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Improving Student Interests and Learning Outcomes Using Project Based E-Learning Models

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ABSTRAK

Permasalahan yang melatar belakangi dilakukannya penelitian ini adalah kurang efektifnya proses pembelajaran setelah pandemi Covid-19 yang mengakibatkan rendahnya minat belajar dan hasil belajar peserta didik. Sehingga perlu dilakukan pemulihan proses pembelajaran melalui model pembelajaran yang tepat dan sesuai dengan perkembangan zaman peserta didik serta mampu menanggulangi ketertinggalan pembelajaran selama pandemi Covid-19. Tujuan penelitian ini adalah menganalisis perbedaan minat dan hasil belajar Informatika antara peserta didik yang belajar dengan model pembelajaran Project Based E-Learning dibandingkan dengan peserta didik yang belajar menggunakan model pembelajaran direct e-learning. Sehingga penelitian ini diharapkan mampu memberikan gambaran model pembelajran yang lebih efektif pada mata pelajaran informatika dan dapat meningkatkan minat serta hasil belajar peserta didik terutama pada era revolusi industri 4.0. Populasi penelitian eksperimen semu dengan rancangan posttest only non-equivalent control group design ini adalah Siswa Kelas IX SMP dengan dua kelas dipilih sebagai sampel menggunakan teknik group random sampling. Data dianalisis secara deskriptif dan menggunakan Multivariate Analysis of Variance Manova dengan taraf signifikansi 5%. Hasil penelitian menunjukkan bahwa, terdapat perbedaan minat dan hasil belajar antara peserta didik yang belajar dengan model project based e-learning dan peserta didik yang belajar dengan model direct e-learning, dengan hasil yang lebih baik pada peserta didik yang belajar dengan model project based e-learning.

ABSTRACT

The problem underlying this research is the ineffectiveness of the learning process after the Covid-19 pandemic which resulted in low interest in learning and student learning outcomes. So it is necessary to restore the learning process through appropriate learning models and by the development of the times of students and be able to overcome the learning loss during the Covid-19 pandemic. The purpose of this study was to analyze differences in interest and learning outcomes in Informatics between students who studied with the Project E-Learning learning model compared to students who studied using the direct e-learning learning model. So that this research is expected to be able to provide an overview of learning models that are more effective in informatics subjects and can increase students' interest and learning outcomes, especially in the era of the Industrial Revolution 4.0. The population of this quasi-experimental study with the posttest-only non-equivalent control group design plan was Class IX students of junior high school with two classes selected as samples using a group random sampling technique. Data were analyzed descriptively and using Multivariate Analysis of Variance/MANOVA with a significance level of 5%. The results showed that there were differences in interest and learning outcomes between students who studied with the project-based e-learning model and students who studied with the direct e-learning model, with better results for students who studied with the project-based e-learning model.

1. INTRODUCTION

Education is a systematic effort by schools to create an active, creative and innovative learning process, to answer the challenges of 21st century learning. Therefore, identifying learning competencies is an important thing to do in facing the challenges of the times in the 21st century. There are eight keys to educational goals, namely: having faith and piety, having noble character, being healthy, knowledgeable, capable, creative, independent, democratic and responsible (Arwansyah & Wahyuni, 2019; Zubaidah, 2016). One of the objectives of national education explicitly emphasizes the element of independence. Independent here in the sense that students are able to become lifelong learners who learn from a variety of learning sources. Of course this cannot be created instantly. It needs a process and habituation that starts from how students do learning in class and how the teacher takes a position in learning, and trains them how to construct their own knowledge. Students should have enough freedom to develop themselves, explore the potential that exists within them so that they can develop according to the interests and talents that exist in these students (Hendy, 2020; Nurhaliza et al., 2022). The teacher

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is more in charge of facilitating the learning process, creating a good learning space and providing access to learning resources that are relevant to learning. Providing assistance to students in learning is adjusted to the level of students' understanding of the material so that it can foster self-confidence in students in learning and developing into independent learners.

