International Journal of Scientific Research in Computer Science and Engineering
Vol.11, Issue.4, pp.01-07, August 2023
E-ISSN: 2320-7639
Available online at: www.isroset.org

Research Paper

Impact of mBlock Interface Design on Student Interest and Motivation in Primary School Robotics: A Case Study in Indonesia

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Received: 10/Jun/2023; **Accepted**: 14/Jul/2023; **Published**: 31/Aug/2023. | **DOI**: https://doi.org/10.26438/ijsrcse/v11i4.17

Abstract— Incorporating STEAM (Science, Technology, Engineering, Arts, and Math) into primary school education has given rise to integrating the mBlock app into robotics learning. The mBlock app is a platform to teach students basic robotics concepts and skills, encouraging intellectual development and problem-solving abilities. In particular, the design of the mBlock user interface plays a crucial role in the effectiveness of robotics education at the primary school level. A well-crafted user interface should have an intuitive and easy-to-understand layout, facilitating students' understanding of the software and allowing them to learn programming their robots. This study examines the impact of user interface design on students' interest and motivation in primary school robotics education. The findings showed a positive correlation between user interface quality and students' interest and motivation to learn robotics. The coefficient Interest value is 1.23 and intercept -3.93, while the Coefficient Motivation value is 1.03 and intercept -0.82. Meanwhile, UI design impacts student interest and motivation using a Correlation Matrix, the correlation coefficient value of enjoyable UI on Interest is 0.83 and on Motivation is 0.71. Visual appeal and clear instructions are most important.

Keywords— User Interface, Interest and Motivation, Robotics

1. Introduction

The integration of STEAM (Science, Technology, Engineering, Arts, and Math) in the mBlock application has become an essential part of the primary school curriculum in Indonesia. The mBlock app teaches students about robotic concepts and skills, providing technical knowledge and developing intellectual and problem-solving skills. Schools in Indonesia collaborate with foreign educational institutions to implement the mBlock app in their robotics learning [1],[2]. mBlock is a software application used for programming and controlling hardware, especially in STEAM learning; this application was developed by Makeblock, a private technology company headquartered in Shenzhen, China. The company developed Scratch-based software to provide educational tools for learning robotics [3].

The design of the mBlock user interface has a significant impact on robotics learning in primary schools. The user interface is the first thing that students see when they open the software, and it can make a big difference in how easy or difficult they find it to use. A well-designed user interface will be intuitive and easy to understand, making it more likely that students will be able to learn how to use the software and start programming their robots [4]. Human-Computer Interaction (HCI) includes design elements such as layout, navigation, colour, and interaction that influence how students interact and respond to robotic learning materials. Therefore, it is important to understand the influence of user interface design on students' interest and motivation to learn in the context of robotics education in primary schools [5].

In some International schools with SPK (Satuan Pendidikan Kerjasama) status, which is a category of school introduced by the Indonesian government to be organised based on cooperation between foreign education institutions [6], although robotics education in primary schools has received more attention, there is still a lack of understanding of how user interface design can affect students' interest and motivation to learn. Some of the issues that need to be researched are whether an attractive and interactive user interface design can increase students' interest in learning robotics and how it affects students' motivation in undergoing the learning process. In addition, it is also important to see if there are differences in interest and motivation to learn between male and female students related to user interface design.

This research will use a quantitative research approach. The research sample will involve primary school students implementing robotics learning. Data will be collected through questionnaires specifically designed to measure

students' interest and motivation to learn and the influence of user interface design on both variables to gain a deeper understanding of the influence of user interface in robotics learning. The collected data will be analysed using Linear Regression and Correlation Matrix methods to identify the relationship between user interface design and students' interest and learning motivation [7],[8].

This study explores the influence of user interface design on students' interest and motivation to learn in robotics learning in primary schools. This research will analyse various user interface design elements that may affect students' interest, including layout, colour, animation, and interaction. In addition, this study aims to understand whether there are differences between interest and learning motivation among students related to user interface design [9].

This research is expected to provide essential benefits in developing robotic learning applications in primary schools. By understanding the influence of mBlock's user interface design on students' interest and motivation to learn, this research can help develop more effective and attractive user interfaces. Thus, students can be more engaged and motivated in robotics learning, improving their understanding and application of robotics concepts in everyday life. In addition, this research can also provide information on the differences in learning interest and motivation between male and female students, which can be used to design learning strategies that include and consider the different needs of the two groups of students.

