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THE EFFECT OF PROBLEM-BASED LEARNING BY COGNITIVE STYLE ON CRITICAL THINKING SKILLS AND STUDENTS' RETENTION

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Abstract

The purpose of this research is to compare the effectiveness of learning models to develop student critical thinking skills and retention in mathematics through the application of Problem Based Learning (PBL) models and multimedia assisted Direct Instruction (DI) models for students who have different cognitive styles. This research is quasi-experimental type, using non-equivalent control group design. The subjects of this research are students in three senior high schools with two classes samples in each school. There are 102 students of control class with a Direct Instruction learning model by multimedia and 97 students of experiment class with Problem Based Learning model. The instruments of this research are test and questionnaires. The hypotheses were tested using factorial multivariate of covariance (MANCOVA) analysis. The findings of this research, there was a significant difference in student critical thinking skills and retention between groups of the student with Field Dependent (FD) and Field Independent (FI) cognitive styles. Students with Field Independent cognitive styles have better critical thinking and retention than student with Field Dependent cognitive styles. There was a significant difference in student critical thinking skills and retention between the group of students with Direct Instruction model and Problem Based Learning model. Students who learn with Problem-Based Learning model better than students who learn with multimedia-assisted Direct Instruction learning model.

Keywords – Problem-based learning, Direct instruction, Cognitive style, Critical thinking skills, Student retention.

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1. Introduction

Today, the competition to improve the quality of community resources in the industrial revolution era 4.0 is very high, where skills and competencies are the main things that need attention. The students must have good competencies when joining the workforce. Learning in schools is not enough to build critical and creative thinking skills. This is caused by conventional learning, and interaction in learning is still dominated by students who have more ability than others, even educators sometimes still dominate learning.

The efforts to grow and develop critical thinking skills do early by educators to their students. Critical thinking is useful for students to analyse problems, solve problems and make a decision (Johnson, 2002).Critical thinking is an important skill needed in the world of work. This skill even ranks first in list of skills needed. Communication skills, collaboration, global awareness, mastery of technology, life and career skills, learning skills and innovation require a good foundation of critical thinking. On the concept in the Watson-Glaser Critical Thinking Appraisal (WGCTA) test, critical thinking consists of five dimensions namely Inference, Recognition Assumption, Deduction, Interpretation and Evaluation of arguments.

Inference is the ability to assess the probability or accuracy of a conclusion based on available information. Recognition assumption is the ability to identify assumptions implicit in a statement. Deduction is the ability to determine whether conclusion are made logically based on the available information. While interpretation is the ability to assess evidence and make decisions whether the generalizations or conclusion are guaranteed based on available data. And the final dimension, namely argument evaluation, is the ability to evaluate the strength and relevance of an argument related to a particular issue or problem.

These efforts can be done through the application of effective learning models and suitable learning media. The Problem Based Learning (PBL) is one model that can improve critical thinking skills compared to conventional models (Happy & Widjajanti, 2014). Problem-Based Learning is a learning model that is marked by a real problem, a real-world problems as a context for students to learn critically and problem solving skills and gaining knowledge (Setyosari, 2006). The problem-based learning model has a positive influence on students so that they can improve their problem-solving abilities, critical and creative thinking (Selcuk, Caliskan & Sahin, 2013). Implementation of problem-based learning model can improve the students' problem solving skills, so that Problem-Based Learning can be used as an alternative in implementing mathematics learning activities (Sa'dijah, 2016).

The other model is the Direct Instruction (DI) model where appropriate to explain information directly to students by managing learning times as efficiently as possible and teaching the contents of information that students must understand well (Stein, Kinder, Silbert & Carnine, 2005). According to (Eggen & Kauchak, 2012), the direct instruction teaching model is a teaching approach that helps students learn basic skills and obtain information that can be taught step by step. The phases in applying the direct teaching model are the introduction and interview phases, the presentation phase, the guided training phase, and the independent training phase. In the presentation phase the teacher needs the right media that is useful for concrete learning concepts.

