JTEV (Jurnal Teknik Elektro dan Vokasional)
http://ejournal.unp.ac.id/index.php/jtev

Vol. 8 No. 1 (2022)
E-ISSN: 2302-3309
P-ISSN: 2746-6086

An Interactive Learning Environment System on Basic Programming Subjects: Effects of Learning Outcomes and Question Level Patterns

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Abstract
This study reports on the effect of using interactive learning environment system by embedding problem-posing and problem-solving learning pattern as a flow of interaction. This interactive learning environment system is attempted as a solution to help understand and learn basic programming in Vocational High Schools. The effects that will be known are student learning outcomes and tracking of question-level patterns. The research method used was a quasi-experimental design with a nonequivalent control group design, involving 36 vocational high school students who were divided into an experimental group (N=18) and a control group (N=18). For data analysis, the technique of independent sample t-test and paired sample t-test was used. The results showed that student learning outcomes on each test there were significant differences after using interactive learning environment system and there was a good improvement in the experimental group compared to the control group. A total of 20 questions are provided for each test with a different pattern. Analysis of the level pattern of questions is done by distinguishing between the database answer key system and student answers. The tracking results showed that on the 1st test the level of accuracy occurred in 12 questions with the easy category and for the 2nd test the accuracy level occurred in 14 questions with the easy category.

***Keywords**: Basic Programming Learning, Interactive Learning Environment System, Problem-Posing, Problem-Solving, Question Level Patterns*

INTRODUCTION

One of the productive subjects that must be studied in Vocational High Schools throughout Indonesia as a basic skill is Basic Programming. The learning process is carried out in semesters one and two for grade ten, with a standard time allocation of one meeting, namely three hours of lessons [1].

According to [2, 3] Basic Programming is a subject that has a function as an initial foundation for students to practice thinking (logic), hone creativity, and understand programming languages as well as a basis for other related lessons. According to [4] Basic Programming learning aims to build a basic understanding for students and as an initial introduction to understanding programming languages.

The Basic Programming learning process still has many obstacles and problems faced by the school. One of them is that students tend to still find it difficult to understand the subject, the implementation of the practicum is not optimal, and the class feels boring. This is caused by teachers who tend to still apply monotonous/conventional methods and maximize the available learning media.

To prove this, the researcher has conducted interviews and direct observations to several vocational high schools in Indonesia, the findings are very much in line with the facts that have been presented previously. Observations were carried out by distributing questionnaires to students who had studied and those who were still learning Basic Programming subjects. The results show that they tend to dislike Basic Programming subjects, the learning process tends to be boring, and they tend to have difficulty in learning Branching Control Structures as the most difficult subject for students compared to other subjects.

Several Basic Programming teachers were also interviewed, they said that when applying Basic Programming learning they were still done conventionally and the practice also tended to be less than optimal and rarely done. This makes it difficult for students to be able to continue to the next subject,

DOI :https://doi.org/10.24036/jtev.v8i1.113579

repetition of the subject continues to provide understanding to students. Furthermore, other assistive media tend to be rarely even used in Basic Programming learning, do not apply learning models that have potential so that learning is not monotonous and looks more active and enthusiastic. As a result, learning motivation is low and the end effect is low student learning outcomes with a large number of students doing remedial. Obstacles and other problems still tend to exist in the Basic Programming learning process caused by many factors.

Furthermore, researchers have equated perceptions and agreed that learning Basic Programming tends to have obstacles and problems faced. Especially the most vital problem is the difficulty of students understanding Basic Programming subjects, even though these programming skills are needed by the industrial market, companies, and even government departments. According to [5] to become an expert and reliable programmer, for at least ten years you must focus on learning, understanding, and practicing programming. This means that to support programming skills and understand the subject in programming tends not to be easy.

In line with the current research findings, several previous studies, namely from [6] stated that students are very difficult to learn computer programming, even though computer programming is a very important field of knowledge in computer science with a constantly changing curriculum. Then [7] found the fact that mastering the concepts and skills of computer programming is a big challenge for both teachers and students.

Learning to program, especially in the object-oriented paradigm, is a difficult job for many students, especially for beginners who are just learning programming [8]. Furthermore, research conducted by [9] shows that Basic Programming subjects are very difficult for students to understand, so it is necessary to develop media in the form of educational games and other media technologies. Then research by [10] ActionScript programming is most likely difficult to learn for beginners who do not have a programming background. Last from [11] programming skills are indispensable to meet the performance of learners for future careers.

However, the obstacle faced in recent years is to introduce programming concepts in the right way, which is a challenge in the world of vocational and engineering education, including in higher education. From the obstacles and problems faced, several researchers have provided solutions, both in the form of design recommendations for development in the form of educational media, educational games, interactive learning environment, other assistive media, and even proposed instruments to design the effectiveness of the Basic Programming learning process.

