



The Effect of AI-Based Adaptive Learning Approach, Learning Satisfaction on Learning Outcomes of ISE Class X SMAN Ngoro

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Keywords

AI, Learning outcomes, ISE, Learning satisfaction, Adaptive learning.

Abstrak

This research is motivated by the low learning outcomes of ISE subjects in class X of SMAN Ngoro and the demand for the use of artificial intelligence-based learning technology in improving the quality of learning processes and outcomes. The purpose of this study is to analyze the influence of AI-based adaptive learning approach and learning satisfaction on student learning outcomes in ISE class X subjects of SMAN Ngoro. This study uses a quantitative approach with an ex post facto design, the population of all students of class X and a sample taken with the techniques described in the proposal, using questionnaires and grade documentation as data collection instruments. Data was analyzed using inferential statistical techniques according to a procedure that has been designed to test the hypothesis of the influence of each independent variable and its simultaneous influence on learning outcomes. The expected results show that AI-based adaptive learning and learning satisfaction have a positive and significant effect on learning outcomes, so that it can be the basis for the development of economic learning innovations in high school.

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Introduction

Education in the digital age increasingly demands learning methods that are able to adapt to the individual needs of students, especially when artificial intelligence (AI) technology provides opportunities for personalization and real feedback-time in the learning process. (Respati, 2024) states that the integration of AI in teaching allows for more responsive material

adjustments to students' learning styles and pace, thus potentially improving engagement and learning outcomes. On the other hand, learning satisfaction remains an important factor that affects motivation and academic achievement; Previous research has shown a positive correlation between student satisfaction levels and their academic achievement ([Haholongan et al., 2025](#))

In the context of education, learning outcomes are not only understood as final grades, but as evidence of changes in knowledge, skills, and attitudes after students have followed the learning process for a certain period of time. ([Munawaroh et al., 2022](#)) explained that the achievement of learning outcomes is greatly influenced by learning designs that are able to foster interest and motivation. The results of the study confirm that when technology-based learning models are able to activate involvement, curiosity, and learning independence, learning achievement increases significantly. In this study, the learning outcomes of ISE are understood in a similar framework, namely as academic achievements born from the AI-based adaptive learning process which is expected to optimize the cognitive, affective, and psychomotor domains of students.

Although the literature shows the benefits of AI and learning satisfaction separately, the application of AI-based adaptive learning has not been widely studied along with learning satisfaction variables in the context of Socio-Economic Sciences (ISE) subjects. Several previous studies have reported positive results of using AI on learning achievement, but are limited to a single variable or to different levels of access to technology-Different; For example, ([Wondal et al., 2025](#)) found a positive influence of AI on learning outcomes but the research sample was limited to one school, whereas ([Sappaile & Judijanto, 2024](#)) emphasizing academic improvement related to the frequency of use of adaptive tools without exploring the role of learning satisfaction in explaining variation in outcomes. Lack of research-The research included limited generalizations (sample of one school or level), lack of simultaneous analysis between adaptive learning and satisfaction, and lack of attention to cognitive, affective, and psychomotor domain indicators in the evaluation of learning outcomes.

This study fills this gap by simultaneously examining the influence of AI-based adaptive learning approaches and learning satisfaction on the learning achievement of ISE subjects in class X students. However, the limitations that may arise are the variation in technology access between participants and the need for teacher training to implement adaptive systems, which will be discussed in the methods section and the limitations of the research.

Considering these theoretical and practical gaps, this study is important to provide empirical evidence on the extent to which AI-based adaptive learning and learning satisfaction contribute to improved achievement in ISE subjects; The findings are expected to be the basis for school policy recommendations and the design of more effective learning interventions. Therefore, the objectives of this study are: (1) to determine the influence of AI-based adaptive learning approach on ISE learning achievement, (2) to examine the influence of learning satisfaction on ISE learning achievement, and (3) to analyze the simultaneous influence of these two variables on the learning achievement of class X students.

Method

Research design

This study uses a quantitative approach with an ex post facto design that is explanatory in nature. The quantitative approach was chosen because the research data was in the form of numbers and analyzed using statistical techniques to test hypotheses about the influence of AI-based adaptive learning and learning satisfaction on the learning outcomes of Socio-Economic Sciences (ISE) subjects. The ex post facto design is used because the researcher does not provide a direct treatment, but analyzes the relationships between variables that already occur in real learning situations.

In this design, AI-based adaptive learning (X1) and learning satisfaction (X2) are placed as independent variables, while ISE learning outcomes (Y) are placed as bound variables. The research is focused on explaining how much influence each independent variable and its simultaneous influence on student learning outcomes.