To realize learning that is capable of producing independent learners and possessing 21st century skills, the role of learning technology is very important. Learning technology is theory and practice in the design, development, utilization, management, and evaluation of processes and resources for learning (Aini et al., 2020; Sukendro et al., 2020; Teräs et al., 2020). Learning technology itself has five areas, namely design areas, development areas, utilization areas, management areas and assessment areas. The design area is a process for determining learning conditions which includes the study of learning systems, message design, learning strategies, and learning characteristics. Development area means the process of translating design specifications into physical form which includes the development of print technology, audio-visual technology, computer-based technology and multimedia. The utilization area includes actions using instructional methods and models, media materials and equipment to enhance the learning atmosphere (Fearnley & Amora, 2020; Yeni & Cagiltay., 2017). The management area includes controlling learning technology through planning, organizing, coordinating and supervising. The assessment area is the process of determining the adequacy of learning and learning which includes problem analysis, measuring benchmarks, formative assessments, and summative assessments.

The era of society 5.0 also demands learning that supports the industrial revolution 4.0 where digital penetration has touched almost all segments of human life, including in the world of education. The various kinds of demands that the paradigm of the learning process should also shift and change using an approach that is able to prepare students to master 21st century competencies by utilizing advances in digital technology in the industrial revolution 4.0 (Akbar, 2017; Bosica et al., 2021). The implementation of innovative learning models in every learning process has been echoed by the government for a long time. As well as paying special attention to the 2013 curriculum and the independent curriculum. Innovative learning with a scientific approach to the 2013 curriculum and innovative learning that takes into account the diversity of students or better known as differentiated learning is the spirit of an independent curriculum. Teachers are required to be creative and innovative in designing learning by utilizing digital devices so that they can improve the competence of creative thinking skills, critical thinking and problem solving, communication, and collaboration among students (Chick et al., 2020; Erniwati, 2022; Widiana, 2022).

Previous research on the effect of the question student have (QSH) learning model assisted by the snakes and ladders game on science learning outcomes stated that so that students want to be more directly involved in learning, teachers are advised to use learning models that are varied and in accordance with the learning objectives to be achieved (Candra & Retnawati, 2020). This of course aims to make learning fun and encourage students' interest in learning. It is clear here that it is emphasized that the importance of a teacher's creativity in designing learning with learning models that are able to attract students' interest in learning so that later they are able to improve their learning outcomes. But the reality on the ground is not like that, teachers still feel that conventional learning using direct instructional models is an effective way of conveying material to students. This is inseparable from the demands of the teacher who must complete the learning material within the stated deadline. With this model students will be passive and only accept whatever information is conveyed by the teacher.

Learning tends to go in one direction by giving less room for students to develop and express themselves. Thus this model is not appropriate for developing creative thinking skills, critical thinking and problem solving, communication, and collaboration in students according to the demands of 21st century skills (Huertas-Abril, 2021; Sulaiman & Ismail, 2020). This is also one of the causes of students' lack of interest in learning as shown by students who do not want to participate actively in class learning activities, do not complete assignments given by the teacher and also students feel forced to participate in the learning process. Declining interest in learning also has implications for student learning outcomes, this is indicated by the declining average national exam scores from year to year.

Interest in learning itself is an aspect that can determine a person's motivation in carrying out certain activities. Meanwhile, according to previous study interest in learning is a preference for and a sense of interest in something or activity without being told (Slameto, 2003). From the two definitions above, it can be concluded that interest in learning is acceptance of a relationship between oneself and something that is outside one's self. The stronger or closer the relationship, the more interest it generates. While learning outcomes are student self-assessments and changes that can be observed, proven, and measurable in the abilities or achievements experienced by students as a result of learning experiences (Arwansyah & Wahyuni, 2019; Zaeriyah, 2022). In line with this other study states that several indicators of interest in learning are: feelings of pleasure, interest, acceptance, and student involvement (Slameto, 2003). From the several definitions put forward regarding the indicators of interest in learning mentioned above, this study uses indicators of interest, namely 1) feelings of pleasure; 2) attention; 3) interest; and 4) student involvement.