2. Related Work

This literature review aims to analyse previous research findings to understand the contribution and importance of mBlock interface design in the context of robotics learning at the primary school level. A previous study has emphasised the importance of the user interface, showing that a poorly designed user interface can lead to a poor user experience and inconsistent use of the software. Conversely, a well-designed user interface can improve the usability of software, making it easy and enjoyable for users. From a learning perspective, a well-designed user interface has the potential to provide students with an engaging and enjoyable learning experience. Adaptive learning aims to balance meeting individual learning needs and ensuring efficiency and effectiveness. During the evaluation phase, a User Experience Questionnaire (UEQ) evaluates her six parameters: Charm, clarity, efficiency, precision, excitement and novelty. Analysis of the UEQ rating results revealed that the average ratings for all parameters were positive, indicating a positive user experience [10].

Meanwhile, a study on the e-learning user interface revolution explains that the popularity of e-learning is not only in global business education but also in the academic world. Therefore, it is important to understand the role of a user interface in the learning process and the requirements reflected in educational management. In leading learning centres like Coursera, thousands of courses are available to anyone without time, place or social status restrictions. This support for education is reflected in the number of students reaching millions, enabling participation for those who cannot be full-time students. The use of modern technologies, such as mobile devices, cloud services, and global internet expansion, has changed the design of the education system and enabled more comprehensive access. However, an emerging challenge is how to personalise the learning environment according to the needs of increasingly diverse users [11].

Third, study on the Impact of UI Design on Learner Satisfaction. The evaluation was conducted on various user interaction design strategies in the e-Learning platform, including ease of navigation, resource access, and integrated tool configuration. A comprehensive questionnaire was distributed to teachers and students to identify key design issues that interfere with educational tasks. The statistical analysis results were used to develop a model showing success and failure factors in e-Learning interface design. Guidelines and suggestions were also developed to improve the interface design of the platform. Finally, it is suggested to implement a prototype that can provide intelligent recommendations to users and designers of e-Learning platforms based on user satisfaction factors [12].

Studies on integrating mBots in education highlight the importance of instructional design that integrates robotics and coding using visual programming languages. This approach is valuable for improving students' understanding of logical and mathematical concepts. The successful introduction of robotics and visual programming based on active learning methods in primary education has enhanced students' understanding of computer concepts and demonstrated high student engagement and engagement. This study employed experimental classroom design, descriptive analysis, and participatory observation involving her sixth graders. The results showed a statistically significant improvement in students' understanding of mathematical concepts and acquisition of computational skills. These positive outcomes can be attributed to understanding the characters and participating in dynamic activities, stimulating motivation and interest in the learning content [13].

Fifth is a study conducted in West Java, Indonesia, two years ago that examined the interest of primary school students in learning mathematics through the use of Scratch as a learning tool. The research employed qualitative descriptive methods and test instruments such as student interest scale questionnaires, tests, and interviews. Scratch, a visual programming language, was utilised as a medium for learning, incorporating elements such as games, quizzes, and animations. The findings revealed a high percentage of student interest in learning mathematics, indicating that using Scratch in elementary school classrooms resulted in high student engagement and enthusiasm [14].

In the literature that has been reviewed, several findings are relevant to research on the effect of mBlock interface design on student interest and motivation in robotics subject matter

in primary schools. Previous research shows that educational software games can increase student motivation and combine learning with fun. In addition, educational technologies such as e-learning and robotics-based teaching and visual programming have also been effective in improving conceptual understanding and student interest. Therefore, it is essential to investigate how mBlock's interface design can influence students' interest and motivation in robotics learning in primary schools. In light of these findings, this research can provide valuable insights into the development of engaging and effective learning approaches in robotics subject matter at the primary school level.

3. Method

The research method used in this study consists of several stages. First, data were collected using a questionnaire to measure student interest and motivation toward robotics subjects using the mBlock interface. This questionnaire analysed student interest and motivation based on the user interface. This research can provide a more comprehensive understanding of the effect of mBlock interface design on student interest and motivation in robotics subjects in primary schools. The overall method of conducting this research is shown in Figure 2.

Figure 2 depicts how this study progressed. This case study analysis is a method of gathering primary data from survey findings and secondary data related to supporting primary data, such as literature data, like literature studies from books, journals, seminar proceedings, the internet, and others, choosing the appropriate research methodology and estimating the size of the study's sample population based on the size of the current population.

