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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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Abstract— The incorporation of STEAM (Science, Technology, Engineering, Arts, and Math) into primary school education has given rise to the integration of the mBlock app in robotics learning. The mBlock app serves as a platform to teach basic robotics concepts and skills to students, 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 aims to examine 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, the T-Test showed a P-score is 0.67 indicating no significant difference in the average level of interest and motivation. UI design impacts student interest and motivation by 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— Human Computer Interaction, Interest and Motivation, User Interface

1. Introduction

The integration of STEAM (Science, Technology, Engineering, Arts, and Math) in the mBlock application has become an important 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 are collaborating 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 with the aim of providing 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 organized on the basis of 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 robot 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].

The purpose of this study is to explore the influence of user interface design on students' interest and motivation to learn in robotics learning in primary schools. This research will analyze various user interface design elements that may affect students' interest, including layout, colour, animation, and interaction. In addition, the purpose of this study is 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 the development of 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 in the development of more effective and attractive user interfaces. Thus, students can be more engaged and motivated in robotics learning, which in turn will improve 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 analyze the findings of previous research in order 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 emphasized 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. Using adaptive learning as a method aims to strike a balance between 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, 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, such as Coursera, thousands of courses are available to anyone, without restrictions of time, place or social status. 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 wider access. However, an emerging challenge is how to personalize 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 results of statistical analysis 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 the integration of mBots in education highlight the importance of instructional design that integrates robotics and coding using visual programming languages. This approach serves as a valuable tool in 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 a high level of 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 participating in the process of understanding the characters and participating in dynamic activities, thereby stimulating motivation and interest in the learning content [13].

Fifth, is a study conducted in West Java, Indonesia, two years ago 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 employed test instruments such as student interest scale questionnaires, tests, and interviews. Scratch, a visual programming language, was utilized 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 the use of Scratch in elementary school classrooms resulted in a high level of engagement and enthusiasm among students [14].

In the literature that has been reviewed, there are several findings that 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 the use of educational software games can increase student motivation and combine learning with fun. In addition, the use of educational technologies such as e-learning and robotics-based teaching and visual programming has also been shown to be effective in improving conceptual understanding and student interest. Therefore, it is important to investigate the extent to which mBlock's interface design can influence students' interest and motivation in robotics learning in primary schools. In light of these findings, it is hoped that 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 collection was conducted using a questionnaire to measure the level of student interest and motivation towards robotics subjects using the mBlock interface. This questionnaire was designed to analyze 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 the following figure.

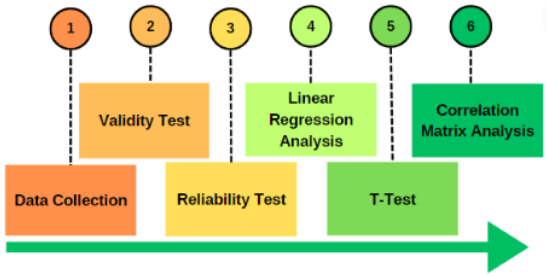

Figure 1: Flow of research method.

3.1. Data Collection

The population in this study were primary school students who took robotics subjects using the mBlock application. The sampling technique used is purposive sampling, by selecting samples that meet certain criteria, namely grade 6 primary school students and following the robotics learning material [15]. The sample of students who have experience in 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	No	Item
User Interface Design Evaluation (X)	1	The visual design of the application is highly enjoyable.
	2	The visual design of the application is easy to understand.
	3	The interface design features provide clear instructions for using the application.
	4	The user interface design offers interesting interactive features.
Interest (Yi)	6	How interested are you in robotics?
	7	Did you enjoy learning about robotics at school?
	8	How keen are you to learn more about robotics?
	9	Do you have fun when doing robotics tasks or projects?
Motivation (Ym)	10	I feel happy when successfully completing robotics tasks or projects.
	11	I feel want to continue learning and developing my skills in robotics
	12	I feel motivated to participate in robotics learning activities.
	13	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 context of research, the validity test with Pearson correlation is used to evaluate whether there is a significant relationship between the two variables being measured. Positive numbers indicate a positive relationship, negative values indicate a negative link, and values close to zero indicate no relationship. The range of Pearson correlation values is -1 to 1 [16], [17]. The validity test with Pearson correlation helps researchers test the validity of the construct and understand the relationship between the variables involved in the study.