Learning outcomes can describe students' abilities after what they know and learn. Learning outcomes are abilities that students acquire through learning activities. In another sense, learning outcomes are patterns of behavior, values, notions, attitudes, appreciation, and skills (Nikmawati et al., 2021; Nurhasanah & Sobandi, 2016). Learning itself is a process of someone trying to obtain a relatively permanent form of behavior change. The description above provides an understanding that learning outcomes are changes that occur in individuals who learn, both changes in knowledge and behavior, which are shown through test scores. Student learning outcomes are influenced by two factors, namely internal factors and external factors of students. Internal factors of students include health problems, disabilities, psychological factors (intelligence, interest in learning, attention, talent, motivation, maturity and readiness of students), and fatigue factors (Nurdin, 2019; Qomariyah, 2020; Yuanta, 2020). Meanwhile, external factors that influence student learning processes and outcomes include family, school and community factors (Angga et al., 2020; Devi & Sudarma, 2023; Garad et al., 2021).

To foster interest in learning and improve student learning outcomes, a learning model is needed that is able to stimulate students' curiosity, creativity and critical thinking reasoning which is also in accordance with the nature of the current era of students which cannot be separated from the development and use of technology. Previous research stated that the use of Google Classroom as a teaching tool in higher education is very interesting, motivates students, increases students' positive attitudes, and is very useful (Yakin et al., 2022). In line with that, other research stated that the MoLearn-assisted Blended Web Mobile Learning Model has better HOTs-based learning outcomes compared to those who do not use the Blended Web Mobile Learning Model (Hariadi et al., 2022). This further reinforces that the role of electronic learning will be able to strengthen students' interest in learning. However, to translate this emerging interest into a learning activity that can develop creative thinking skills, critical thinking and problem solving, communication, and collaboration among students, an appropriate learning model is needed and one of the appropriate learning models is project based learning. Other research shows that PJBL can specifically promote the use of collaboration, artifacts, technological tools, problem solving, and certain scientific practices, such as conducting research, presenting results, and reflection in science education (Markula & Aksela, 2022). This was also corroborated by other study who stated that the PjBL model applied to the experimental group significantly influenced students' creative thinking skills compared to the Direct Instructional model applied to the control group on temperature and expansion material (Biazus & Mahtari, 2022). This is because this research specifically aims to analyze differences in interest and student learning outcomes between students who study with the project-based e-learning model and students who study using the direct e-learning model.

From the explanation above, it can be seen that various studies have explored the influence of learning models on interest and learning outcomes. However, until now there has been no research that examines the relationship between the project based e-learning learning model and students' learning interest and learning outcomes simultaneously. What's more, informatics is a new subject that appears in the independent curriculum and there has not been much research related to this subject. The aims of this study is to analyze differences in interest and learning outcomes in Informatics between students who studied with the Project E-Learning learning model compared to students who studied using the direct e-learning learning model. It is hoped that this research can serve as an initial foundation for further research, especially in informatics subjects.

2. METHOD

The design of this research is a quasi-experimental quantitative research. Experimental research is a research method used to find the effect of certain treatments on others under controlled conditions (Rogers & Revesz, 2019). In this study, research data will be analyzed using statistical methods. The research design used was a posttest only non-equivalent control group design. This research divides the group into two, namely the experimental group or class and the control group or class. The experimental class was given a learning treatment with a project based e-learning model and the control class was given direct e-learning learning. The experimental class and the control class were selected without a random placement procedure. This design was used because it was not possible to control and/or manipulate all relevant variables. The design pattern of this research is as described in Figure 1.

