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Development of a Self-Evaluation Model Based on an Intelligent Tutoring System to Increase Student Learning Motivation in Basic Programming Subjects

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ABSTRACT

Learning evaluation is a series of efforts to improve the quality of learning. Evaluation activities will have a positive impact on students motivation to encourage themselves to make improvements that affect their learning achievement. However, the implementation of learning evaluation in the field is not always easy. According to the results of field studies conducted at SMK BPI Bandung, there are obstacles to the continuity of learning evaluations, and the implementation has not been optimal. This study aimed to develop a self-evaluation model based on an intelligent learning system (ITS) as a support in the learning process where students can actively and independently evaluate their abilities, thereby increasing learning motivation, which has an impact on their learning achievement. In this research that was conducted using a nonequivalent pretest-posttest control group design, it was concluded that: 1) The evaluation media based on the ITS got a percentage value of 97.78% in the "very good" category and was feasible to use. 2) ITS evaluation media proved to increase learning motivation in the experimental class, marked by an increase in the average value of pre-test to post-test of 0.83% and showing differences in motivation with the control class. 3) Students responses to the ITS evaluation media resulted in a "very good" category with a percentage of 83.58%.

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1. INTRODUCTION

In implementing the learning process, there are measures of success (Renata *et al*., 2018) that can be measured from the results of their learning achievements (Muhammad, 2017). Excellence in learning achievement is the main assessment, as learning achievement is the results achieved by students when participating in learning activities at school and doing the tasks given (Syafni, 2018). These learning outcomes can be seen from a series of observations or the assessment scores carried out on students, which are then evaluated.

Evaluation, according to Edwin Wandt and Gerald W. Brown, is oriented towards actions or processes to determine the value of something, where this value will become the basis for making improvements to the progress of a process. In this case, educators have an important role in being able to evaluate and guide students in improving the quality and capacity of their learning. Feedback provided after the evaluation will play a major role in whether or not students' learning achievements improve (Morris *et al*., 2021).

However, implementing learning evaluations in the field is not always easy. According to the results of a field study conducted at Vocational School BPI Bandung, there were obstacles to the continuity of learning evaluation, which resulted in the implementation of the evaluation not being optimal. This has an impact on a minimal improvement in the quality of students' abilities. It is also exacerbated by the lack of learning motivation among students who do not have the initiative to improve their abilities independently. With these considerations, researchers tried to develop a self-evaluation model, or what is called the self-evaluation model. This model is used to overcome problems in the classroom, support a more effective learning process (Hignasari and Supriadi, 2020), and be meaningful for long-term learning (Sebesta and Speth, 2017). Helping students evaluate their abilities in subjects so that they are able to fully understand the lessons and even improve their learning achievements (Andrade, 2019).

Several studies reveal that self-evaluation is liked by students because it gives them the opportunity to increase their expectations, and the feedback they get from the evaluation is meaningful for improving their abilities. Through self-evaluation, students can get an idea of their quality and immediately get feedback to correct mistakes in the future (Aminu *et al*., 2021).

The self-evaluation model in this research was developed using an information technology approach, where the evaluation model is carried out with tools that can make it easier for educators and students. Moreover, in the evaluation process, educators have limitations in monitoring student development (Saifulloh and Darwis, 2020). The tool is a system based on an intelligent tutoring system (ITS). With intelligent system tools, evaluations carried out can be more effective and efficient (Agustini, 2017). Students can evaluate themselves actively and quickly, which is also monitored by educators (Ramirez *et al*., 2017).

The Intelligent Tutoring System acts as an intelligent system that acts like a teacher who understands the characteristics of students to help the learning process independently (Yusuf *et al*., 2022). ITS provides the ability to adapt to the needs of the students, as the approach is one-to-one, such as providing information regarding learning outcomes or what kind of teaching strategies can be applied to these students. The existence of ITS also helps educators have no difficulty supervising the student learning process (Mohamed and Lamia, 2018).

