mathematics to the use of interactive multimedia conducted through distributing questionnaires with 20 statement items, it is known that most students respond positively and are more interested in the video. Through the response sheet filled out by students by showing the average percentage of very good categories obtained a value of 86%, good 13%, less 1%. The difference from the results of student responses with good to very good criteria is influenced by attitudes that show enthusiastic positive responses to interactive multimedia. Most of them prefer learning that is fun and not boring, thus making students understand the material more quickly. Although based on the value of the distribution of student response questionnaires there are differences, the use of interactive multimedia is very useful as a means of delivering material in the learning process and can make students have broad insights, can think creatively, be able to imagine from what they see in interactive multimedia. The implementation of learning by using interactive multimedia has a positive effect on students' computational thinking ability at the end of learning. This is in line with previous research on the effect of interactive multimedia on learning that can be utilized as a tool for students in understanding learning materials.

4. CONCLUSION

Based on the results of data description and analysis in this study, the following conclusions are presented: 1) The data obtained from the analysis of the final test of students then tested using the t test. From the calculation of the t test obtained the results of T of 2.583 and T_{table} 1.684 ($T_{test} > T_{table}$) or the probability value of Sig 2 tailed < α (0.000 < 0.05), then the hypothesis decision can be stated Ho is rejected and Ha is accepted. Thus, there is a significant difference in the exploration of computational thinking ability in the concept of limit function algebra with interactive multimedia. 2) From the calculation results obtained pretest results obtained before the interactive multimedia is given is an average of 30 with the lowest value of the pretest is 19 while the highest value is 41. In contrast to the posttest value done after students are given interactive multimedia, the results obtained with significant changes are an average of 88.75 with the lowest value of the posttest is 75 and the highest value is 94. The difference in the results of the pretest and posttest scores was influenced by the interactive multimedia provided because the interactive multimedia not only contains written material but there is an animation that explains the limit of algebraic functions. 3) Through interactive multimedia viewing, students use more of the sense of vision around 77%, the sense of hearing 18%, and other senses around 5% during the learning process. 4) Through the response sheet filled out by students by showing the average percentage of very good categories obtained a value of 86%, good 13%, less 1%. The difference from the results of student responses with good to very good criteria is influenced by attitudes that show enthusiastic positive responses to interactive multimedia. Based on the above conclusions, it is obtained that the use of interactive multimedia is very useful as a means of delivering material in the learning process and can make students have broad insights, can think creatively, can imagine what they see in interactive multimedia. The implementation of learning by using interactive multimedia has a positive effect on students' computational thinking ability at the end of learning. This is in line with previous research on the effect of interactive multimedia on learning that can be utilized as a tool for students in understanding learning materials.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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