Learning media is important to support student learning activities, especially to optimize human senses. A person's learning experience is 75% obtained from the sense of sight, 13% of the sense of hearing and 12% of the other senses (Dale, 1969). Therefore, it is important to combine various sensory functions in the media, which is commonly called multimedia. According to (Suyanto 2003), multimedia is the use of computers to create and combine texts, graphics, audio, moving images (video and animation) by combining links and tools to navigate, interact, create, and communicate. In mathematics learning using multimedia has an effect of 85% on student achievement (Pradana, 2015). Another benefit of the media is clarifying the message so that it is not too verbally, overcoming space limitations and passivity in the classroom (Barokati, 2013). According to (Setyosari, 2007), usage multimedia learning precise and varied can improve how to learn students more actively. This is the reason why makes researchers interested in trying to improve students' critical thinking skills through the learning scenario of direct teaching models (multimedia-assisted direct instruction) in mathematics learning. Therefore, it is necessary to have a study of the effect of multimedia-assisted direct instruction models on students' critical thinking skills in mathematics.

Another thing that affects (strengthens or weakens) the learning success is the cognitive styles and student retention. Cognitive styles are different from cognitive behaviour, thinking behaviour, and memory behaviour that will affect individual behaviour and activities both directly and indirectly (Lebar & Mansor, n.d.). Retention is the ability to capture information, accept it as part of the thinking process, take the information and get it back when the information is needed. Retention of each student is different, including depending on the application of the learning model. Based on these learning problems, a study is needed to compare the effectiveness of learning in improving critical thinking skills and retention in mathematics learning by the application of Problem Based Learning model and multimedia-assisted Direct Instruction learning model for students who have different cognitive styles.

2. Methodology

This research is a quasi-experimental type, where the researcher manipulates and controls the independent variables, the moderator variable and observes the dependent variable to find variations along with the manipulation of the independent variables without changing class conditions. The experimental design used in this research is a non-equivalent control group design, design models of this research is (2x2) factorial design shown in Table 1. In this design, both the experimental and control groups used existing groups (not randomly selected), because it is difficult to randomize the sample (Sugiyono, 2010). This design is the most suitable design, if the selection of samples is not possible to be randomized (Setyosari, 2010).

The research samples are students in three schools. There are SMAN 1 Wringinanom Gresik, SMAN 1 Driyorejo Gresik and SMAN 1 Kedamean Gresik. The research samples were taken from 3 different schools, to get more accurate research data because they were applied to the conditions of the study sample schools which had different characteristics. Each school takes two science classes, one class for the experimental group (Problem-Based Learning model) and one other class for the control group (multimedia-assisted Direct Instruction learning model). There are 102 students of control group with a multimedia-assisted Direct Instruction learning model and 97 students of experiment group with Problem Based Learning model.

Moderate Variable \ **Independent Variable**		**Learning Model**	
		Problem-Based Learning Model	**Multimedia-Assisted Direct Instruction Learning Model**
Cognitive Style	Field Dependent (FD)	$Y_{111}, Y_{112}, Y_{113}, \ldots, Y_{11n}$	$Y_{121}, Y_{122}, Y_{123}, \ldots, Y_{12n}$
	Field Independent (FI)	$Y_{211}, Y_{212}, Y_{213}, \ldots, Y_{21n}$	$Y_{211}, Y_{222}, Y_{223}, \ldots, Y_{22n}$

Table 1. Research design (2x2) factorial

The instrument of this research consisted of (1) the cognitive style questionnaires and (2) student achievement test (performance assessment). Student's cognitive style are measured using cognitive style questionnaire based on Group Embedded Figure Test (GEFT) to collect data relating to the cognitive style of Field Dependent and Field Independent students. The measurement of performance assessment using a test consisted of initial-test (pre-test) and final-test (post-test) both critical thinking skills and student retention.

The first instrument is cognitive style questionnaire based on Group Embedded Figure Test (GEFT) developed by Philip K. Oltman, Evelyn Raskin and Herman A. Witkin. This questionnaire measures the ability of students to find simple shapes hidden in more complex patterns. Simple shapes in complex patterns have the same size, the same proportions and the same direction as a simple form that stands alone. The questionnaire consisting of 18 simple shapes in 3 sections. The categorization of student's cognitive style, if the student's score is smaller than 9, the student has a Field Dependent cognitive style. Whereas if a student's score is greater than 9, the student has a Field Independent cognitive style. Some example of cognitive style questionnaire in 3 sections to look for a simple "G" shape as shown in the Table 2 below.