Research that has proposed educational media, educational games, and interactive learning environment to solve the problem of difficulties in learning Basic Programming, among others, by [12] developed arcade games to learn to program. Then [6] proposed the design and framework of a basic programming educational game. Then, the research conducted by [13] proposed a problem-posing method to develop problem-solving skills in the programming class, then developed a system to help operate the method in the actual classroom. Research [14] developed educational media for sorting-algorithm (insert sort) subject on Basic Programming. From [15] proposed educational games for Basic Programming concepts. Then [16] developed educational games for repetition subject. Research from [17] proposes educational media in the form of e-learning for Basic Programming introductory subject. Lastly [18] developed educational games to learn to program with C language subject.

The current research area is to find out the effect of using an interactive learning environment as a tool in learning Basic Programming with problem-posing and problem-solving interaction paths that have been embedded in student learning outcomes and conducting question-level analysis.

INTERACTIVE LEARNING ENVIRONMENT SYSTEM ON BASIC PROGRAMMING

In an interactive learning environment system, it consists of three main processes that must be carried out and passed by students in the interaction process, namely the problem-posing process is presented in Figure 1, the problem-solving process is presented in Figure 2, and feedback is presented in Figure 3.

Problem-posing embedded in an interactive learning environment system in Basic Programming subjects adheres to the open-posing type which can be described as an open problem-posing process that allows students to create their problems. The concept of the problem-posing learning model according to [19] is an action in building new problems that have the aim of exploring certain conditions or reformulating problems based on a given problem. In research [20] the application of problem-posing is that students can create simple problems that have benefits for learning and submit them to the teacher. According to [21] divides three forms of cognitive activity in applying problem-posing, namely pre-solution posing, within-solution posing, and post-solution posing. Furthermore, [22] divide two types of treatment in applying problem-posing to the interactive learning environment called MONSAKUN, namely open-posing and close-posing.

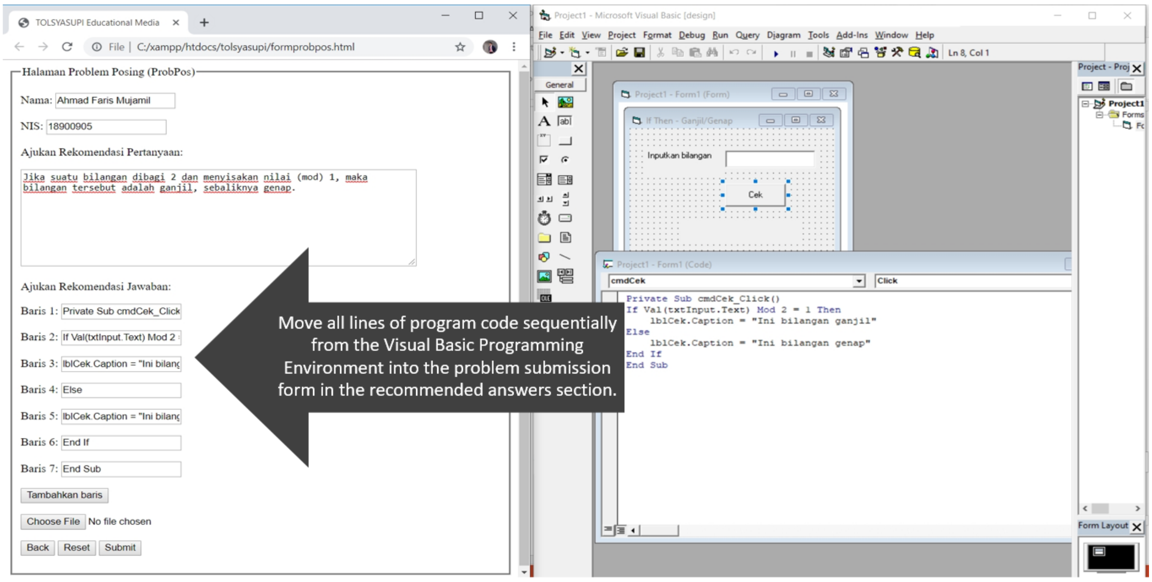

Figure 1. Problem-Posing Interaction Interface

The problem submission process consists of submitting problems and recommending answers (See Figure 1). For problem submission, it is a description/sentence of what problems will be solved by programming about the branching control structure subject. Then the recommended answers are in the form of an ordered arrangement of lines of program code and a screenshot attachment of the program user interface generated by the program code lines. In the process of submitting this problem, validation is needed before it is submitted to the system, the validation process has been submitted in [23, 24].

Problem-solving embedded in an interactive learning environment system for Basic Programming learning with the flow of interaction, namely by solving problems in the form of a series of card arrangements presented through lines of program code that will be arranged sequentially. According to [25] the concept of problem-solving is a process of how students find solutions in solving problems and overcoming difficulties, with this process forming new knowledge and thinking more systematically.

