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THE IMPLEMENTATION OF FLIPPED CLASSROOM USING MOODLE TO INCREASE STUDENTS' MATHEMATICS CREATIVE THINKING FROM LEARNING STYLE VIEWPOINT

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Abstract. This study aimed to describe the success of flipped classroom using Moodle to increase students' creative thinking abilities in view of learning styles. This study used quasi-experiment non-equivalent control group design with the participants consisted of 72 students of SMA Negeri 1 Ciawigebang in the academic year of 2022/2023 who 36 XD students as the experimental group and 36 XC students as the control group. The instruments used were tests and questionnaires. The results of data analysis with significance level of 5% revealed that on the learning model factors obtained values 0.012 < 0.05 with the conclusion that there were differences in the ability to think creatively between students who are given flipped classroom using Moodle and conventional learning. N-Gain score in the experimental class is 0.6153 while the control class is 0.3803. Hypothesis testing on learning style factors has value 0.766 > 0.05 with the conclusion that there were no differences in the ability to thkcreatively between students with visual, auditory, and kinesthetic learning styles. Interaction diagrams shows that visual students are better suited to learning with flipped classroom using Moodle models and auditory students are better suited to learning with conventional models.

Keywords: Flipped Classroom, Moodle, Creative Thinking, Learning Style

Abstrak. Penelitian ini bertujuan untuk mendeskripsikan keberhasilan flipped classroom dengan menggunakan Moodle dalam meningkatkan kemampuan berpikir kreatif siswa ditinjau dari gaya belajar. Penelitian ini menggunakan desain quasi eksperimen non-equivalent control group dengan peserta terdiri dari 72 siswa SMA Negeri 1 Ciawigebang tahun pelajaran 2022/2023 yang terdiri dari 36 siswa XD sebagai kelompok eksperimen dan 36 siswa XC sebagai kelompok kontrol. Instrumen yang digunakan adalah tes dan angket. Hasil analisis data dengan taraf signifikansi 5% diketahui bahwa pada faktor model pembelajaran diperoleh nilai 0,012 < 0,05 dengan kesimpulan bahwa terdapat perbedaan kemampuan berpikir kreatif antara siswa yang diberikan pembelajaran flipped classroom dengan menggunakan Moodle dan pembelajaran konvensional. Skor N-Gain pada kelas eksperimen sebesar 0,6153 sedangkan kelas kontrol sebesar 0,3803. Pengujian hipotesis terhadap faktor gaya belajar memiliki nilai 0,766 > 0,05 dengan kesimpulan bahwa tidak ada perbedaan kemampuan berpikir kreatif antara siswa dengan gaya belajar visual, auditori, dan kinestetik. Diagram interaksi menunjukkan bahwa siswa visual lebih cocok belajar dengan flipped classroom dengan menggunakan model Moodle dan siswa auditori lebih cocok belajar dengan model konvensional.

Kata Kunci: Flipped Classroom, Moodle, Berpikir Kreatif, Gaya Belajar

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INTRODUCTION

In the 21st century and the rise of the ere society 5.0 the development of science and technology is becoming more rapid and changes human life that makes people required to improve their quality by having the 4C competencies (Collaboration, Communication, Creativity and Critical thinking) (Ashim et al., 2019). Education as a field that has an important role in creating the next generation is expected to deal with these four elements by creating human to have skills in the digital field and think creatively (Nastiti & Abdu, 2020). According to Firdausi & Asikin (2018) education with good quality is efforts to increase creativity to deal with challenges, demands, changes, and the times.

In mathematics learning, think creatively is important and need to be owned by students because it participates in determining learning outcomes (Sholikhah et al., 2018). Creative thinking interpreted as the ability to create new idea, unusual, original ideas that bring definite and precise results (Afriyanti et al., 2018). Through creative thinking, students will be able to develop math problems into alternative answers in solving problems related to systemic logic, patterns and sequences (Fadillah, 2016). The ability to think creatively will make students not fixated on the solutions that have been given, but they will see a problem from a different perspective and relate it to existing knowledge.

However, the mathematical creative thinking skills of Indonesian students are still relatively low (Damayanti et al., 2020). The results of the Trends in International Mathematics and Science Study (TIMSS) and also Programming for International Student Assessment (PISA) show that student achievement in Indonesia is still at a lower level compared to other participating countries (Nur & Palobo, 2018). This is reinforced by a preliminary study conducted by researchers on class XI students for the 2022/2023 academic year in Kuningan Regency that 60% of students are not able to think fluently in solving problem, 61.5% are not able to think flexibly to find solutions, 56.3% are not able to find different ideas to solve problems, and 62.2% of them unable to solve the problem in detail.