Figure 1. Research Design

Information :
X1 : Treat the experimental class in the form of a PJBeL model; X2: Treat the control class in the form of a direct e-learning model; O_1, O_2: Final observation of interest and learning outcomes in the experimental class and control class;

Data analysis in this study used a 1×2 factorial design with Multivariate Analysis of Variance / Manova analysis. The choice of MANOVA has four benefits. First, Manova can detect combinations of differences found in univariate tests. Second, it can provide a dimension of difference that can discriminate between groups better than a single variable. Third, control for the experimental error rate when some degree of intercorrelation between the dependent variables. Fourth, it provides more statistical power than Anova when the number of dependent variables is 5 or fewer.

The population in this study was class IX at State Middle School 2 Negara for the 2022/2023 Academic Year which consisted of 10 classes with a total of 319 students. The research sample was taken using a group random sampling technique through a lottery to determine two classes as research samples from a total of 10 classes IX. This technique is used because the characteristics of the population have been formed in certain classes so it is not possible to randomize individuals, and each class that has been formed has the same opportunity to be part of the sample. And before the research, the initial data collection was carried out in the experimental class and control class to do an equivalence test with the aim of ensuring that the experimental class and control class were homogeneous. The number of samples took all students in class IX-A and IX-B of SMP Negeri 2 Negara, namely 64 people. The composition of the study sample members according to the analysis design is summarized in Table 1.

Table 1. Composition of Members of the Research Sample

No	Model	Number of Samples
1	Project Based E-Learning	32 People
2	Direct E-Learning	32 People

Prior to the research, initial data collection was carried out in the experimental class and control class to do an equivalence test with the aim of ensuring that the experimental class and control class were equivalent. The equivalence test is carried out by taking students' daily scores on the previous basic competencies, namely basic competencies. Understand the functions of a computer system (hardware and OS) that allows it to receive input, store, process and output data according to its specifications. Test the equality of the sample group before the study was carried out by conducting a t-test on the results of the daily assessment of basic competence. Based on the value of the t-test results, the significance value (Sig.) of the Informatics variable for students in the PjBel and Direct e-Learning class groups is 0.546, which is greater than 0.05. It can be concluded that the variance of data on Informatics learning outcomes in the group of students who will be treated with the project-based e-learning model and in the group of students who will be treated with the direct e-learning model is equivalent. Details of the t-test results in the sample group are presented in Table 2.

Table 2. Sample Group Equality Test

		Levene's Test For Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std Error Difference	95% Confidence Interval	
									Lower	Upper
Value of Informatics	Equal Variances assumed	0.296	0.589	-0.61	62	0.546	-2.031	3.349	-8.726	4.664
	Equal Variances not assumed			-0.61	61.986	0.546	-2.031	3.349	-8.726	4.664

The instruments developed in this study were a learning interest questionnaire and an informatics learning achievement test. The two instruments developed were used to obtain data in research. The learning interest questionnaire was used to identify students' learning interests while the student learning achievement test was used to measure students' informatics learning outcomes on the subject of data analysis. The learning interest instrument measures four dimensions of interest into 27 question items with 17 positive questions and 10 negative questions. The calculation of student response questionnaires is analyzed starting by checking and calculating the score for each answer chosen by students on the questionnaire that has been given. Next, proceed with recapitulating the

scores obtained by each student. In this study, a score for each answer was obtained using a Likert scale is show in Table 3.

Table 3. Likert Scale Category

Answer Category	Score for item	
	Positive	Negative
STS	1	4
TS	2	3
S	3	2
SS	4	1

The learning outcomes test instrument used in this study was a multiple-choice test with twenty items of cognitive questions, while affective and psychomotor with observational assessment. The way to develop a test instrument is to first create a question grid that functions to map the teaching material used for assessment. The informatics learning outcomes test grid in this study was compiled based on competency achievement indicators developed from the basic competencies of data analysis material. Parameters for each instrument are listed in Table 4.