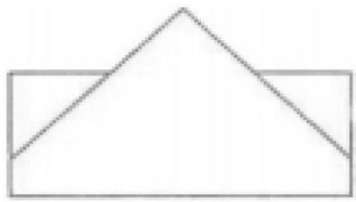
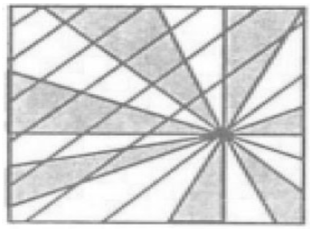
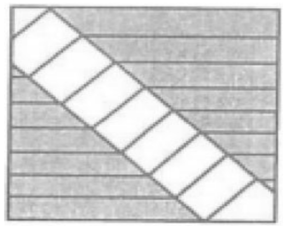
Section 1	Section 2	Section 3
		
Look for a simple "G" shape	Look for a simple "G" shape	Look for a simple "G" shape

Table 2. Group Embedded Figure Test (GEFT) in Each Section

The second instrument is performance assessment which consist of 30 questions both critical thinking skills and student retention. Questions are presented in the form of multiple choice with 5 answer choices.

To get a feasible instrument, the instrument has been validated by a content expert based on the test orientation. The content experts stated that the instrument used was feasible. Then find out the level of validity and reliability using SPSS 23. The instrument has tested to 20 students who were not the subject of the research. The validity level of the cognitive style instrument and the performance assessment instrument are determined by looking at the Corrected Item-Total Correlation column as shown in Table 3. If the score is less than r table, which is 0.4438, then the item is categorized as invalid. It is known that each has an item-total correlation value greater than r table (0.4438) both the cognitive style instruments and the performance assessment instrument. So, all items deserve to be a research measurement tool. The reliability of the cognitive style instrument for all items was obtained by the value of Cronbach's Alpha (on standardized items) of 0.941. While the reliability of the performance assessment instrument for all items was obtained by Cronbach's Alpha value (on standardized items) of 0.951 as shown in Table 4. The Interpretation of reliability coefficient in this research refers to (Arikunto, 2010) as follows: Very high (0.80 - 1.00), High (0.60 - 0.799), sufficient (0.40 - 0.599), low (0.200- 0.399), and very low (0.00 - 0.20). According to (Arikunto, 2010), both the cognitive style instruments and the performance assessment instrument included in the very high-reliability category.

Cognitive Style Instrument		**Performance Assessment Instrument**			
	Corrected Item-Total Correlation		**Corrected Item-Total Correlation**		**Corrected Item-Total Correlation**
Item 1	.572	Item 1	.563	Item 19	.591
Item 2	.809	Item 2	.495	Item 20	.557
Item 3	.550	Item 3	.588	Item 21	.568
Item 4	.521	Item 4	.482	Item 22	.678
Item 5	.665	Item 5	.559	Item 23	.599
Item 6	.665	Item 6	.661	Item 24	.647
Item 7	.649	Item 7	.666	Item 25	.573
Item 8	.625	Item 8	.599	Item 26	.599
Item 9	.575	Item 9	.673	Item 27	.638
Item 10	.460	Item 10	.520	Item 28	.804
Item 11	.737	Item 11	.638	Item 29	.721
Item 12	.625	Item 12	.476	Item 30	.599
Item 13	.809	Item 13	.614		
Item 14	.726	Item 14	.599		
Item 15	.761	Item 15	.495		
Item 16	.804	Item 16	.638		
Item 17	.525	Item 17	.649		
Item 18	.864	Item 18	.737		

Table 3. Validity Test of Cognitive Style and Performance Assessment Instrument

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized item	N of Items
Cognitive Styles Instrument	.940	.941	18
Performance Assessment Instrument	.950	.951	30

Table 4. Reliability Test of cognitive styles and Performance Assessment Instrument

The complete data were analysed by SPSS 23 to compare the effectiveness of learning models to develop student critical thinking skills and retention in mathematics through the application of Problem Based Learning (PBL) models and multimedia assisted Direct Instruction (DI) models for students who have different cognitive styles. To analyze the research data, a descriptive analysis and factorial multivariate of covariance (MANCOVA) analysis were used. The analysis includes 1). assumptions test (data are normally distributed, and variance between groups is homogeneous), and 2). hypothesis test. The research hypothesis test used data analysis techniques using factorial multivariate of covariance (MANCOVA) analysis with a significance level $\alpha = 0.05$ or 5%.

3. Result and Discussion

Data collection activities began with identifying the cognitive styles of students in the experimental and control group. The result of student cognitive styles identification and the initial test of critical thinking skill as shown in Table 5 below. The result of the identification showed that the number of student's cognitive style of Field Dependent more than the number of student's cognitive style of Field Independent in the control group. Another side, the number of student's cognitive style Field Independent more than the number of student's Field Dependent in the experimental group.