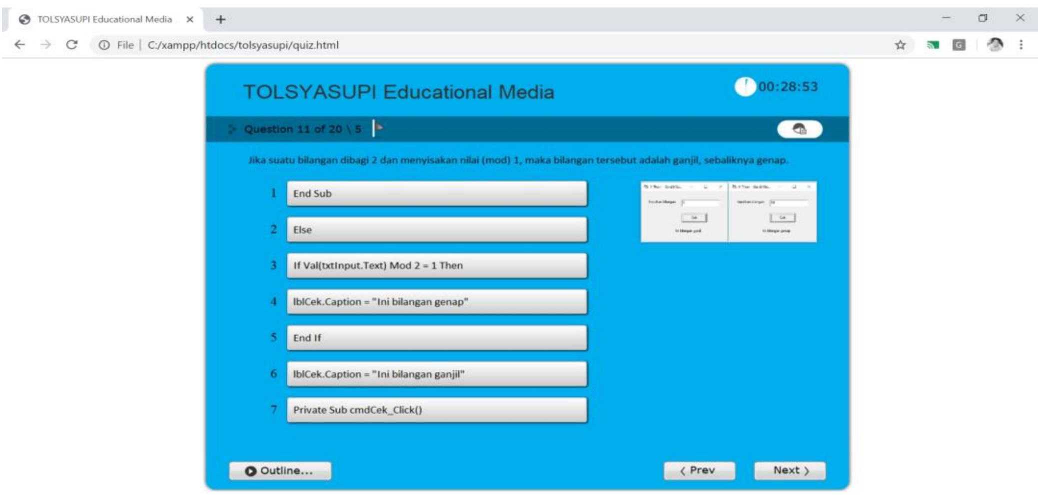

Figure 2. Problem-Solving Interaction Interface

The problem-solving process is that students must interact by drag and drop to move the card composition series then arrange them appropriately and structured according to the questions presented and the resulting program interface visualization output (see Figure 2). This problem-solving consists of 20 items with a duration of 30 minutes for completion. Students are freely welcome to return and continue to other problems in the process of solving this problem.

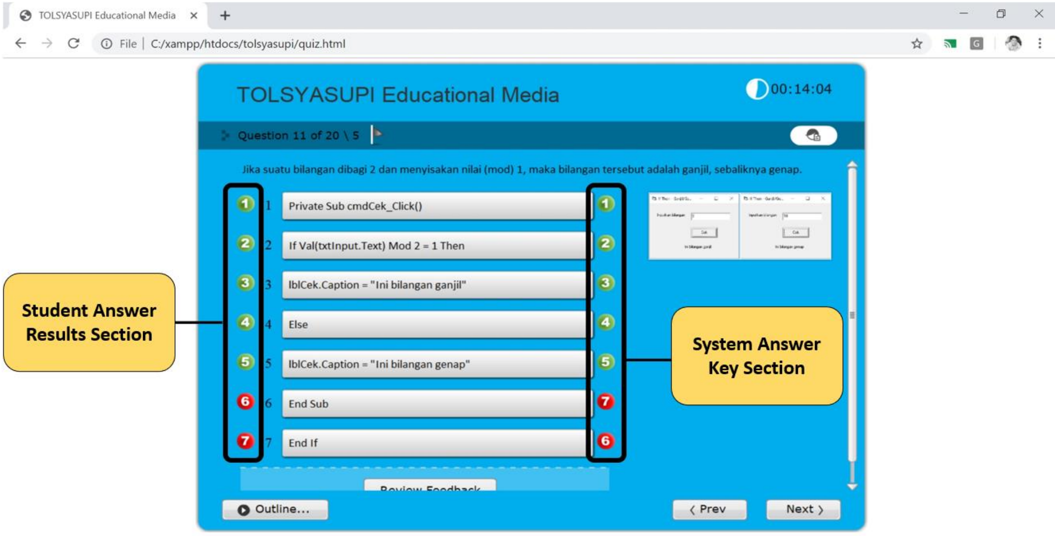

Figure 3. Feedback Interface

In the feedback process section, students are welcome to find out and rediscover information about solving problems that have been done, which parts are true and false solutions. The interactive learning environment system will match the answer pattern between the system's answer key and the student's answer results (see Figure 3).

RESEARCH METHODOLOGY

This study used a quasi-experimental design method with a nonequivalent control group design, involving 36 vocational high school students with divisions for the experimental group (N=18) and control group (N=18). For data analysis, the technique of independent sample t-test was used to determine the results of the treatment values and paired sample t-test to determine the difference in values between the results of the pre-test and post-test.

Based on the research scenario, it consists of two implementation cycles. Then the number of samples involved were 36 people who were divided into two groups. In this activity, what is very striking is that the two groups are equally treated, namely solving problems/questions in an interactive learning environment system. However, the early stages of asking questions/problems (the core process of the problem-posing type of open-posing) were only carried out by the experimental group, while the control group was not. This is to find out the difference in the results obtained from the point of view of effects, between those who pose a problem first and those who do not pose a problem.