3.3. Reliability Test

Cronbach's alpha is a method for measuring reliability by assessing the internal consistency of a scale. It is calculated by dividing the variance of item scores by the variance of total scores. A high Cronbach's alpha indicates that the items in the scale measure the same construct. A low Cronbach's alpha indicates that the items in the scale are not measuring the same construct [18], [19]. Reliability testing is important because it ensures that the scores on the scale are accurate and consistent. If a scale is not reliable, then the scores on the scale cannot be used to make inferences about the constructs measured by the scale.

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], [20]. The equation for the simple linear regression model is as follows.

$$Y = a + bX \quad (1)$$

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, 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.

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

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

In the calculation, the value of b is the slope, the value of a is the point of intersection or intercept, and n is the amount of data used.

3.5. T-Test

A t-test is a statistical test comparing the mean (average) of two groups. It is a parametric test, which means that it assumes that the data is normally distributed. The t-test is used to determine whether the difference between the means of the two groups is statistically significant [9], [21]. This means that the difference is not likely to be due to chance alone. The t-test is a powerful tool that can be used to answer various research questions. The T-test here is used to compare the average interest and motivation of students who use the mBlock application with the average interest and motivation of students who do not use the application.

3.6. 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 that most influenced student interest and motivation [20], [21]. correlation matrix of each average value in each element.

5. Results and Discussion

This study was conducted with the aim of exploring the relationship between the mBlock user interface and students' interest and motivation levels in learning robotics materials. The research data was collected by distributing questionnaires to two different classes, with 26 respondents consisting of 17 female students and 9 male students. The data collected included mBlock User Interface (UI) scores, interest scores, and motivation scores. Furthermore, this data was analyzed through Pearson Validity Test, Cronbach's alpha Reliability Test, regression analysis, t-test, and matrix correlation analysis to draw conclusions about the relationship between the mBlock user interface and students' interest and motivation in the context of robotics learning.

In this analysis, Google Colab is used as a platform based on the Python programming language. In this study, a validity test analysis with Pearson correlation was conducted between the User Interface variable and two other variables, namely Interest and Motivation. The correlation analysis results show that there is 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) variables. 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 level of students' Interest and Motivation 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 with each other and that they 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 with each other, indicating that they are all measuring the same underlying construct. This provides confidence in the reliability and consistency of the questionnaire as a tool for assessing student interest and motivation. The use of Cronbach's alpha helps ensure that the questionnaire yields consistent and accurate results, enhancing the validity of the study's findings. By employing Cronbach's alpha method, researchers can assess the internal consistency of the questionnaire and determine its suitability for measuring the targeted construct effectively. The results of the regression analysis show that there is a significant influence between interest in learning robotics and user interface (UI). Shown in the figure below.

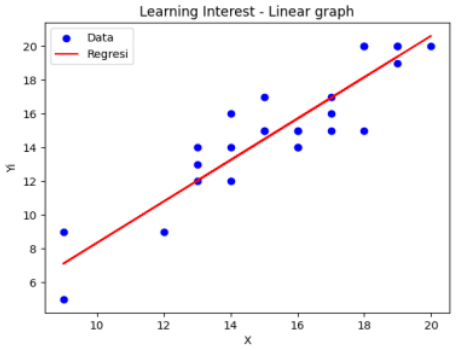

Figure 2. Regression Graph of Learning Interest.

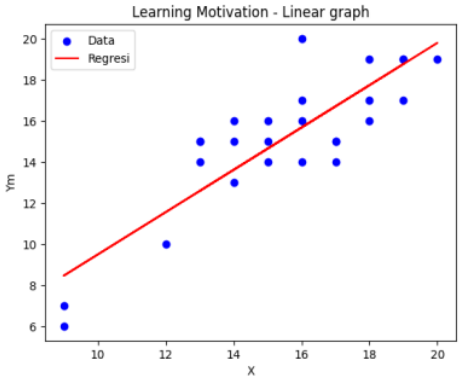

Figure 3. Regression Graph of Learning Motivation.