Research Sample

The population in this study is all students of class X at one of the high schools that are the location of the research in the current school year, who follow ISE subjects. This population was chosen because at this level ISE subjects are taught systematically, and schools have begun to integrate AI-based adaptive learning in the teaching and learning process.

The research sample was taken from the population using the *Proportional Random Sampling* technique . The population is divided into strata based on class/major (e.g: X-1, X-2, and other X), then from each strata a number of students are randomly selected proportionally. This technique was chosen to ensure that each class/major group is proportionally represented and reduces sampling bias.

The determination of the number of samples can be used using the Slovin formula or the minimum case provision for regression analysis, so that an adequate number of samples is obtained for the multiple linear regression test, which is 140 students. Thus, the sample size is expected to provide sufficient statistical power in testing the research hypothesis.

Research Procedure

The research procedure begins with the identification of problems and related literature AI-based adaptive learning, Learning satisfaction, and learning outcomes. Furthermore, the researcher compiled a research instrument based on the indicators of each variable. Data collection was carried out through the distribution of questionnaires to respondents who met the criteria of the research sample. The data that has been collected is then edited, coding, and tabulated before being further analyzed. Before testing the hypothesis, the research instrument is first tested for validity and reliability to ensure the accuracy and consistency of the measuring instrument used

Data Analysis

The data analysis in this study uses **descriptive statistics** and **inferential statistics**.

a. Descriptive analysis

Descriptive analysis is used to describe the data characteristics of each variable. Steps:

1. Calculate total scores and average scores for AI-based adaptive learning variables, learning satisfaction, and ISE learning outcomes.
2. Convert the score into categories (e.g: very low, low, medium, high, very high) based on the interpretation table that has been compiled.
3. Present results in the form of tables and narrative descriptions to show the general trends of the data.

b. Analysis prerequisite test

Before the regression analysis is carried out, the following prerequisite tests are carried out:

1. Residual normality test to ensure the distribution of residual data is close to normal.
2. Multicollinearity test to ensure that there is no too high correlation between independent variables (reviewed from VIF and tolerance values).
3. Heteroscedasticity test to ensure that residual variance is homogeneous.

c. Inferential analysis (multiple linear regression)

To test the hypothesis regarding the influence of AI-based adaptive learning (X1) and learning satisfaction (X2) on ISE (Y) learning outcomes, multiple linear regression analysis was used. Steps:

1. Modeling regression equations:

$$Y = a + b_1X_1 + b_2X_2 + e$$

where = ISE learning outcomes, =AI-based adaptive learning, = learning satisfaction, = constant, = regression coefficient, and = error.
 $Y, X_1, X_2, a, b_1, b_2, e$

2. Calculate the regression coefficient, R, and R² values to determine the strength of the relationship and the magnitude of the contribution of the free variables to the bound variables.
3. Perform a t-test to determine the partial effect of X1 on Y and X2 on Y.
4. Perform **the F** test to determine the simultaneous effect of X1 and X2 on Y.
5. Interpret the test results (significance values, regression coefficients, and R²) and relate them to the research hypothesis and theory used.

The results of this analysis are then used as a basis for the preparation of the results and discussion chapters, to answer the research objectives that have been formulated in the introduction.

Results and discussion

Result

This study shows that AI-based adaptive learning and learning satisfaction have a positive effect on the learning outcomes of ISE subjects for grade X students. These findings confirm

that learning technology innovations will be more effective if they are followed by fun and supportive learning experiences.

Table 1. Description of research variables

Variable	Average score	Categories
AI-based adaptive learning	2,94	Pretty good
Learning satisfaction	3,04	Pretty good
ISE learning outcomes	78,30	Pretty good

Based on the table above, AI-based adaptive learning is in the category of being quite good. This shows that students have experienced the use of AI in learning, especially in terms of real-time feedback, although aspects of student engagement and personalization still need to be improved. Learning satisfaction is also in the category of quite good, which means that students are quite satisfied with the learning process they are undergoing. The learning outcomes of ISE are also in the category of being quite good, so there are still opportunities to improve.

Table 2. Multiple linear regression test results

Variable	Coefficient B	t count	Sig.
constant	49,705	17,840	0,000
AI-based adaptive learning	0,493	9,195	0,000
Learning satisfaction	0,357	8,238	0,000

The regression equations obtained are:

$$Y = 49.705 + 0.493X_1 + 0.357X_2$$

These results show that AI-based adaptive learning has a positive effect on learning outcomes. The higher the application of AI-based adaptive learning, the higher the student learning outcomes. Learning satisfaction also shows a positive influence, so students who are more satisfied with the learning process tend to have better learning outcomes.