Furthermore, to find out student learning outcomes, the interactive learning environment system provides facilities in the form of a problem-solving process, which when students have finished working, the system will directly direct it to information on learning outcomes. For the calculation of student learning outcomes, it uses an objective test technique without correcting answers. According to Rofieq in [26] for the method of scoring objective tests, there are three kinds, namely: scoring without answer correction, scoring with answer correction, scoring with different weight items.

In this study, it takes the form of scoring without correcting answers, namely scoring by means of each item answered correctly gets a score of 5. Student scores are obtained by counting the number of items answered correctly. In the interactive learning environment system, it has been arranged for the evaluation section of the results of students' answers after taking the quiz, that is, if the entire series of card compositions/blocks of program code are arranged according to the answer key, correct, and appropriate, then the score obtained by the student is 5 points. If one, more, or even all of the code block arrangement is wrong, then it does not get a score or is worth 0 points.

Based on the Minimum Completeness Criteria or KKM determined by the school concerned that the learning outcomes of Basic Programming subjects, the subject of branching control structures are said to be "complete" if individually a student gets a minimum score of ≥ 70.00, and if individually a student gets a score below < 70.00 then it is said to be "incomplete". For the interpretation of the value of learning outcomes according to the curriculum of the school which is also referred to as the predicate of competency achievement, namely: 95-10: Very Competent (A+); 90-94: Very Competent (A); 85–89: Very Competent (A-); 80-84: Competent (B+); 75-79: Competent (B); 70–74: Quite Competent (C); < 70: Less Competent (D).

After that, for systems that exist in interactive learning environments, when the results of these values have been calculated, the system will process and select them. If the final score obtained is ≥ 70.00, then the system will immediately give a "successful" decision. If the final score is < 70.00, then the system also directly declares the decision "failed".

To calculate the average value of the research results obtained, the collected data is analyzed by finding the mean of a single data which some or all of the scores have a frequency of more than one and then calculating the percentage [27].

Then, after the two groups were given treatment, namely by using the interactive learning environment system, only the experimental group asked questions (problems) and answers into the system and then participated in solving the problem, while the control group was enough to just solve the problem, without posing the problem into the system. Then the data obtained were analyzed to determine the magnitude of the difference/influence of student learning outcomes between the experimental group class and the control group class.

Data analysis techniques to determine the effect using the Independent Sample T-Test. According to [28] this test is also referred to as a comparison of two independent variables (T-Test) which is used to compare (differentiate) whether the two variables are the same or different. The point is to test the generalization ability (the significance of the research results in the form of a comparison of the state variables of the two sample averages). In this study, it is intended to determine the difference in interaction in the use of an interactive learning environment system between those who submit problems first to the system and without submitting problems, where the submission of problems into the system as an independent variable on student learning outcomes which is the dependent variable.

The principle of Independent Sample T-Test testing is to see the difference in the variation of the two groups of data so that before testing, it must first be known whether the variance is the same (equal variance) or the variance is different (unequal variance). The degree of homogeneity of variance should be tested.

The data is declared to have the same variance (equal variance) if F-Count < F-Table, and vice versa. Data variance is declared unequal (unequal variance) if F-Count > F-Table. The form of the variance of the two groups of data will affect the standard error value which will ultimately distinguish the test formula. T-Test for the same variance (equal variance) using the formula polled variance. T-Test for unequal variance using the separated variance formula.

The basis for decision making from the Independent Sample T-Test test (based on the use of the SPSS application), according to [29] it should be noted that before interpreting the output results, we must first know the basis for making decisions in this test, namely: Sig. (2-tailed) > 0.05 then H_o is accepted and H_a is rejected, which means there is no difference in results between the experimental group and the control group or if the value of Sig. (2-tailed) < 0.05 then H_o is rejected and H_a is accepted, which means there is a difference in results between the experimental group and the control group. To find out the difference between the pre-test and post-test, Paired Sample T-Test was used.

Furthermore, to analyze the level of the questions by knowing the estimates of the easy and difficult questions and comparing them with the results of student work. The tracking technique is carried out to match the system answers with student answers, then trace the level of ease and difficulty.

Initially, the admin or teacher will determine whether the questions that have been entered into the system database are included in the easy or difficult category. Labeling the questions is called the process of predicting the level of the questions and adjusting the question id. This question id will have an effect and is permanent on the condition of random presentation or not. After the labeling is done, then it is stored back in the system database. In the process of analyzing the level of questions, what applies is the system will automatically compare the predictions with all the results of student answers.