Data analysis is a procedure following the acquisition of the research questionnaire for additional data analysis. Before processing, the questionnaire's responses underwent validity and reliability checks.

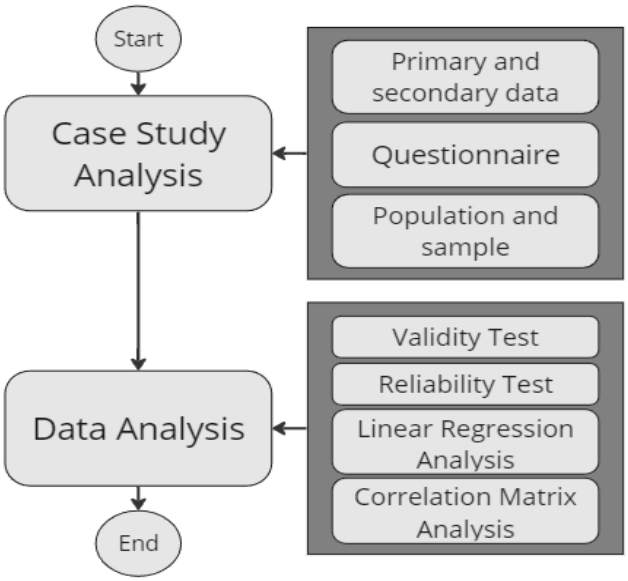

Figure 1: Flow of research method.

3.1. Questionnaire

Questionnaires were utilized as the foundation for the research, focusing on questions related to the user interface that may influence students' interest and motivation. The data collected from the questionnaires will be analyzed using Google Colab. The population of this study consists of primary school students taking robotics classes using the mBlock application. A purposive sampling technique was employed, selecting samples that meet specific criteria, namely primary school students in grade 6 participating in robotics learning [15],[16]. The sample of students who have experience using the mBlock application in robotics lessons using the interface is also a criterion in making the questionnaire. Using a purposive sampling technique, this study aims to obtain a representative sample of students relevant to the research objectives, namely testing the effect of mBlock interface design on students' interest and motivation in robotics subjects in primary schools. Table 1 is an indicator for each questionnaire variable.

Table 1. Questionnaire indicators

Variable	Code	Item
User Interface Design Evaluation (X)	UI.1	The visual design of the application is highly enjoyable.
	UI.2	The visual design of the application is easy to understand.
	UI.3	The interface design features provide clear instructions for using the application.
	UI.4	The user interface design offers interesting interactive features.
Interest (Yi)	Yi.1	How interested are you in robotics?
	Yi.2	Did you enjoy learning about robotics at school?
	Yi.3	How keen are you to learn more about robotics?
	Yi.4	Do you have fun when doing robotics tasks or projects?
Motivation (Ym)	Ym.1	I feel happy when completing robotics tasks or projects.
	Ym.2	I want to continue learning and developing my skills in robotics.
	Ym.3	I feel motivated to participate in robotics learning activities.
	Ym.4	I feel confident in using robots and technology.

3.2. Validity Test

The validity test with Pearson correlation is a statistical method used to measure the extent of the linear relationship between two variables. In the research context, the validity test with Pearson correlation is used to evaluate whether a significant relationship exists between the measured variables. Positive numbers indicate a positive relationship and negative values indicate a negative link and values close to zero indicate no relationship. The range of Pearson correlation values is -1 to 1 [17],[18]. The findings of this validity test will assist in determining how reliable the questions in this study are in evaluating students' interest and motivation, as well as if the relationship between interest, motivation, and mBlock interface design adheres to the study's assumptions.

3.3. Reliability Test

Cronbach's alpha is a technique for determining dependability by evaluating a scale's internal consistency. It is determined by dividing the item score variance by the total score variance. The scale's items measure the same construct when Cronbach's alpha is high. When the scale's items don't measure the same construct, Cronbach's alpha is low [19],[20],[21]. The reliability test will provide critical information about the questionnaire's validity and how correctly it gauges students' interest and motivation in robotics study. As a result, this study can contribute to a better understanding of the relationship between mBlock interface design, student engagement, and motivation in the context of primary school robotics instruction.