From the results of the students' work, in solving the problems almost all of them use the method taught by the teacher, although it can be solved in other ways. Therefore, besides providing knowledge and experience, teachers must also be able to pay attention to students' creative thinking abilities (Fitri & Sari, 2020). The efforts to achieve good mathematical creative thinking skills can be achieved by involving students' inner potential, a conducive environment, and continuous practice (Mawaddah et al., 2015).

Developments in technology which are rapidly can be utilized in the effort to achieve good creative thinking skills, namely through online learning. Setyorini (2020) states that online based learning involving digital platforms have changed the substance of education in a superior, more effective and more charming course. The innovation and creativity in

packaging the materials and learning activity can create enthusiasm and interest from students. Therefore as an effort to develop teacher innovation and creativity in learning, technology-based learning models need to be supported and adapted to the times (Yuliardi & Habibi, 2016). As an implementation of student centered learning as well as technology-assisted learning, the flipped classroom is a models that needs to be considered for use in the student learning process (Kurniawati et al., 2019).

The application of flipped classroom could make students active in the learning process with the class concept reversed. In the flipped classroom models, the lesson material was studied first by students at home before learning takes place. Activities in class no longer explain the material, but to understanding the material more deeply through practice questions or other activities such as debates, presentations, discussions, and so on (Chandra & Nugroho, 2016). In practice, the flipped classroom is divided into two activities, namely outside the classroom in the form of watching learning videos plus understanding the material and in the classroom in the form of practicing questions and solving problems (Ario & Asra, 2018). Therefore, students are prepared and able to deepen the material in class because they have previously studied at home.

As part of blended learning, flipped classroom can be assisted by utilizing technology such as Learning Management System (LMS) which makes teaching and learning activities easier. Rawashdeh et al. (2021) argue that through the use of LMS students can be more actively involved through text, video, sound, collaborative sharing, and interactive graphics which will ultimately make learning higher quality. This study used Moodle as LMS which is a website-based e-learning software that used for teaching and learning purposes. The learning process with flipped classroom concept can also give students option to learn according to their respective learning styles. The right learning style will maximize students' thinking and absorption which will also indirectly affect the level of understanding and learning outcomes. Concept of flipped classroom makes students will be directed to understand the type of learning style because ofthe freedom to learn when outside the classroom to overcome the differences in thinking abilities between students who have visual, auditory, and kinesthetic learning style (Karim, 2014).

Based on a previous study by Damayanti et al. (2020) showed that the flipped classroom had a positive impact on increasing students' creative thinking skills so that the results were higher compared to other models. The use of LMS also makes teaching and learning activities easier and has a considerable effect because students are actively involved with text, video,

sound, collaborative sharing, and interactive graphics which make learning higher quality (Rawashdeh et al., 2021; Pérez-Pérez et al., 2020).

Researchers realize that combining the flipped classroom learning model, LMS, and learning styles can be an opportunity to improve students' creative thinking skills which are still low because in addition to learning models, another important component that needs to be considered in efforts to improve students' abilities is learning styles (Asyafah, 2019). As well as to introduce the flipped classroom and LMS Moodle learning models which are still rarely applied in the world of education in Indonesia.