Table 4. Grid of Research Instruments

Questionnaire	Aspect
Interest to learn	Feeling happy Attention Interest Student Engagement
Post Test Learning Outcomes	**Aspect**
	Indicators of basic competency in data processing materials using the advanced features of Microsoft Excel

Content validity for informatics learning outcomes in the form of tests on data processing materials using advanced features of Microsoft Excel, made according to basic competencies, indicators and test questions as outlined in the form of multiple choice questions. Theoretical validation is determined by expert judges. The test results were then tested empirically by testing the validity of the items which included an analysis of the level of difficulty, discriminating power and distractor effectiveness. The reliability test was analyzed with the Kuder Richardson 20 formula. In addition, the content validity of the interest in learning questionnaire is in accordance with the indicators of interest and statements as outlined in the questionnaire. The 25 statements that have gone through the theoretical test validation were then tested on 96 students as respondents. The results of the student questionnaire in the form of learning interest score data were then tested empirically including testing the validity of the items with the product moment correlation formula and reliability testing using Crohnbach's alpha. The test results are then analyzed to test the hypothesis. Sequentially, data analysis was carried out with data description, assumption test, and hypothesis testing. Hypothesis testing through manova analysis required several assumption tests, namely normality test, variance homogeneity test, box test, variance homogeneity test, and multicollinearity test. All assumption tests were carried out at a significance level of 5%. The data normality test was used as a reference to be able to see that the sample data came from a normally distributed population. Normality testing using SPSS based on the Kolmogorov-Smirnov test. Homogeneity test is to be able to see that two or more sample data groups come from populations that have the same variance. The box test is used to test the Manova assumption which requires that the variance/covariance matrix of the dependent variable is the same (not different).

While the multicollinearity test in this study is intended to determine whether there is a significant relationship between the dependent variables. If there is a high enough relationship, it means that there are the same aspects measured in the dependent variable. Multicollinearity testing was carried out to see the relationship between the variables of interest in learning and the variables of students' Informatics learning outcomes, both of which are dependent variables. Multicollinearity testing is carried out with the help of SPSS which is guided by the value of the variance inflation factor (VIF) or tolerance.

Discussion

The application of the project based e-learning model is carried out in 6 learning paths and is completed in 3 weeks. The six stages of learning consist of question, plan, schedule, monitor, assess and evaluate. These six stages of learning are integrated with the use of the Google Classroom application as a learning management system that assists students and teachers in managing material, assignments and assessments. Each stage of

learning provides a different and interesting learning atmosphere for students and encourages students to be active in the learning process. At the end of the meeting the researcher conducted a post test in the form of 25 multiple choice questions and provided an interest questionnaire to measure learning outcomes and students' interest in learning after receiving treatment. From the results of the posttest, in general, a descriptive analysis is obtained as shown in Table 5.

Table 5. Summary of Results of Descriptive Analysis of Research Data

Data Posttest	Learning model	Mean	STD	N
Interest	PjBeL	73.72	7.46	32
	Direct	69.25	6.78	32
	Total	**71.48**	**7.12**	**64**
Learning outcomes	PjBeL	82.97	6.33	32
	Direct	76.72	6.55	32
	Total	**79.84**	**6.44**	**64**

While the interest questionnaire distributed to students was analyzed descriptively using data concentration measures such as mean, median, and mode as well as data distribution measures such as deviation (standard deviation and variance). Table 5 contains the recapitulation of the results of calculating the value of student interest in learning based on the project-based e-learning and direct e-learning models and is also presented in the form of a bar chart for the total score data for each indicator of interest in learning in Figure 2.