3.4. Linear Regression Analysis

In addition, a statistical analysis using linear regression was conducted to determine the relationship between the mBlock user interface and student interest and motivation. This analysis enabled the identification of the influence of the interface variables on the level of student interest and motivation [8],[22]. The equation for the simple linear regression model is as follows.

$$Y = a + bX \tag{1}$$

Where: Y is the regression line or response variable, a is the constant (intercept) which is the point of intersection of the regression line with the vertical axis, and b is the regression constant (slope) which describes the tendency or slope of the regression line, and X is the independent variable or predictor used to predict the value of Y. The constants a and b are regression constants where the values of a and b can be found using the equation below.

$$b = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{n(\Sigma x^2) - (\Sigma x)^2} \tag{2}$$

$$a = \frac{\Sigma y - b(\Sigma x)}{n} \tag{3}$$

In the calculation, b is the slope, a is the point of intersection or intercept, and n is the amount of data used. This linear regression will provide significant information regarding how the mBlock interface design affects student interest and motivation. If there is a substantial association, it means that the mBlock interface design significantly enhances students' interest and motivation in learning robotics.

3.5. Correlation Matrix Analysis

Finally, a correlation matrix analysis was conducted to evaluate the relationship between various aspects of the mBlock user interface and students' interest and motivation levels. This correlation analysis helped identify the interface elements influencing student interest and motivation [20],[21]. Correlation matrix of each average value in each element, The following formula is used to compute the correlation coefficient (r) between two variables X and Y:

$$r = \frac{\Sigma(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\Sigma(X_i - \bar{X})^2 (Y_i - \bar{Y})^2}} \tag{4}$$

With:

- r is the correlation coefficient between variables X and Y.
- X_i is the variable *X* value at observation *i*.
- Y_i is the variable *Y* value at observation *i*.
- $\bar{X}$ is mean variable *X*.
- $\bar{Y}$ is mean variable *Y*.

This study will calculate correlation values for all variable combinations: mBlock interface design with student interest, mBlock interface design with student motivation, and interest with student motivation. The correlation matrix findings will provide an overview of the degree of the association between these variables, whether positive or negative and the relationship's strength. This will aid academics in analyzing the impact of mBlock interface design on primary school children's interest and motivation to pursue robotics.

5. Results and Discussion

This study explored the relationship between the mBlock user interface and students' interest and motivation in learning robotics materials. The research data was collected by distributing questionnaires to two classes, with 26 respondents consisting of seventeen female and nine male students. The data collected included mBlock User Interface (UI), interest, and motivation scores. Furthermore, this data was analyzed through Pearson Validity Test, Cronbach's alpha Reliability Test, regression analysis, and matrix correlation analysis to conclude the relationship between the mBlock user interface and students' interest and motivation in the context of robotics learning.

This analysis uses Google Colab as a platform based on the Python programming language. This study conducted a validity test analysis with Pearson correlation between the User Interface variable and two other variables: Interest and Motivation. The correlation analysis results show a significant relationship between the User Interface variable and the two variables. Based on the data obtained, there are several results and discussions of the analysis, which are described as follows:

Table 2: Pearson Validity Test.

Indicator	User Interface (X)
Correlation coefficient	
Interests (Yi)	0.9073173113555912
Motivation (Ym)	0.8470152995631929
p-value	
Interest (Yi)	1.6409303512277007e-10
Motivation (Ym)	4.8582305161404126e-08

The Pearson correlation results illustrate the relationship between variable X (User Interface value) with variable Yi (Interest) and variable Ym (Motivation). These results indicate a strong positive correlation between the value of User Interface (X) and Interest (Yi). The correlation coefficient of 0.907317 shows the strength of the relationship between the two variables. The closer to 1, the stronger the positive relationship between variables X and Yi. The very low p-value (1.6409303512277007e-10) indicates that the correlation is highly statistically significant, or in other words, the correlation results found do not occur by chance.

There is also a strong positive correlation between User Interface (X) and Motivation (Ym) values. The correlation coefficient of 0.847015 indicates the strength of the relationship between the two variables. The very low p-value (4.8582305161404126e-08) also indicates that the correlation is highly statistically significant. Overall, the Pearson correlation results show that there is a strong positive relationship between the value of User Interface (X) and both Interest (Yi) and Motivation (Ym). The higher the User Interface score, the higher the students' Interest and Motivation level in learning robotics.

The Cronbach's alpha method results show that the questionnaire used to measure student interest and motivation to learn robotics based on the mBlock user interface is highly reliable. The alpha value of 0.947216 indicates that the questions in the questionnaire are highly consistent and accurately measure the construct being studied. Cronbach's alpha is a statistical measure of internal consistency, and in this context, it demonstrates the reliability of the questionnaire in assessing student interest and motivation in learning robotics. The high Cronbach's alpha value suggests that the questionnaire items are strongly correlated, indicating that they all measure the same underlying construct. This provides confidence in the reliability and consistency of the questionnaire as a tool for assessing student interest and motivation. Using Cronbach's alpha helps ensure that the questionnaire yields consistent and accurate results, enhancing the validity of the study's findings.