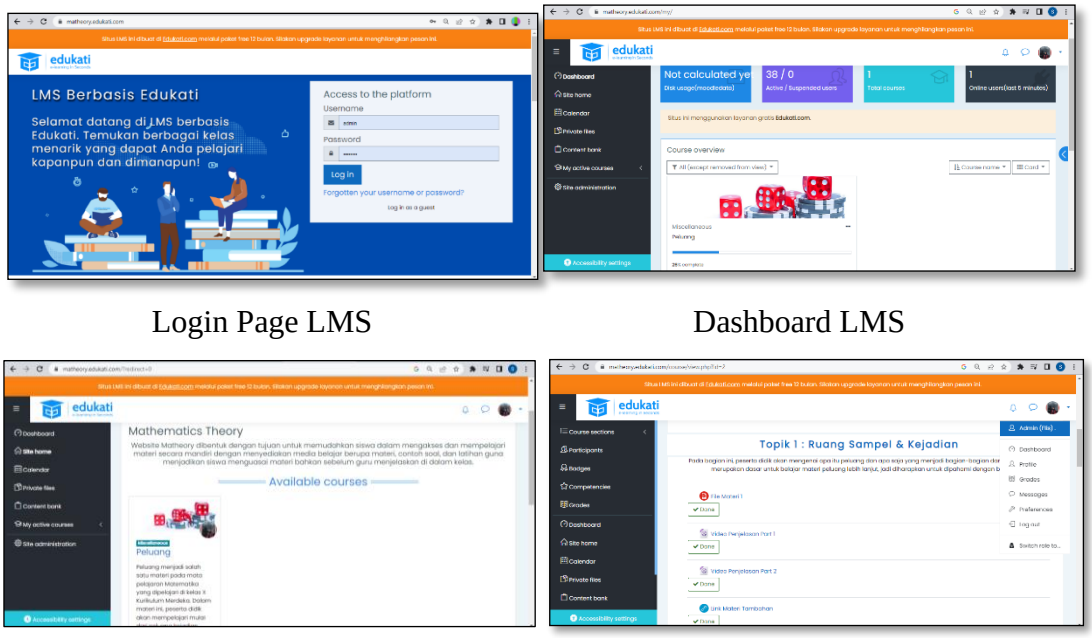
METHOD

This study used a quasi-experimental quantitative method with non-equivalent control group design. This study took one class as the experimental group given treatments using learning models flipped classroom using Moodle and one other class as a control class that uses a conventional learning model. The population were all students of class X SMA Negeri 1 Ciawigebang for the academic year 2022/2023. The sampling technique used was purposive sampling with the sample were class XD as the experimental class totaling 36 students and class XC as the control group totaling 36 students. Therefore, the sample in this research totaling 72 students. Prior to treatment, students in each class were grouped based on three types of learning styles there are visual, auditory, and kinesthetic learning styles. The following is the research design used.

Tabel 1. Research Design 2 x 3

Learning Models (A)	Gaya Belajar (B)		
	Visual (B_1)	Auditory (B_2)	Kinesthetic (B_3)
Flipped Classroom (A_1)	A_1B_1	A_1B_2	A_1B_3
Konvensional (A_2)	A_2B_1	A_2B_2	A_2B_3

In the experimental class, learning activities were carried out using Moodle. The Moodle display used in this study is as follows.



Login Page LMS | Dashboard LMS

Page Site Home | Material Page

Figure 1. LMS-Moodle view through dekstop

Data collection techniques in this study include questionnaires and tests. The questionnaire used likert scale with 5 answer options that consists of learning style questionnaire given to the two groups before treatment and student response questionnaire given to the experimental class after treatment. The learning style questionnaire consists 36 questions containing 19 positive and 17 negative sentences. Meanwhile, the student response questionnaire totaled 30 questions containing 15 positive and 15 negative sentences with indicators of students' attitudes, interests, and understanding while using the flipped classroom models.

The second data collection technique is the test. The tests in this study consisted of a pretest and posttest on the mathematics probability material adjusted to indicators of creative thinking skills. The test consists of 4 questions, each of them represents an indicator of the ability to think creatively, there are fluency, flexibility, originality, and elaboration. Students are expected to be able to solve problems in questions by prioritizing their creative thinking skills.

The data that has been obtained from the experimental and control classes are then analyzed. First, data on learning styles are grouped by type of visual, auditory, and kinesthetic. This activity is carried out by calculating the score of the questionnaire and looking for the learning style that is more dominant in each student. Second, pretest and posttest data were analyzed quantitatively used two-way ANOVA and independent sample

t test. The two-way ANOVA test is used to determine the effect of learning models factors and learning styles on creative thinking, as well as the interaction between the two factors. While the independent sample t test was used to find out the difference in the average increase in creative thinking skills between students who used flipped classroom models by using Moodle and the conventional models. Third, analysis of student response questionnaires by looking at the results of filling in the questionnaire based on each indicator to find out students' responses in use of the flipped classroom learning models.

RESULTS

Analysis of Student Learning Styles

Based on the results of filling out the student learning style questionnaire in the experimental and control classes, learning style groups were obtained with the results shown in the following table.

Table 2. Distribution of Students' Learning Styles

Class	Learning Style	Number of Students
Experiment	Visual	21
	Auditory	5
	Kinesthetic	10
Control	Visual	13
	Auditory	12
	Kinesthetic	11

Determination of student learning styles is taken from the highest score obtained in one of the learning style categories, if there is the same score in more than one learning style category, then an observation is made to narrow down the type of learning style students have. As a percentage, the results of the distribution of learning styles show that 58% of students in class XD as an experimental class have a visual learning style, 14% auditory, 28% kinesthetic. Meanwhile, students in class XC as the control class had an even distribution of learning styles with 36% visual, 33% auditory, and 31% kinesthetic.