Based on the explanation above, the development of a self-evaluation based on the Intelligent Tutoring System is aimed at

(i). Develop an independent evaluation model (self-evaluation model) using an intelligent learning system (intelligent tutoring system).

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(ii). Analyze the increase in student learning motivation based on non-test instruments.
(iii). Analyze student responses using ITS evaluation media.

2. METHODS

This research uses the Research and Development (R&D) method. Research and Development (R&D) is a research method used to produce certain products and test their effectiveness. The R&D method has a large-stage procedure consisting of the analysis stage, design stage, development stage, implementation stage, and assessment stage. The application of these stages in this research can be seen in **Figure 1**.

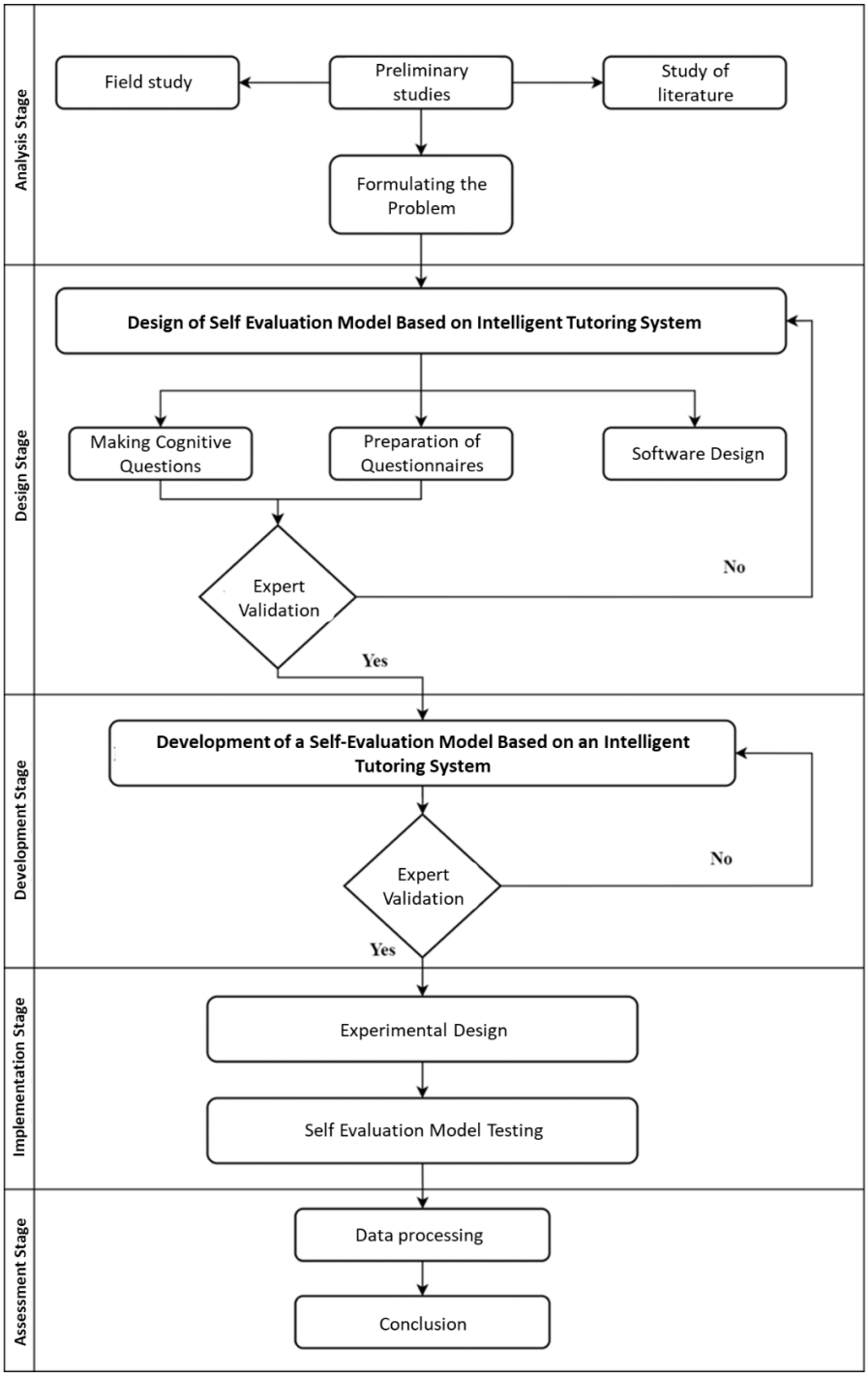

Figure 1. Stages of R&D method research

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The analysis stage consists of a preliminary study that includes field study activities to obtain data directly from the field and a literature study to obtain information and theories related to research from various sources. At the design stage, the Intelligent Tutoring System software, the cognitive questions for assessment tests carried out in ITS, and the questionnaire to measure student learning motivation were designed. After the design is complete, the next step is the ITS development stage. Then the next stage is the implementation stage in the form of a self-evaluation trial of the ITS-based model in the field. The trial results are then processed and discussed at the assessment stage.

The research implementation was carried out at BPI Bandung Vocational School using a nonequivalent pretest-posttest control group design, involving 22 students from class X-RPL as the experimental class and 22 students from class X-TKJ as the control class, as can be seen in **Table 1**. Each experimental and control class was given a pretest and posttest in the form of a student learning motivation questionnaire before and after receiving treatment. The treatment given to the experimental class was ITS evaluation media, while the control class was given a Google form containing test questions to measure basic competency abilities.

Table 1. Pre-test and post-test control group design