To determine the results of the analysis, it will then be re-labeled that is accurate and inaccurate with the following rules:

1. If the prediction is TRUE (EASY) and the student's answer is TRUE (EASY), then the label is ACCURATE
2. If the prediction is TRUE (EASY) and the student's answer is FALSE (DIFFICULT), then the label is INACCURATE
3. If the prediction is FALSE (DIFFICULT) and the student's answer is FALSE (DIFFICULT), then the label is ACCURATE
4. If the prediction is FALSE (DIFFICULT) and the student's answer is TRUE (EASY), then the label is INACCURATE

RESULTS AND DISCUSSION

Learning Outcomes Analysis

To determine student learning outcomes, the final assessment is carried out based on the scores obtained by each student after they have completed the questions in the system with a time limit of 30 minutes. Each answer from each correct number of questions is given 5 points, if one of the program code compositions is wrong then all are considered wrong and given 0 points. This assessment of learning outcomes is carried out when they have solved problems in the system carried out at the second and fourth meeting. At the second meeting, the questions were in random status, and at the fourth meeting, the questions were sorted by category/level from the easiest to the hardest.

Obtaining student learning outcomes at the second meeting with a system of distributing questions randomly regardless of the easy-to-difficult level. Obtaining student learning outcomes at the fourth meeting with a system of distributing questions in order based on the level of the easiest to the hardest questions, then the data obtained will be analyzed. The following are the results of the analysis obtained from the learning outcomes data presented in Table 1 for the second and fourth meeting.

Table 1. Learning Outcomes Data

Second Meeting		Fourth Meeting	
Question Number	**Total Overall Score**	**Question Number**	**Total Overall Score**
1	70	1	180
2	180	2	180
3	145	3	180
4	120	4	175
5	180	5	180
6	145	6	180
7	170	7	180
8	115	8	175
9	70	9	175
10	175	10	175
11	180	11	175
12	180	12	165
13	130	13	165
14	170	14	165
15	180	15	155
16	165	16	165
17	180	17	140
18	120	18	135
19	90	19	115
20	115	20	85

Total	2,880	**Total**	3,245
Mean	80	**Mean**	90.14
Predicate	Competent	**Predicate**	Very Competent
Label	B+	**Label**	A
Successfully	26	**Successfully**	33
Failed	10	**Failed**	3

The results from Table 1 are student learning outcomes at the end of the first cycle at the second meeting, where the system for distributing questions in the quiz is 20 questions with a random system without paying attention to the point of view of the ease and difficulty of the questions. The score obtained by the students was at number 80 with the predicate Competent or the letter B+, but in this condition, there were still 10 people who failed to get good learning outcomes. Furthermore, the excavation of findings on the learning outcomes of the second cycle at the fourth meeting.

The results obtained are based on Table 1, that the acquisition value of student learning outcomes of the second cycle at the fourth meeting is at an average value of 90.14 with the predicate of Very Competent with the letter A, and the level of student failure tends to decrease, namely only three people who fail.

Then the analysis of the learning outcomes of the second and fourth meetings is compared. The increase in roughness occurred between the learning outcomes of the second and fourth meetings which were at a difference of 10.14 with the final average score of 85.07 (See Table 2), the time required also decreased, meaning that at the fourth meeting the students tended to solve the problems. faster. Most likely they have understood the pattern of the problem, or even the branching control structure subject has been absorbed by them well.

Table 2. Comparative Analysis of Learning Outcomes

Average Learning Outcomes	Score	Predicate	Label	Average Time Required (Time Elapsed)
Second Meeting	80	Competent	B+	23:26
Fourth Meeting	90.14	Very Competent	A	15:26
Hasil Akhir	85.07	Very Competent	A-	19:26

If analyzed further, the need to compare the performance of the experimental group with the control group is presented in Table 3.

Table 3. Comparison of Analysis of Student Learning Outcomes in Two Groups

Group	Type	Second Meeting	Fourth Meeting
Experimental Group	Average Time Elapsed	< 21 minutes	< 11 minutes
	Number of Successful Students	17	18
	Number of Failed Students	1	0
	Lowest Score	65	90
	Highest Score	100	100
Control Group	Average Time Elapsed	> 21 minutes	> 11 minutes
	Number of Successful Students	9	15
	Number of Failed Students	9	3
	Lowest Score	45	55
	Highest Score	90	90

From the data listed in Table 3, it can be analyzed that the experimental group tends to be superior in achievement compared to the control group, where the numbers appear with very striking differences. Researchers have the assumption that, with the experimental group carrying out the question-posing process first (problem-posing process), they experience a phase of thinking and analyzing problem-solving indirectly. Compared with the control group who did not ask questions first and were immediately given a quiz to complete.

Then to ensure the results of the analysis are valid or not, the researchers conducted an analysis using the Independent Sample T-Test assisted by SPSS software with the results presented in Table 4 and Table 5.