Analysis of Increasing Creative Thinking Skills

The analysis was carried out to test the hypothesis whether or not there is an average difference in the increase in creative thinking skills. Previously, it was confirmed that in the two groups there was no difference in the initial ability of students' creative thinking. The difference test using the non-parametric Mann Whitney.

Table 3. Test Statistics[a]

	Early Mathematical Creative Thinking Skills (Pretest)
Mann-Whitney U	629.000
Wilcoxon W	1295.000
Z	-.218
Asymp. Sig. (2-tailed)	.828

a. Grouping Variable: Learning Models

Based on table, Mann Whitney test shows asymp values. sig (2-tailed) of 0.828 > 0.05 so it can be concluded that there is no difference in students' initial mathematical creative thinking abilities. In other words, the students' initial abilities in the experimental and control groups were the same.

Subsequent analysis was carried out after the completion of the treatment given to the two groups by utilizing the data from the students' pretest and posttest results to test the hypothesis. Before testing the hypothesis, a data normality and homogeneity test was performed with SPSS using the Kolmogorov-Smirnov test at a significance level of 5%.

Table 4. Tests of normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Learning Models	Statistic	df	Sig.	Statistic	df	Sig.
Mathematical Creative Thinking Skills	Flipped Classroom	.199	36	.073	.880	36	.053
	Conventional	.087	36	.200*	.955	36	.152

a. Lilliefors Significance Correction

Based on table 4 that shows the normality test, the sig. 0.073 > 0.05 and sig. 0.200 > 0.05 with the conclusion that the data is normally distributed.

Table 5. Test of homogeneity of variance

		Levene Statistic	df1	df2	Sig.
Mathematical Creative Thinking Skills	Based on Mean	.704	1	70	.404
	Based on Median	.091	1	70	.764
	Based on Median and with adjusted df	.091	1	66.343	.764
	Based on trimmed mean	.576	1	70	.450

The second prerequisite test performed was the SPSS homogeneity test of variance using the Lavene test with a significance level of 5%. Based on the homogeneity test on table 5, the sig. 0.404 > 0.05 with the conclusion that the data is homogeneous. The data fulfills the prerequisite test, so the test can be continued by using an independent sample

t test to find out the average increase in students' mathematical creative thinking skills in the experimental and control classes.

Tabel 6. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mathematical Creative Thinking Skills	Equal variances assumed	.704	.404	3.051	70	.003	.23500	.07702	.08139	.38861
	Equal variances not assumed			3.051	69.693	.003	.23500	.07702	.08137	.38863

Based on table 6, a significance value of 0.003 < 0.05 so it was concluded that there was a difference in the average increase in mathematical creative thinking skills between experimental students who used the flipped classroom models using Moodle and control students who use conventional models. The differences supported by the Ngain score of the two classes shown in the following table.

Table 7. Group statistics

		N	Mean	Std. Deviation	Std. Error Mean
Ngain Score	Flipped Classroom	36	.6153	.33744	.05624
	Conventional	36	.3803	.31574	.05262

The score of N-Gain value for each group is 0.6153 for experimental class and 0.3803 for control class. The N-Gain value shows that the thinking ability of the experimental class that uses the models increases flipped classroom is higher than the control class that uses a conventional model. In other words, the flipped classroom models are more able to improve students' creative thinking skillswhen compared to other learning models.

Factor Analysis of Learning Models and Learning Styles

This analysis was conducted to determine the influence of learning models factors and learning styles in improving creative thinking skills. In addition, an analysis was also carried out to find out the interaction between the two factors in influencing the ability to think creatively. Before testing the hypothesis, data normality test was first performed.

Tabel 8. Tests of normality

	Learning Models and Learning Style	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual for Mathematical Creative Thinking Skills	Flipped Classroom	.185	36	.095	.895	36	.067
	Conventional	.113	36	.200*	.964	36	.277
	Visual	.134	34	.127	.891	34	.003
	Auditory	.152	17	.200*	.916	17	.125
	Kinesthetic	.097	21	.200*	.977	21	.876

a. Lilliefors Significance Correction

Based on the normality test on table 8, the sig. > 0.05 with the conclusion that the data is normally distributed.