Table 5. Recapitulation of Score Acquisition for Each Indicator of Learning Interest

Model	Indicator	Data Calculation Types			
		Total	Average	Geomeans	Harmean
PjBel	Feeling happy	625	19.53	19.40	19,27
	Attention	791	24,72	24.51	24,29
	Interest	573	17,91	17.78	17,64
	Student Engagement	360	11.25	10.96	10.68
Direct	Feeling happy	601	18.78	18,68	18.58
	Attention	753	23.53	23,41	23,29
	Interest	543	16.97	16,76	16.57
	Student Engagement	319	9.97	9.78	9.58

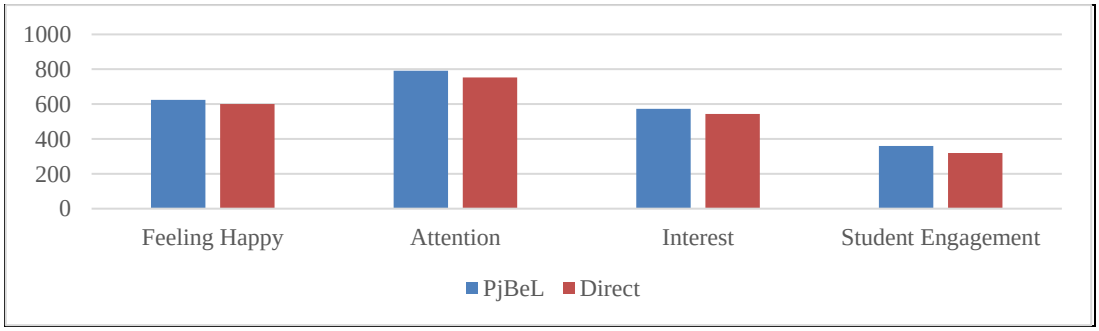

Figure 2. Achievement of the Total Score of Each Indicator of Student Learning Interest

Data on student interest in learning based on the data presented above shows that data acquisition following the project based e-learning model is higher than the direct e-learning model. Data on informatics learning outcomes were obtained from the results of the posttest groups of students who took part in the project-based e-learning model with the direct e-learning model. The research data were analyzed descriptively to describe the state of the data. Descriptive analysis was carried out in the form of a measure of the concentration of the data, namely the mean, median, and deviation (standard deviation and variance). Table 6 illustrates the recapitulation of learning outcomes calculated using project based e-learning and direct e-learning models.

Table 6 provides an overview of student informatics learning outcomes data. In detail, a description of student informatics learning outcomes in this study is as follows. Data obtained from informatics learning outcomes by applying the Project Based E-learning model on the posttest showed a score range of 70-95. The

mean score is 82.97 with a standard deviation of 6.33. Referring to the criteria for classifying informatics learning outcomes, the qualification for an average score of X of 82.97 is included in the very good category. The range of informatics learning outcomes scores from students following the direct e-learning model in the posttest was between 65-90, with an average score of 76.72 and a standard deviation of 6.55. Based on the guidelines for classifying student learning outcomes, an average score of X of 76.72 is classified as very good. This study uses the Multivariate Analysis of Variance Method (MANOVA) to test the hypothesis and is analyzed using the SPSS for Windows program. Table 7 presents the results of the multivariate test in this study.

Table 6 . Recapitulation of Informatics Language Learning Value Calculation Results

Statistics	Model	
	PjBeL ($A_1 Y_1$)	Direct ($A_2 Y_2$)
Means	82.97	76,72
Median	82.50	75.00
Variance	40.09	42.92
Standard Deviation	6.3	6.55
Maximum Score	95.00	90.00
Minimum Score	70.00	65.00
Range	25.00	25.00

Table 7 . Multivariate Test Results

	Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	0.996	7.835E3	2.000	61.000	0.000	0.996
	Wilks' Lambda	0.004	7.835E3	2.000	61.000	0.000	0.996
	Hotelling's Trace	256.889	7.835E3	2.000	61.000	0.000	0.996
	Roy's Largest Root	256.889	7.835E3	2.000	61.000	0.000	0.996
Model	Pillai's Trace	0.200	7.602	2.000	61.000	0.001	0.200
	Wilks' Lambda	0.800	7.602	2.000	61.000	0.001	0.200
	Hotelling's Trace	0.249	7.602	2.000	61.000	0.001	0.200
	Roy's Largest Root	0.249	7.602	2.000	61.000	0.001	0.200