Table 4. Statistical Comparison of Learning Outcomes of the Second Meeting

Group	N	Mean	Std. Deviation	Std. Error Mean
Experimental	18	90.556	9.8352	2.3182
Control	18	69.444	14.8412	3.4981

Based on the data in Table 4, it can be seen that the number of data on learning outcomes in the experimental group was 18 students, while for the control group there were 18 students. The average value of student learning outcomes at this second meeting, for the experimental group, was 90.556, while the control group was 69.444. Thus, statistically descriptive, it can be concluded that there is a difference in the average student learning outcomes between the experimental group and the control group. Furthermore, to prove whether the difference is significant or not, it is necessary to interpret the output using the Independent Sample T-Test.

The result can be seen that the value of Sig. Levene's Test for Equality of Variances is 0.023 < 0.05, it can be interpreted that the data variance between the experimental group and the control group is not homogeneous or not the same but the amount is equivalent. So that the interpretation of the output table from the Independent Sample T-Test is guided by the line data value for "Equal variances not assumed". The data in the Equal variances not assumed is known that Sig. (2-tailed) of 0.000 <0.05, so as the basis for decision making in the Independent Sample T-Test, it can be concluded that H_o is rejected and H_a is accepted. Thus, the conclusion is that there are differences in learning outcomes between the experimental group who asked questions (problem-posing process) first on interactive learning environment system compared to the control group who did not ask questions (problem-posing process) on interactive learning environment system. Furthermore, the researcher re-analyzed the learning outcomes for the fourth meeting and to ensure the progress of the results obtained at the second previous meeting which already provided answers to the hypothesis.

Table 5. Statistical Comparison of Learning Outcomes of the Fourth Meeting

Group	N	Mean	Std. Deviation	Std. Error Mean
Experimental	18	98.889	2.7416	.6462
Control	18	81.389	10.5448	2.4854

From the data in Table 5, it is known that the number of data on learning outcomes in the experimental group was 18 students, while for the control group there were 18 students. The average value of student learning outcomes at the fourth meeting, for the experimental group, was 98.889, while the control group was 81.389. Thus, statistically descriptive, it can be concluded that there is a difference in the average student learning outcomes between the experimental group and the control group. Furthermore, to prove whether the difference is significant or not, it is necessary to interpret the output using the Independent Sample T-Test.

The result is that the value of Sig. Levene's Test for Equality of Variances is 0.002 < 0.05, it can be interpreted that the data variance between the experimental group and the control group is not homogeneous or not the same but the amount is equivalent. So that the interpretation of the output table from the Independent Sample T-Test is guided by the line data value for "Equal variances not assumed". The data in the Equal variances not assumed is known that Sig. (2-tailed) of 0.000 <0.05, so as the basis for decision making in the Independent Sample T-Test, it can be concluded that H_o is rejected and H_a is accepted. Thus, the conclusion is that there are differences in learning outcomes between the experimental group who asked questions (problem-posing process) first in the interactive learning environment system compared to the control group that did not ask questions (problem-posing process) in the interactive learning environment system.

Question Level Analysis

The analysis of determining the level of questions that have been raised is based on the number of students who answer correctly. As for the distance stated: if 0-18 people have the correct answer, then the question is indicated to be difficult and if 19-36 people answer is correct then the question is indicated to be easy, this rule has also been explained in the research methodology section on the analysis of determining the level of the question.

In implementing the problem-solving process by solving problems in the system, each student from the experimental group has a chance of getting the correct answer, which is 1 question out of 20 questions, in the sense of 5% they are likely to be able to answer correctly, because they perform the stages of submitting recommendations for questions and answers (the problem-posing process) first into the system, but it is also based on the level of students' memory, while the control group has no chance for correct answers, because they are only included to solve problems, without recommending questions and answers first. The results of the analysis of the level of learning outcomes at the second meeting are presented in the Table 6.

Table 6. Results of the Level Analysis of Learning Outcomes at the Second Meeting

Number of Question	Number of Students with Correct Answers	Question Category/Level	Percentage	Predicate
1	14	Difficult	38.90%	Weak
2	36	Easy	100%	Very Strong
3	29	Easy	80.56%	Very Strong
4	24	Easy	66.70%	Strong
5	36	Easy	100%	Very Strong
6	29	Easy	80.60%	Very Strong
7	34	Easy	94.40%	Very Strong
8	23	Easy	63.90%	Strong
9	14	Difficult	38.90%	Weak
10	35	Easy	97.20%	Very Strong
11	36	Easy	100%	Very Strong
12	36	Easy	100%	Very Strong
13	26	Easy	72.20%	Strong
14	34	Easy	94.40%	Very Strong
15	36	Easy	100%	Very Strong
16	33	Easy	91.70%	Very Strong
17	36	Easy	100%	Very Strong
18	24	Easy	66.70%	Strong
19	18	Difficult	50%	Enough
20	23	Easy	63.90%	Strong
Mean	28,80	Easy	80%	Strong

Based on Table 6, it can be seen that the questions that are indicated to be easy are 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 20. The questions that are indicated to be difficult are 1, 9, and 19. However, overall the questions are at an easy level (See Figure 4).