Table 9. Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
Mathematical Creative Thinking Skills	Based on Mean	1.050	5	66	.396
	Based on Median	.457	5	66	.807
	Based on Median and with adjusted df	.457	5	52.610	.807
	Based on trimmed mean	.975	5	66	.440

a. Dependent variable: Creative Thinking Skills
b. Design: Intercept + A + B + A * B

Based on table 9, the sig, values of the homogeneity test is 0.396 > 0.05 with the conclusion that the data is homogeneous. The fulfillment of the prerequisite tests which include normality and homogeneity testsmakes hypothesis testing possible by means of a parametric test, namely by using the 2 way ANOVA. Based on the results of the 2-way ANOVA test with SPSS software, the resultsare as follows.

Table 10. Tests of between-subjects effects

Dependent Variable: Ngain Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Models	1.205[a]	5	.241	2.189	.046
Intercept	14.475	1	14.475	131.514	.000
Learning Models	.731	1	.731	6.642	.012
Learning Style	.059	2	.029	.268	.766
Learning Models * Learning Style	.098	2	.049	.446	.642
Error	7.264	66	.110		
Total	26.309	72			
Corrected Total	8.469	71			

a. R Squared = .142 (Adjusted R Squared = .077)

Table 10 shows in the factor section of the learning models a significance value of 0.012 < 0.05 so it can be concluded that there are differences in the ability to think creatively between students who use the flipped classroom models using Moodle and students who use the conventional models. Meanwhile, the learning style factor section showed a significance value of 0.766 > 0.05 so there was no difference in creative thinking ability between students who had visual, auditory and kinesthetic learning styles. In the factor interaction section between learning models and learning styles, it shows a significance value of 0.642 > 0.05 which indicates that there is no interaction between learning models and learning styles on students' mathematical creative thinking abilities. Visually, the interaction between the two is depicted in the following figure.

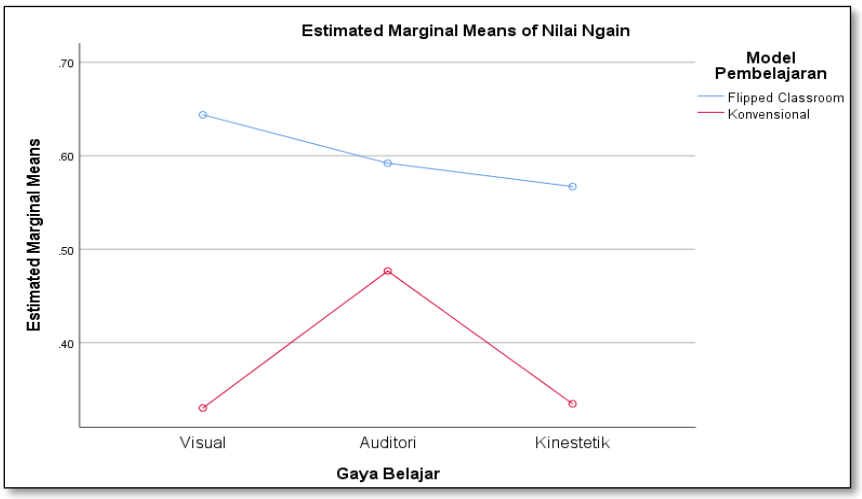


Figure 2. Diagram of the interaction of learning models and learning styles

In figure 2, the blue line as flipped classroom models using Moodle and red line as conventional learning models do not intersect. However, from figure 2 it is known that in the experimental class the mathematical creative thinking abilities of students with visual learning styles were higher, followed by students with visual learning styles and then students with kinesthetic learning styles. Meanwhile, in the control class the mathematical creative thinking ability of students with auditory learning styles is higher than students with visual and kinesthetic learning styles, both of which tend to be the same.

Students Response Analysis

This analysis was conducted to determine the response of experimental class students to the use of the flipped classroom models using Moodle. The analysis was carried out using data from the results of filling out response questionnaires by students of the

experimental class which were arranged based on the assessment aspects of interest, attitude and understanding indicators. The following is the results of student responses.