The test results as shown in Table 7 show that the learning model has a significant influence on students' interest and learning outcomes in informatics. This can be seen from the statistics of Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root which show a significance level of 0.000 which is less than 0.05. Based on these results, H0 is rejected and H1 is accepted, which means that simultaneously (overall) the learning model has a significant influence on students' interest and learning outcomes in informatics. From the results of calculating the effect of interest in learning, it appears that the statistical significance value for Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root is 0.001, which is smaller than the significance value of 0.05. Therefore, it can be concluded that H_0 is rejected and H_1 is accepted, which means simultaneously (overall), the Project Based E-learning model has a significant effect on students' interest and learning outcomes in informatics.

The F value between learning models on student learning outcomes and interest was obtained F_{hitung} = 7.602. The value of F_{tabel} at a significant level of 0.05 is 4.140. It turns out that $F_{count} > F_{table}$ (7.602 > 4.140) and a significance value of 0.001 at a significance level of 0.05. Based on these results, H_0 is rejected and H_1 is accepted. That is, there are differences in the results and interest in studying Informatics students jointly and significantly between students who study project-based e-learning with direct e-learning. This is also supported from the results of the descriptive calculations where the average posttest score of learning outcomes following the PjBEL model is 82.97 and the average posttest score of the interest group of students following the PjBEL model is 73.72, while the group of students following the Direct model learning outcomes is 76.72 and the average interest score is 69.25. This shows that the learning outcomes and interests of students following the PjBEL model are better than the learning outcomes and interests of students following the Direct E-Learning model.

This conclusion is strengthened based on table 6 on the multivariate test which informs that there are significant differences in learning interest and learning outcomes of students from different classes, where the value of F = 7,602, p < 0.001; Wilks'Lambda = 0.800, ŋp = 0.200. Judging from the eta square table above, the eta square value is used to determine the magnitude of the effect size of the inter-class variable (effect size) of ŋp = 0.200 > 0.14, based on the Cohen Chart Magnitude table it can be concluded that together the PjBEL model has a large effect on both variables, namely students' learning outcomes and interest in Informatics. Furthermore, the MANOVA test results are seen from the data tests of between subjects effects as presented in Table 8.

Table 8. Multivariate Analysis of Variance Test Results of Between Subject Effects

Source	Dependent Variables	Type III Sum of Squares	df	MeanSquare	F	Sig.	Partial Eta Squared
Corrected Model	Learning outcomes	410,063	1	410.063	9.994	002	0.139
	Interest to learn	301,891	1	301.891	6.097	0.016	0.090
Intercepts	Learning outcomes	409280062	1	409280062	9.975E3	0.000	0.994
	Interest to learn	327613.141	1	327613.141	6.616E3	0.000	0.991
Model	Learning outcomes	410,062	1	410.062	9.994	002	0.139
	Interest to learn	301,891	1	301.891	6.097	0.016	0.090
Error	Learning outcomes	2543,875	62	41,030			
	Interest to learn	3069969	62	49.516			
Total	Learning outcomes	412234000	64				
	Interest to learn	330985000	64				
Corrected Total	Learning outcomes	2953938	63				
	Interest to learn	3371859	63				

Base on Table 8 the F value between learning models on student learning interest was obtained F_{hitung} = 6.097. The value of F_{tabel} at a significant level of 0.05 is 4.140. It turns out that $F_{count} > F_{table}$ (6.097 > 4.140) and a significance value of 0.016 at a significance level of 0.05. Based on these results, H_0 is rejected and H_1 is accepted. This means that there are significant differences in students' interest in learning Informatics between students who study project-based e-learning and direct e-learning. This is also supported by the results of the descriptive calculations where the average posttest interest score for the group of students following the PjBEL model is 73.72, while the group of students following the Direct model has an average score of 69.25. This shows that the learning interest of students following the PjBEL model is better than the results and learning interest of students following the Direct E-Learning model. This conclusion is strengthened based on Table 9 with pairwise comparisons of learning interest data.