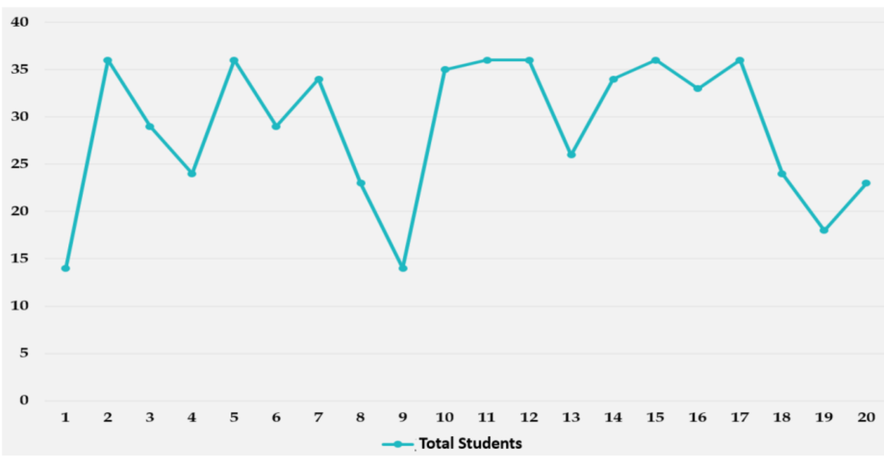

Figure 4. Random Question Level Analysis Graph

Based on Figure 4, the pattern that occurs for the level of questions at random, the probability of correct answers for students lies in question numbers 2, 3, 11, 12, 15, and 17. Meanwhile, those who have a very small chance of correct answers are in questions numbers 1 and 9.

Furthermore, a match was made to the predictive design of the question level with the results of the level analysis of student learning outcomes for the second meeting, the tracking results are presented in the Table 7.

Table 7. Results of Matching and Tracking Question Levels on Learning Outcomes of the Second Meeting

Number of Question	Level Pattern Prediction Design from System	Answer Patterns from Students	Tracking Results
1	Difficult	Difficult	Accurate
2	Easy	Easy	Accurate
3	Difficult	Easy	Inaccurate
4	Easy	Easy	Accurate
5	Easy	Easy	Accurate
6	Difficult	Easy	Inaccurate
7	Easy	Easy	Accurate
8	Difficult	Easy	Inaccurate
9	Difficult	Difficult	Accurate
10	Difficult	Easy	Inaccurate
11	Easy	Easy	Accurate
12	Difficult	Easy	Inaccurate
13	Easy	Easy	Accurate
14	Easy	Easy	Accurate
15	Easy	Easy	Accurate
16	Difficult	Easy	Inaccurate
17	Easy	Easy	Accurate
18	Difficult	Easy	Inaccurate
19	Difficult	Difficult	Accurate
20	Difficult	Easy	Inaccurate

Based on the data from Table 7, the detection results obtained are that as many as 12 items were tracked accurately and 8 items were tracked inaccurately. The meaning of accurate and inaccurate here is in accordance with the existing rules in the research methodology section. The more accurate the tracking results, meaning that the predictive design of the question level and student learning outcomes when solving problems in the system can be controlled. If the tracking result is inaccurate, it means that it cannot be controlled or the prediction design is not correct.

Furthermore, the results of the analysis of the level of learning outcomes at the fourth meeting are presented in the Table 8.

Table 8. Results of the Level Analysis of Learning Outcomes at the Fourth Meeting

Number of Question	Number of Students with Correct Answers	Question Category/Level	Percentage	Predicate
1	36	Easy	100%	Very Strong
2	36	Easy	100%	Very Strong
3	36	Easy	100%	Very Strong
4	35	Easy	97.20%	Very Strong
5	36	Easy	100%	Very Strong
6	36	Easy	100%	Very Strong
7	36	Easy	100%	Very Strong
8	35	Easy	97.20%	Very Strong
9	35	Easy	97.20%	Very Strong
10	35	Easy	97.20%	Very Strong
11	35	Easy	97.20%	Very Strong

12	33	Easy	91.70%	Very Strong
13	33	Easy	91.70%	Very Strong
14	33	Easy	91.70%	Very Strong
15	31	Easy	86.10%	Very Strong
16	33	Easy	91.70%	Very Strong
17	28	Easy	77.80%	Strong
18	27	Easy	75%	Strong
19	23	Easy	63.90%	Strong
20	17	Difficult	47.20%	Enough
Mean	32,45	Easy	90.14%	Very Strong

Based on Table 8, it can be seen that the questions that are indicated as difficult are only number 20 and the questions that are indicated to be easy are 1 to 19. It is also very visible that the pattern of numbers that form the number of students with correct answers tends to be narrowed. From 36 to 17, it means that the elements of ease to the difficulty are described indirectly. However, overall the questions are at an easy level with a percentage of 90.14% with a Very Strong predicate. The students tend to feel that it is easy to answer these questions (see Figure 5). The ease in solving these questions is most likely due to experience in solving previous questions or perhaps already knowing the pattern from the previous questions.