The regression analysis results significantly influence interest in learning robotics and user interface (UI). Shown in the figure below.

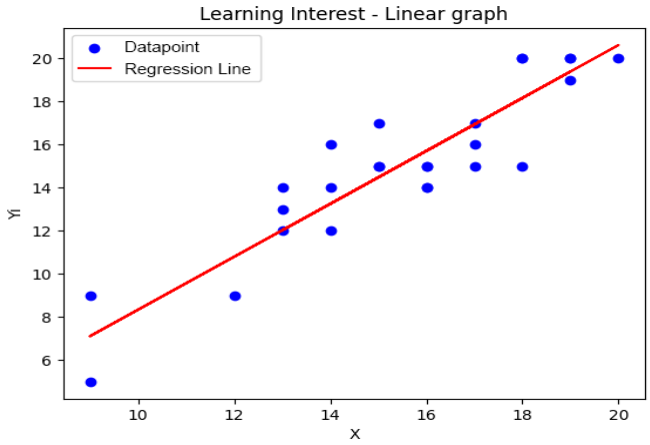

Figure 4. Regression Graph of Learning Interest.

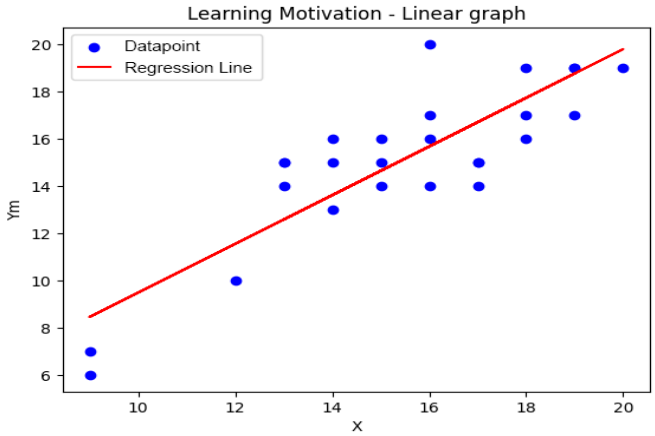

Figure 5. Regression Graph of Learning Motivation.

Figures 4 and 5 show a scatterplot of data points, each representing student interest and motivation in studying robotics and the related mBlock interface design score. The x-axis shows the mBlock interface design score, while the Yi and Ym axes indicate the dependent variables' level of interest and motivation.

The straight line on the graph is the regression line, representing the overall trend of the data the best. This line was generated using a linear regression model, which produces the line's equation based on the link between the mBlock interface design score and degrees of interest and motivation. For each unit change in the mBlock interface design score, the slope of the line shows the change in interest and motivation.

Table 3. Regression Result Table

Indicator	Regression Coefficient	Intercept
Interests	1.226766	-3.929228
Motivation	1.030700	-0.820830

The regression coefficient of 1.226766 indicates that every one-unit increase in interest in learning robotics will contribute to an increase of 1.226766 in the user interface. The intercept of -3.929228 indicates that when interest in learning robotics is zero, the value of the user interface will be at -3.929228. Furthermore, the regression analysis results also show a significant influence between robotics learning motivation and user interface (UI). The regression coefficient of 1.030700 indicates that every one-unit increase in robotics learning motivation will contribute to an increase of 1.030700 in a user interface. The intercept of -0.820830 indicates that when the motivation to learn robotics is zero, the value of the user interface will be at -0.820830.

Based on the regression analysis results and the figures presented, it can be concluded that interest in learning robotics and motivation to learn robotics significantly influence the user interface (UI). These results indicate that the more students like the user interface, the better their interest and motivation to learn robotics. This finding provides important implications for developing user interface designs to increase student interest and motivation in learning robotics.

This study analyzed the correlation matrix between the User Interface (UI) variable and the Interest and Motivation variable in the context of robotics learning. This correlation matrix helps researchers find detailed factors influencing student interest and motivation in learning robotics using mBlock learning media. The following is a picture of the correlation matrix as a Heatmap.