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 results of the regression analysis 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 the development of user interface designs that can increase student interest and motivation in learning robotics.

Table 4 shows the results of the t-test, a t-test was conducted to test the significant difference between Interest and Motivation variables in the context of robotics learning. The t-test results can be seen in the following table:

Table 4. T-test Result Table

Indicator	Mean	SD	T-Score	P-Score
Interests	3.4231	1.0266	0.4251	0.6726
Motivation	3.3077	0.9282		

The t-test results show that the t-score obtained is 0.4251 with a p-value of 0.6726. Based on these results, there is no significant difference between the mean Interest and the mean Motivation. This shows that in the population studied, there is no significant difference between the level of interest and motivation of students in learning robotics. Furthermore, the standard deviation of Interest and Motivation was analyzed. The standard deviation of Interest is obtained as 1.0266, while the standard deviation of Motivation is 0.9282. This shows that the variation or data dispersion level in the Interest variable is higher than the Motivation variable. In addition, the average interest obtained is 3.4231 and the average Motivation is 3.3077. The higher average in the Interest variable indicates that overall, respondents tend to have a higher interest in learning robotics than motivation. The results are shown in the following table.

Based on the results of analysis, it can be concluded that in the population studied, there is no significant difference between the mean interest and the mean motivation in learning robotics. This indicates that students' interest and motivation levels in the context of robotics learning tend to be in line or have no significant differences.

In this study, a correlation matrix between the User Interface (UI) and Interest and Motivation variables in the context of robotics learning was also analyzed. the following is a picture of the correlation matrix in the form of a Heatmap.

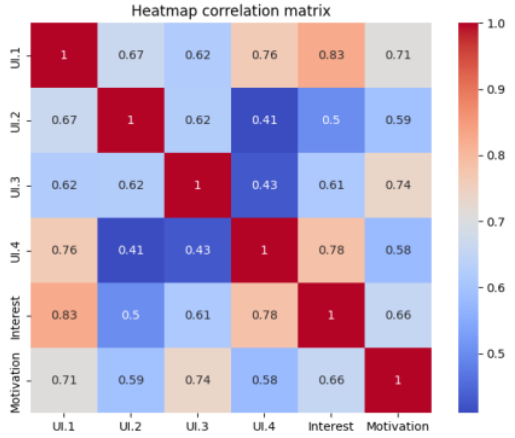

Figure 4. Correlation matrix heatmap.

Based on the correlation matrix, several findings can be drawn. 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 fairly strong 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.

6. Conclusion

In conclusion, the regression analysis results indicate a significant influence of both interest and motivation in learning robotics on the user interface (UI). Higher levels of interest and motivation lead to improved user interface experiences. This highlights the importance of designing interfaces that enhance student engagement and motivation. The t-test results demonstrate no significant difference between the mean interest and motivation levels, suggesting comparable levels of student engagement in the population studied. Moreover, the correlation matrix reveals strong positive relationships between a visually enjoyable interface design and interest and motivation. Additionally, interface design features providing clear instructions positively impact student interest and motivation. However, an easy-to-understand interface design shows a relatively weak relationship between interest and motivation. These findings emphasise the significance of user interface design in fostering student interest and motivation in robotics learning.

In summary, the study concludes that interest and motivation are crucial in influencing the user interface of robotics learning applications. Designing visually enjoyable interfaces and incorporating clear instructional features can enhance student engagement and motivation. The t-test results indicate no significant difference between the mean interest and motivation levels, suggesting that students' interest and motivation in learning robotics are generally aligned. The correlation matrix reveals the strong positive relationships between enjoyable and clear interface design elements with interest and motivation. However, the impact of an easy-to-understand interface design on student interest and motivation is relatively weak. These findings underline the importance of considering user interface design in robotics education to effectively foster student engagement and motivation.

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