Table 11. Results of student's response analysis

Aspect	Percentage	Category
Students' interest in using flipped classroom models using Moodle	72%	Positif
Attitudes of students towards the use of flipped classroom models using Moodle	73,89%	Positif
Student's understanding of math material	71,54%	Positif
Average	**72,48%**	**Positif**

Based on table 11 it was found that the percentage of aspects of student interest in using flipped classroom models using Moodle was 72% with a positive category, aspects of students'attitudes towards the use of flipped classroom models using Moodle of 73.89% in the positive category, and aspects of students' understanding of mathematics material was 71.54% in the positive category. From these results, it was obtained that the average value of student responses was 72,48% which include in a positive category, which means that almost all students gave a positive response to the use of the flipped classroom models using Moodle and can accept and follow well the learning process.

DISCUSSION

This research looks at the effectiveness of the flipped classroom model using Moodle in the process and efforts to improve creative thinking skills in terms of learning styles. Data were obtained from the results of filling out questionnaires and tests by students of class XC and XD at SMA Negeri 1 Ciawigebang who received different treatment. The process of data analysis is carried out on data that has been previously obtained. First, an analysis of learning styles was carried out based on the results of the questionnaire. The distribution of student learning styles in the control class is more even than in the experiment class. Learning style in the control class for each type tends to be the same, while students in the experimental class have more visual learning styles, followed by kinesthetic and auditory learning styles.

Data analysis continued by processing student pretest and posttest data which showed that there were differences in the ability to think creatively between experimental students and conventional students. This is indicated by the experimental N-Gain value being higher than conventional N-Gain. The flipped classroom by using Moodle influences students to be more actively involved in the learning process through the provision of material that

has been studied at home, so students prepared to learn more deeply. Flipped classroom with student centered learning approach gives students the chance to construct their own knowledge through teaching materials that have been provided through the LMS-Moodle and then proceed with problem solving activitiesin class. This concept has made flipped classroom using Moodle get a positive response from students.

These results are consistent with previous studies that the flipped classroom model is superior to other learning models in improving student abilities. Such as research by Lin (2019) that the flipped classroom model is superior in increasing achievement, learning motivation, learning attitudes, and problem-solving skills compared to conventional learning models because students are better prepared to study. The same thing is also found in the research by Sari et al. (2020) that the application of the flipped classroom is able to improve problem solving abilities and students' independence learning. The use of LMS is also one of the supporters in the successful implementation of the flipped classroom model. As in the research by Ramadhani et al. (2019) that mathematical understanding tends to increase more among students who use the LMS-Google Classroom flipped classroom model.

On the learning style factor, the results show that there is no influence on the ability to think creatively. In addition, there is no interaction between learning models and learning styles on creative thinking abilities. However, from the interaction diagrams can be drawn that the flipped classroom models is suitable for students with a visual learning, followed by auditory students and then kinesthetic students. This is due to Moodle containing learning videos as audio-visual media which makes students with visual and auditory learning styles able to learn with the right method and form creative abilities by seeing and listening to material exposure. The modules provided in Moodle also have a display that makes it easier for students to learn because it highlight important points.

Meanwhile, the conventional models are suitable for students with an auditory learning style, followed by students with visual and kinesthetic learning styles who tend to have the same abilities. This is because in the implementation of the conventional model, the teacher will explain the material and students will listen more. This makes conventional methods suitable and appropriate for auditory students, but not for visual students who need eye-catching objects and kinesthetic students who need to keep moving. This finding is consistent with research conducted by Igirisa (2018) that students with a visual learning style will learn better with the flipped learning model, while students with an auditory learning style are suitable for learning using conventional models because the teacher uses verbal language.

CONCLUSION

Based on the research results, it can be concluded that the flipped classroom using Moodle with the reverse learning concept can improve students' creative thinking abilities and get positive responses. Students can maximize their learning methods according to their learning styles because not all learning methods are suitable for every learning style. With the learning modules and videos provided in Moodle, the flipped classroom model is suitable for a visual learning style, while the conventional model is suitable for an auditory learning style where students listen a lot to the teacher's explanations.

RECOMMENDATIONS

This study provides recommendations to teachers to pay attention to student learning styles as a consideration to choose learning methods that can maximize the learning process. The flipped classroom model using Moodle can be alternative for improving students' creative thinking abilities as a contribution to supporting the achievement of 4C competencies in 21st century towards the era of society 5.0. Before implementing the flipped classroom model, teachers are expected to be able to clearly explain, direct, and guide students in the implementation of synchronous and asynchronous learning, so that the application of this model can be in accordance with the learning plan, including monitoring and ensuring students learn the material provided before meeting the teacher in class. The LMS-Moodle that will be used must also be well socialized to students before, so that students can truly understand to use the LMS-Moodle.

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