Integration of STEAM in Solving Numerical Method Problems

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Abstract: *The learning model prepared for the 21st century is STEAM. In particular, the numerical method topic of the bisection method is taught using the STEAM learning model with the help of MS Excel. The problem in this study is whether the STEAM learning model can help students solve bisection method problems. The aim of this study is to determine whether the STEAM learning model can assist students in solving bisection method problems. This is a quantitative study with a population of all students taking the numerical methods course. The sample consists of semester 6 students from classes A and B, and the sampling technique used is saturated sampling. The prerequisite tests conducted are normality and homogeneity tests. The analysis technique used is the t-test, with the results showing t_calculated = 2.107 and t_table = 2.074. The null hypothesis (H0) is rejected, indicating that STEAM and conventional learning models have different effects. Furthermore, based on the average scores of both classes, the STEAM learning model has a more significant effect than the conventional method. In conclusion, the STEAM learning model with the help of MS Excel can assist students in solving numerical method problems.*

Key Words*: STEAM, Numeric Methods, Learning Model*

Introduction

Education is one of the main factors in advancing the nation of Indonesia. Education in Indonesia is required to incorporate technology in the learning process, in line with the rapid technological developments today. According to Barkah (2024), the Ministry of Education and Culture has launched the "21st Century Skills Education" program, which is intended to be implemented in the 21st century. Students need to possess skills required in the 21st century, namely the 4C skills (critical thinking, creative thinking, collaboration, and communication); ICT (Information and Communication Technology literacy, media and information literacy); spiritual values (religious beliefs and spiritual awareness); and character development (teacher attitudes and scientific attitudes).

Learning takes place from early childhood education to higher education. The teaching models applied to students vary depending on the level and the subject matter. One example is the learning model used for students in the Mathematics Education Program at IKIP PGRI Bojonegoro, where students still face difficulties in solving problems, particularly in the numerical methods course. They tend to solve problems manually or use calculators, and often are unsure whether they have completed the problem or need further work, leading to difficulties in understanding numerical method problems and obtaining low grades. This is consistent with the research of Trisnowali & Arifin (2023), which states that students often receive low grades, particularly in the Integral Calculus course.

Based on the above explanation, the learning model that aligns with 21st-century skills and can assist students in solving numerical method problems is the STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning model. Emilidha (2024) states that STEAM is a learning model that emphasizes the integration of knowledge and skills in science, technology, engineering, arts, and mathematics (STEAM) in problem-solving. The application of STEAM requires students to identify problems, generate ideas, collaborate to solve problems, communicate effectively, and provide feedback on the same ideas. According to Wandraini (2022), STEAM-based learning can help develop students' soft skills. Moreover, STEAM is used as an alternative framework for secondary knowledge and 21st-century skills (Motimona & Maryatun, 2023).

The steps in the implementation of STEAM according to Trisnowali & Arifin (2023) include:

1. Observation

    Students observe their surroundings in relation to the scientific concepts being taught.

2. New Idea

    After observing, students gather information about the scientific concepts discussed, and then generate new ideas based on the information they have obtained. In this stage, analysis and critical thinking are essential skills that students must possess.

3. Innovation

    Students are able to describe the new ideas, including the steps that should be taken to implement them.

4. Creativity

    Students are capable of accepting suggestions and opinions from others to apply to the new ideas they have generated.

5. Value

    The new ideas proposed by students can be evaluated by others.

The implementation of STEAM can have a positive impact on the learning process. The advantages of STEAM include:

1. Students' scientific knowledge shows positive results.
2. Active, creative, and innovative thinking in problem-solving is provided to students.
3. Students' ideas can be applied using the latest technology.
4. The application of learning outcomes is enhanced.

The integration of STEAM in the numerical methods course is achieved by utilizing MS Excel to solve numerical method problems, particularly the bisection method. MS Excel helps students simplify the calculations involved in solving bisection method problems.

The research problem is whether the STEAM learning model can assist students in solving bisection method problems. This study aims to determine whether the STEAM learning model can help students in solving bisection method problems.

Method

This study is a quantitative research with a population of all students enrolled in the numerical methods course. The sample consists of two classes, with a saturated sampling technique. The data collection methods used are observation, tests, and documentation. The prerequisite tests conducted include normality and homogeneity tests. Data analysis is performed using the t-test with the assistance of SPSS.

Results and Discussion

The numerical methods course is taught in the 6th semester of the Mathematics Education Program at IKIP PGRI Bojonegoro. One of the topics taught in this course is the bisection method. Based on observations, some students face difficulties in understanding problems related to the bisection method. They still perform calculations manually with the help of a calculator and are unsure whether the solution has been completed or if it needs to continue further. Based on these observations, the researcher implemented STEAM learning using MS Excel to solve the bisection method problems.

Students were taught how to formulate formulas in MS Excel to obtain accurate calculations in solving the problems. However, some students still struggled with formulating the formulas in Excel, so they worked in groups to solve the bisection method problems. Additionally, students who had difficulty formulating the formulas used Google to find ways to create the formulas, such as using the formula for ex in MS Excel as EXP(x).

After the STEAM-based learning using MS Excel, the researcher wanted to assess the results of applying STEAM with the assistance of MS Excel in teaching the bisection method. The researcher administered a test with fill-in-the-blank questions, which had been pre-tested. The results of the normality test are as follows:

Table 1. Summary of Normality Test Results

Group	L_{obs}	L_{table}	Test Decisions
STEAM	0,122	0,180	H_0 accepted
Conventional	0,102	0,180	H_0 accepted

The results of the homogeneity test show that $\chi^2_{obs} = 3,91$. The critical region for this test is $DK = \{\chi^2 > \chi^2_{0,05;1} = 5,991\}$. This means that H_0 is accepted. The results of the t-test with a significance level of $\alpha = 0,05$ show that $t_{calculate} = 2,107$ while $t_{table} = 2,074$, The decision to reject h_0, means that STEAM and conventional learning methods have different effects. Furthermore, based on the average scores of both classes, the STEAM learning model has a greater impact than the conventional method. These results are consistent with the study by Nasrah (2021), which concluded that the STEAM model in science education is effective.

STEAM learning using MS Excel has been effectively implemented, as follows:
1. Students review the problems given by comparing them with the example problems provided by the researcher. They discuss the problems with their group and refer to the notes given by the researcher.

2. Students also search for additional information on the internet regarding the formulas that need to be formulated in MS Excel.
3. They formulate the formulas in MS Excel and calculate the solution until it stops.
4. Finally, they observe the results from MS Excel and check the calculations to determine the final result.

Based on the results of the normality test, both classes have a normal distribution. In addition, both classes are homogeneous. The results of the t-test show that the class taught using STEAM with the help of MS Excel to solve numerical method problems had better scores than the class taught using the conventional method.

The learning process with STEAM provides an opportunity for students to express their ideas. Additionally, numerical learning becomes more enjoyable. This aligns with Buinicontro in Trisnowali & Arifin (2023), who state that STEAM gives students the opportunity for skill development and problem-solving.

Conclusion

Based on the analysis results, it can be concluded that the STEAM learning model with the help of MS Excel can assist students in solving numerical method problems. This is evident from the average scores in the STEAM class being higher than those in the conventional class.

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