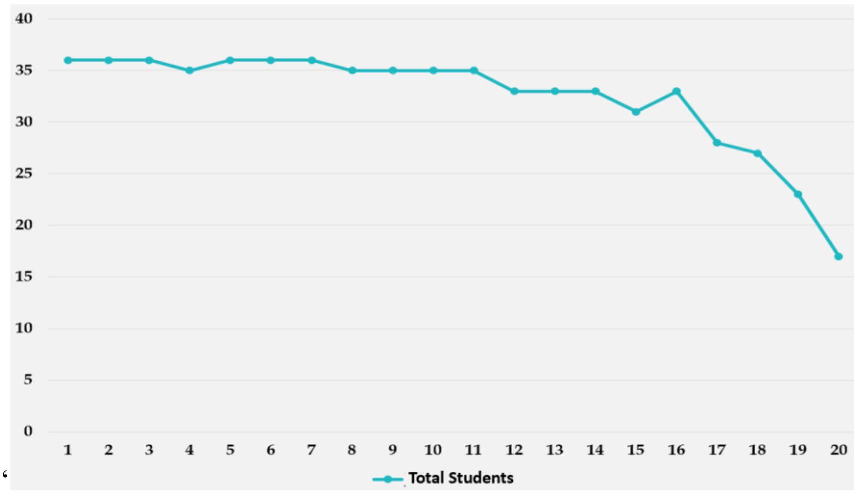

Figure 5. Non-Random Question Level Analysis Graph (Easy to Difficult Pattern)

Based on Figure 5, it is clear that the pattern that occurs is that the more students move on to the next question, the smaller the chances of students getting the correct answer. Except for question number 16, there should be a small chance of being right, but in fact, there are many students whose answers are correct. The system has tracked that the decrease in the probability of correct answers for easy to difficult questions is gradual and has a regular pattern.

Furthermore, a match was made to the predictive design of the question level with the results of the level analysis of student learning outcomes for the fourth meeting, the tracking results are presented in the Table 9.

Table 9. Results of Matching and Tracking Question Levels on Learning Outcomes of the Fourth Meeting

Number of Question	Level Pattern Prediction Design from System	Answer Patterns from Students	Tracking Results
1	Easy	Easy	Accurate
2	Easy	Easy	Accurate
3	Easy	Easy	Accurate
4	Easy	Easy	Accurate
5	Easy	Easy	Accurate

6	Easy	Easy	Accurate
7	Easy	Easy	Accurate
8	Easy	Easy	Accurate
9	Easy	Easy	Accurate
10	Easy	Easy	Accurate
11	Easy	Easy	Accurate
12	Easy	Easy	Accurate
13	Easy	Easy	Accurate
14	Difficult	Easy	Inaccurate
15	Difficult	Easy	Inaccurate
16	Difficult	Easy	Inaccurate
17	Difficult	Easy	Inaccurate
18	Difficult	Easy	Inaccurate
19	Difficult	Easy	Inaccurate
20	Difficult	Difficult	Accurate

Based on the data from Table 9, the detection results obtained were 14 items tracked accurately and 6 items tracked inaccurately. In this non-random question level design, the level of accuracy is increased compared to the previous random question level design. The problem level pattern, which generally starts from the easiest to the most difficult, is attempted to provide a defense session for students to be persistent in solving these questions. This strategy is a way and process in solving problems.

The results of tracking the level pattern of this question will be used further to determine and design the emotional level of students in solving problems, the level of student defense, and also the element of student unsaturation in solving problems.

CONCLUSIONS AND FUTURE WORK

In this study, an interactive learning environment system has been implemented that instills a flow of problem-posing and problem-solving interactions, the system is used as a tool for learning basic programming on branching control structure subject. As for the results of the extracted effects in the form of learning outcomes based on the data on the equal variances not assumed, it is known that Sig. (2-tailed) of $0.000 < 0.05$ with the results showing that there is a difference in learning outcomes between the experimental group that asks questions (problem-posing process) first on the system compared to the control group that does not ask questions (problem-posing process) on the system. Furthermore, for the analysis of the level of questions in random form with a prediction accuracy level of 12 questions and in non-random form (easy to difficult) the level of prediction accuracy is 14 questions. Question level analysis like this will be used to further improve the system in tracking student conditions.

The recommended future work is to conduct an analysis of activities, motivations, recording the movement pattern of the series composition of the program code line cards for each question and each student, to find knowledge of data from patterns of thinking, how to pose problems, and techniques for solving problems from each student.

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