Table 9. Pairwase Comparisons of Learning Models on Interest Variables

(I) Factor 1	(J) Factor 1	Mean Difference (IJ)	std. Error	Sig.	95% Confidence Interval for Difference	
					LowerBound	Upperbound
1	2	4.344	1.543	008	1.197	7.490
2	1	-4.344	1.543	008	-7.490	-1.197

Based on Table 9, it can be seen that the significance value of the posttest interest is less than 0.05 so that student interest differs significantly between students who learn by following the PjBEL model and the interest of students who learn by following the Direct E-Learning model.

Almost the same thing is seen for the influence of learning models on student learning outcomes. The F value between learning models on students' Informatics learning outcomes was obtained F_{hitung}= 9.994. The value of F_{tabel} at a significant level of 0.05 is 4.140. It turns out that $F_{count} > F_{table}$ (9.994 > 4.140) and a significance value of 0.002 at a significance level of 0.05. Based on these results, H_0 is rejected and H_1 is accepted. This means that there are significant differences in students' Informatics learning outcomes between students who study with project-based e-learning and students who study with direct e-learning. It is also supported by the results of descriptive calculations in Table 5 where the average posttest score for learning outcomes following the PjBEL model is 82.97, while the group of students following the Direct model has a learning outcome of 76.72. This shows that the learning outcomes of Informatics students who follow the PjBEL model are better than the learning outcomes of students who follow the Direct E-Learning model. This conclusion is strengthened based on Table 10 on pairwise comparisons of study results.

Table 10 . Pairwise Comparisons of Learning Models on Informatics Learning Outcomes Variables

(I) factor 1	(J) factor 1	Mean Difference (IJ)	std. Error	Sig.	95% Confidence Interval for Difference	
					LowerBound	Upperbound
1	2	5.062	1.553	003	1894	8.231
2	1	-5.062	1.553	003	-8.231	-1.894

Based on Table 10, it can be seen that the significance value of the posttest learning outcomes is less than 0.05 so that student learning outcomes differ significantly between students who learn by following the PjBEL model and the learning outcomes of students who learn by following the Direct E-Learning model.

Furthermore, in this study, data on responses to interest in learning were collected using a questionnaire technique which contained statements to explore student responses to the learning model applied. The questionnaire used consisted of 4 answer choices, namely SS (Strongly Agree), S (Agree), TS (Disagree), and STS (Strongly Disagree). Student responses were said to be very good if the results of the questionnaire responses ranged from 81% - 100%, good ranged from 61% - 80%, unfavorable ranged from 41% - 60. The average results of student response questionnaires to the Project Based e-Learning learning model can be seen in Table 11.

Table 11. Student Responses to the Project Based e-Learning Model

No	Indicator	Average	Category
1	Feeling happy	82.58	Very good
2	Attention	77.56	Good
3	Interest	74.75	Good
4	Student Engagement	63.79	Good

Table 11 indicates that on the social interaction quality indicators, student responses to the Project Based E-learning model reach a certain percentage. Specifically, the results show that the highest average score reaches 82.58 and is in the good category, while the lowest score is still in the good category on the student engagement indicator with a score of 63.79. This finding indicates that the Project Based E-learning model gets a positive response from students and can be used in learning activities.

3. CONCLUSION

Based on this explanation, it can be concluded that the project based e-learning model is superior to the direct e-learning model in achieving interest and learning outcomes together. However, in this study there are still some problems related to the attainment of student interest and learning outcomes. One of these problems is that, even though the Project Based E-learning model gives good overall results, there are still some students who do not achieve very good categories in terms of interest scores and individual learning outcomes. This finding could occur due to several factors, namely as follows. First, the concept of constructivism learning states that students are able to build their own knowledge in a time that is adapted to their respective cognitive structures. The second factor, group-based learning can lead to student dependence on group members. The success of the group in cooperative learning depends on the ability of each member. Third, because they are still accustomed to the direct learning model, students still have difficulty adapting to the project-based learning model.

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