Class	*Pretest*	*Treatment*	*Posttest*
Experiment	O_1	X_1	O_2
Control	O_3	X_2	O_4

3. RESULTS AND DISCUSSION

Research results and discussions were obtained from each stage carried out based on previously designed research procedures. The following are the results of these stages:

3.1. Analysis Stage

In the results of the analysis stage of the literature study, researchers found various information regarding the concepts and applications needed in the research. As for the field study, points obtained from interviews were in the form of obstacles to the learning evaluation process at BPI Vocational School, which resulted in the learning process being less than optimal and the impact that would ideally be felt by students, as well as a description of the students' conditions during learning activities.

3.2. Design Phase

The questions designed to test students' cognitive abilities are 50 questions validated by lecturers who are material experts and experienced in validating questions. For the student learning motivation questionnaire, 33 questions were designed based on aspects of cognitive motives, self-expression, and self-enhancement. The questionnaire was then validated by a guidance and counseling teacher who had experience increasing students' learning motivation in schools. Various functional and non-functional system requirements and system flow for ITS software design are shown in a diagram that provides features according to the self-evaluation model cycle.

3.3. Development Stage

ITS media was developed in the form of a website using the PHP programming language framework, namely CodeIgniter. The media is used by two actors, namely students and

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teachers, with a description of the activities made in the form of a use case diagram in **Figure 2**.

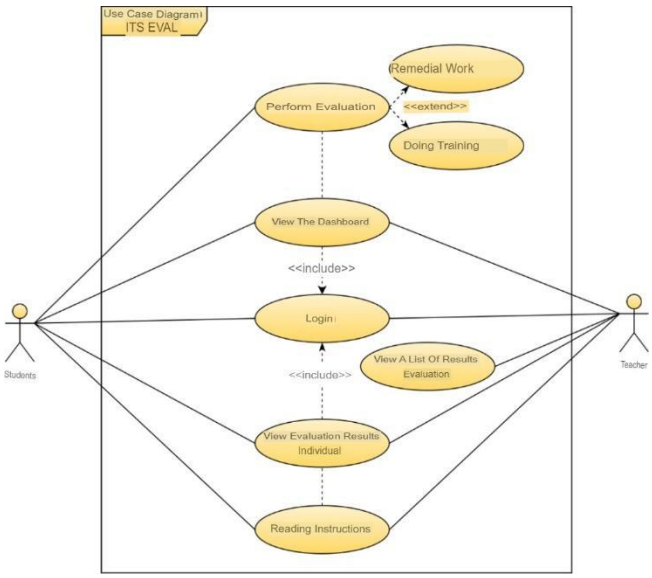

Figure 2. ITS Use Case Diagram

The features in the ITS evaluation media, as can be seen through the use case diagram, consist of login, dashboard containing evaluation result statistics that can be seen by students and teachers, evaluations that can be carried out by students, and remedial and training if they have not met criteria for completeness of grades, see the list of evaluations by teachers, detailed evaluations by teachers and students, as well as instructions for using ITS media. The following is one of the ITS page interface displays in **Figure 3**.