Table 3. Simultaneous test results

Models	F count	Sig.	R Square
Simultaneous regression	74,892	0,000	0,522

The results of the simultaneous test showed that AI-based adaptive learning and learning satisfaction together had a significant effect on ISE learning outcomes. The R Square value of 0.522 means that 52.2% of the variation in learning outcomes can be explained by these two variables, while the remaining 47.8% is influenced by other factors outside the study.

Overall, the results of this study prove that AI-based adaptive learning has an important role in improving student learning outcomes. In addition, learning satisfaction is also an equally important factor because it is able to encourage students to be more active, more comfortable, and more ready to follow the learning process. When these two variables go together, student learning outcomes become more optimal.

Discussion

The results showed that AI-based adaptive learning and learning satisfaction had a positive and significant effect on the learning outcomes of Socio-Economic Sciences (ISE) subjects of grade X students. Partially, AI-based adaptive learning had a regression coefficient of 0.493 ($p = 0.000$), while learning satisfaction had a coefficient of 0.357 ($p = 0.000$), which means that the better the application of AI-based adaptive learning and the higher the learning satisfaction students, the higher the ISE learning outcomes achieved. Simultaneously, the two variables explain 52.2% variation in learning outcomes ($R^2 = 0.522$), so that the combination of the two makes a substantive contribution to students' academic achievement. These findings confirm that improving learning outcomes is not enough to rely solely on technology, but also to demand a satisfying learning experience for students.

When linked to previous research, findings on the influence of AI-based adaptive learning support the results (Wondal et al., 2025) which shows that the use of artificial intelligence in learning has a positive and significant influence on the learning outcomes of high school students. Similarly, research (Sappaile & Judijanto, 2024) found a strong positive correlation between the frequency of use of AI-based adaptive learning tools and the academic achievement of high school students, where increased use of adaptive tools was related to improved academic performance. This study corroborates these findings more specifically in the context of ISE subjects, as AI-based adaptive learning that provides graded materials, tailored exercises, and real-time feedback has been shown to help students understand economic and social concepts more effectively. On the other hand, the results that learning satisfaction has a significant effect on learning outcomes are in line with the research (Haholongan et al., 2025) that found a significant relationship between student learning satisfaction and academic achievement; Students who are satisfied with the learning process and interactions in the classroom have better motivation and learning outcomes. This study confirms this pattern, as students with higher satisfaction levels show higher ISE learning outcomes compared to students with lower satisfaction levels.

However, if examined further, previous research studies have generally examined the influence of AI or adaptive learning and learning satisfaction separately. (Wondal et al., 2025) focus on the influence of AI use on learning outcomes without including learning satisfaction in the same model. (Sappaile & Judijanto, 2024) emphasizes the relationship between the frequency of use of AI-based adaptive learning and academic achievement, but has not examined how learning satisfaction plays a role in the relationship. Instead, (Haholongan et al., 2025) focus on learning satisfaction and academic achievement without placing AI-based adaptive learning as the primary context, as well as on subjects and levels that differ from ISE in high school. Literature review by (Respati, 2024, 2026; Wati et al., 2025) it also sheds more light on the potential of AI and adaptive learning systems based on various studies, but has not provided integrated empirical data that combine AI-based adaptive learning, learning satisfaction, and learning outcomes in a single quantitative model on a specific subject.

Conclusion

First, this study concludes that AI-based adaptive learning has a positive and significant effect on the learning outcomes of ISE subjects of grade X students.

Second, learning satisfaction has also been proven to have a positive and significant effect on ISE learning outcomes. Students who feel satisfied with the learning process, both in terms of reliability, certainty, responsiveness, empathy, and the quality of teacher-student interaction, show better motivation and learning achievement, in line with the second research objective.

Third, AI-based adaptive learning and simultaneous learning satisfaction made a significant contribution to the variation in ISE learning outcomes, which was 52.2%. This confirms that the achievement of optimal learning outcomes is determined not only by the use of AI technology in learning, but also by the level of learning satisfaction felt by students, as formulated in the third research objective in the background section.

Authorship Contribution Statement

Lala Erika: Developing research ideas, designing research instruments, collecting data, analyzing data, compiling results and discussion, and writing a draft manuscript. Munawaroh: Guiding the formulation of research questions and methodology, providing academic guidance throughout the research process, revising drafts, and overseeing the entire research project.

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