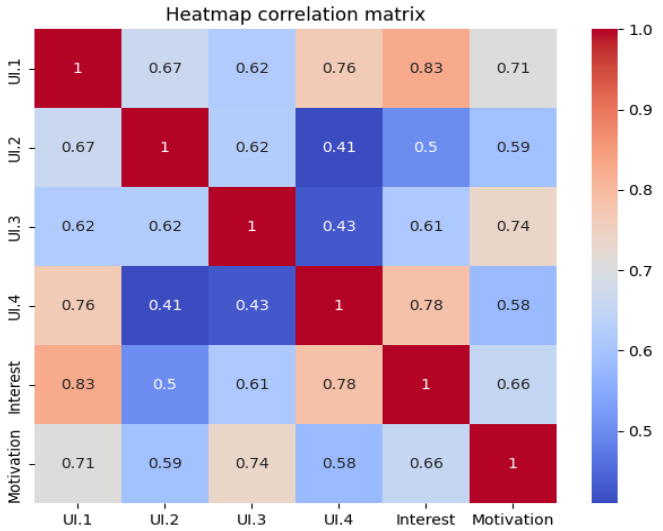

Figure 6. Correlation matrix heatmap.

Three key findings can be observed based on the correlation matrix, indicating varying degrees of relationships among the variables. Firstly, strong positive correlations signify a robust and direct relationship between certain variables. Secondly, some correlations show a moderate association level, indicating a less pronounced but still noteworthy connection between the variables. Lastly, there are correlations with relatively weak values. First, there is a strong positive relationship between variable UI.1 (The visual design of the application is highly enjoyable) with Interest (correlation coefficient = 0.83) and Motivation (correlation coefficient = 0.71). This indicates that the higher the level of pleasant interface design, the higher the students' interest and motivation in learning robotics. Furthermore, there is a moderate positive relationship between variable UI.3 (The interface design features provide clear instructions for using the application.) with Interest (correlation coefficient = 0.61) and Motivation (correlation coefficient = 0.74). This suggests that the presence of interface design features that provide clear instructions can positively affect students' interest and motivation in learning robotics. However, there is a relatively weak relationship between variable UI.2 (The visual design of the application is easy to understand.) with Interest (correlation coefficient = 0.5) and Motivation (correlation coefficient = 0.59). This indicates that an easy-to-understand interface design does not significantly influence students' interest and motivation in learning robotics.

In summary, a strong positive relationship exists between pleasant visual design and student interest and motivation. Meanwhile, interface design with clear instructions also positively affects student interest and motivation, but students tend to be less satisfied with the visual design.

6. Conclusion

In conclusion, the regression analysis results show a significant influence between interest and motivation in learning robotics on the user interface (UI). Higher levels of interest and motivation lead to a better user interface experience. This highlights the importance of designing interfaces that increase student engagement and motivation. In addition, the correlation matrix used to look into the factors that influence student interest and motivation based on the mBlock user interface showed a strong positive relationship between visually pleasing interface design and interest and motivation. In addition, interface design features that provide clear instructions positively impact student interest and motivation. However, easy-to-understand interface design showed a relatively weak relationship between interest and motivation. These findings emphasise the importance of user interface design in fostering students' interest and motivation in robotics learning.

In summary, this study concludes that interest and motivation are critical in influencing the user interface of robotics learning applications. Designing a visually pleasing interface with apparent instructional features can increase student engagement and motivation. The correlation matrix shows a strong positive relationship between the factors of fun and clear interface design elements and interest and motivation. In addition, the impact of easy-to-understand interface design on students' interest and motivation could be stronger. These findings underscore the importance of user interface design in robotics education to foster student engagement and motivation.

Data Availability

Data from this study is accessible upon request, and you can view the data used in this study. It is important to remember that there are limitations to protecting privacy and adhering to moral principles. It is recommended that researchers interested in the data contact the authors via the email provided.

Conflict of Interest

The authors declare that we have no conflicts of interest that could affect how the results of this study are interpreted or presented in this study.

Funding Source

None

Authors' Contributions

Author-1, Mr. Wisnu Priambodo, researched literature, collected data and drafted the study. Author 2 supervised the preparation of the research and gave the article final approval for publication. The article's concept or design benefited greatly from the contributions of Author-3.

Acknowledgements

We thank the International Journal of Scientific in Research in Computer Science and Engineering for their evaluation and recommendations on increasing visibility and clarity. And we would like to express our sincere gratitude to every student participating in our research.

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