Figure 3. ITS interface

3.4. Implementation Stage

The self-evaluation model trial was carried out during two weeks of learning in the experimental and control classes. During class learning, activities run actively and smoothly. In the experimental class, after the process of providing basic competency material is complete, the next step is to test the use of ITS self-evaluation by providing students with directions for using the system. At first, there were some students who were not used to it and found it difficult to log in, but in the end, the students were able to use the system smoothly.

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3.5. Assessment Stage

The trial process results in data, which is then processed and conclusions drawn. The results of the data obtained from the pre-test and post-test are presented in **Figure 4**.

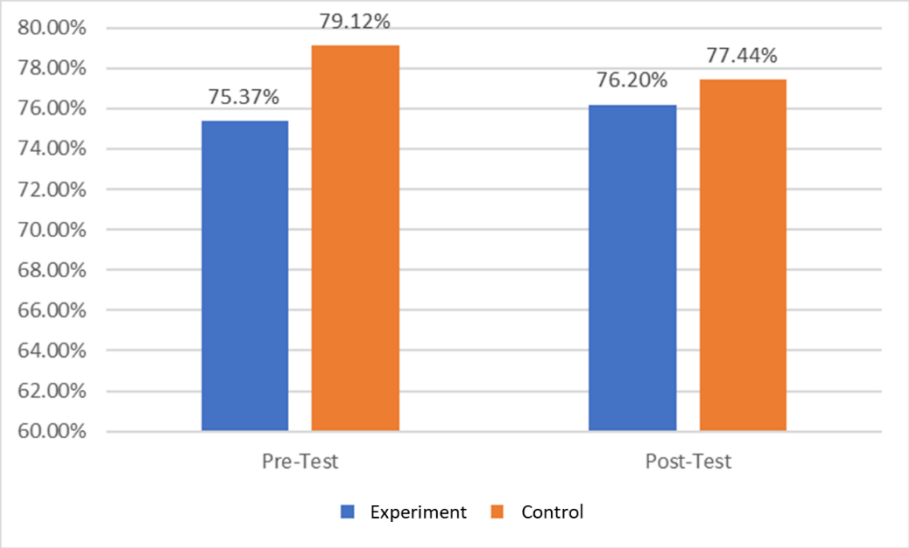

Figure 4. Graph of student learning motivation scores

As can be seen from the graph, the average pre-test score for learning motivation in the experimental class reached 75.37%, compared to the control class score, which was higher, namely 79.12%. Meanwhile, the average post-test score for the experimental class increased by 0.83% to 76.20%, which is a difference from the control class, which got a score of 77.44%. Even though the average score of the control class was higher than the experimental class, the experimental class showed an increase in motivation. This is different from the control class, which experienced a decline.

To prove the effectiveness of using ITS evaluation media, a hypothesis test was carried out using the independent sample t-test, namely a parametric statistical test. It is used to determine the significance of the difference between two means from two independent samples. The requirement for the independent t-test is that the data must be homogeneous and normally distributed, so the Levene statistic test and the Shapiro-Wilk test are carried out to ensure the data is homogeneous and normally distributed. The independent t test decision-making criterion is that if -t table ≤ t count ≤ t table, then H0 is accepted. If the calculated t value > t table, then H0 is rejected and H1 is accepted. The hypotheses in this research are as follows:

(i). H0: There is no difference in learning motivation between students who use a self-evaluation model based on an intelligent tutoring system and students who use Google Forms to support the basic programming learning evaluation process.

(ii). H1: There is a difference in learning motivation between students who use a self-evaluation model based on an intelligent tutoring system and students who use Google Forms to support the basic programming learning evaluation process.

The hypothesis test produced a t-count of 1.840, and the t-table obtained from the research data was 1.682. The results obtained are based on decision-making criteria, namely 1.840 > 1.682, so H0 is rejected and H1 is accepted. It can be stated that there is a difference in learning motivation between students who use a self-evaluation model based on an intelligent tutoring system and students who use Google Forms to support the basic

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programming learning evaluation process. The results of the hypothesis test are depicted in the curve in **Figure 5**.

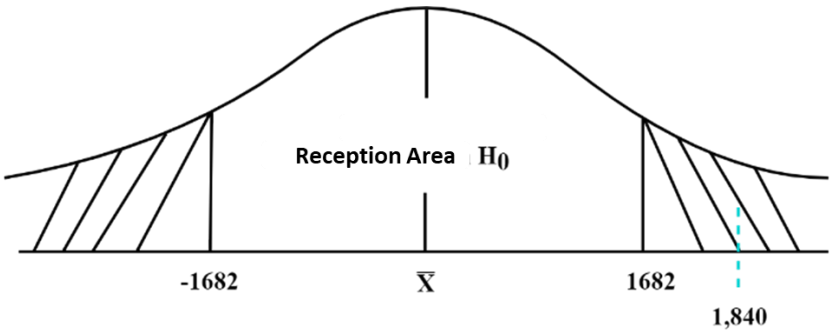

Figure 5. Hypothesis Test Curve

Based on the results of student responses regarding the use of ITS evaluation media, the average media aspect score was 80.6 out of 95 with a percentage of 84.84%. The average score for aspects of the evaluation model applied was 80.6 out of 95 with a percentage of 82.32%, so the overall average of student responses was 79.4 out of 95 with a percentage of 83.58%. From this score, the media and evaluation model as a whole are classified as very good, as can be seen from the rating scale in **Figure 6**.

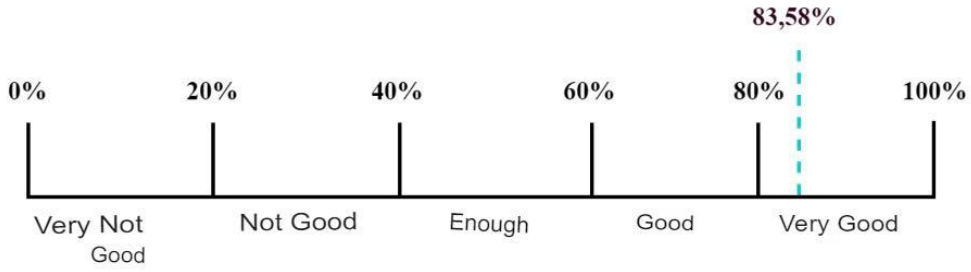

Figure 6. Student response result scale

4. CONCLUSION

According to the research about the development of a self-evaluation model based on an intelligent tutoring system to increase student learning motivation in basic programming subjects carried out at BPI Bandung Vocational School, it was concluded that the development of ITS evaluation media, which refers to the self-evaluation model cycle, can support the learning process, which helps improve student's motivation to study. This is proven by the results of the self-evaluation model trial carried out in the experimental class, which showed an increase in the average score from the pretest of the student learning motivation questionnaire after the learning process to the posttest by 0.83%, where the pretest score was 75.37% and the posttest score was 76.20%. Then, based on the results of the hypothesis testing, it was proven that there were differences in learning motivation between the two.

As for suggestions related to this research, the intelligent tutoring system being developed is intended to be an alternative or support for teachers in learning evaluation activities. However, this does not mean letting students completely improve their abilities independently because the noble role of an educator cannot be replaced by technology. Then, ideally, questionnaires should be distributed periodically, and a personal approach should be taken through interviews to be able to see more accurate results of the increasing student learning motivation.

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5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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