After identifying the cognitive styles and the initial test of critical thinking skills of students. The initial ability of the research subject originating from the results of the initial test was analysed using the SPSS program to get an idea of the significant value of mathematical critical thinking skills between the control and experimental group. The result of the unpaired t-test (independent sample t-test) presented in Table 6.

Cognitive Style	Control Group (*Direct Instruction* (DI))			Experiment Group (*Problem Based Learning* (PBL))			Total
	N	Mean	Std. dev.	N	Mean	Std. dev.	$\sum N$
Field Dependent (FD)	59	55.36	15.03	48	49.58	15.72	107
Field Independent (FI)	43	51.78	17.45	49	62.04	14.78	92

Table 5. Identification of Students Cognitive Styles and The Initial Test of Critical Thinking Skill

Learning Model	N	Mean	std. dev	t	sig. (2-tailed)
Control Group (*Multimedia- Assisted Direct Instruction* (DI))	102	53.85	16.11	-0.877	0.382
Experiment Group (*Problem Based Learning* (PBL))	97	55.87	16.41		

Table 6. The Independent Sample t-Test Learning Models for Initial Test

Based on significant values in Table 6 of 0.382 > 0.05, it means that there is no significant difference in the value of critical thinking skills in the initial test between the control and experiment groups. In other words, before giving treatment to both groups of students using Problem Based Learning model and multimedia-assisted Direct Instruction learning model, the critical thinking skills of mathematics in the two groups were not significantly different. After the independent sample t-test to the control and experimental groups, the independent sample t-test was also given based on the cognitive style presented in Table 7 below.

Cognitive Style	n	Mean	std. dev.	T	sig. (2-tailed)
Field Dependent (FD)	107	52.76	15.54	-1.953	0.052
Field Independent (FI)	92	57.24	16.80		

Table 7. The Independent Sample t-Test Cognitive Style for Initial Test

Cognitive Style	Control Group (*Direct Instruction* (DI))				Experiment Group (*Problem Based Learning* (PBL))			
	Critical thinking		Student retention		Critical thinking		Student retention	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Field Dependent (FD)	72.66	5.76	65.37	5.67	79.58	4.98	71.59	5.87
Field Independent (FI)	82.71	5.74	74.81	7.03	84.97	5.69	79.32	5.48

Table 8. The Final Test of Critical Thinking Skills and Student Retention Based on Cognitive Style

Based on significant values in Table 7 of 0.052 > 0.05, it means that there is no significant difference in the value of critical thinking skills in initial test between Field Dependent and Field Independent students. In other words, before giving treatment to both groups of Field Dependent and Field Independent students, the critical thinking skills of mathematics in the two groups were not significantly different.

The treatment was carried out in five meetings with 2x45 minutes each. The activity was followed by giving the final test and after two weeks each group was given a retention test to find out how much ability still survived in the cognitive structure of the students. The final test results of critical thinking skills and student retention based on cognitive style are shown in Table 8.

Standard deviation (SD) is a reflection of very high deviations. If the average value is smaller than the standard deviation value, the data distribution shows abnormal results and causes bias. Referring to Table 5 (the initial test of critical thinking skills in mathematics learning) shows the SD is quite high, but still in reasonable numbers (SD < mean). this indicating that the data generated is not bad. Referring to Table 8 (the final test of critical thinking skills and student retention) shows the SD of final test is lower than the initial data. If the SD value is very small compared to the mean, the mean value can be used as a representation of the whole data.

In the Table 10 shows the real result of the value of critical thinking between groups of students who used Problem-Based Learning and groups of students who used multimedia-assisted Direct instruction learning model. This is supported by the mean value of critical thinking Problem-Based Learning model of 82.30 is greater than the mean value of critical thinking multimedia-assisted Direct Instruction learning model of 76.89. The difference between the two is about 6.57%. Thus students who learn with Problem-Based Learning model better than students who learn with multimedia-assisted Direct Instruction learning model. Other research conducted by (Fauzia, 2018) proved that Problem-Based Learning could improve student learning outcomes from the lowest 5% to the highest 40% with the average 22.29%. Another study by (Supiandi & Julung 2016) proved that the Problem-Based learning could improve student learning outcomes by 26.65%. And the opinion of (Masek & Yamin, 2011) who said that the process in the Problem Based Learning model theoretically supports the development of critical thinking skills following the design applied. Problem-Based Learning have been proven to be successful in supporting their success in learning.

In this research, students with Field Independent cognitive styles have better critical thinking and retention than student with Field Dependent cognitive styles. This result is strengthened by the existence of a significant difference in average value of the final-test Field Dependent cognitive styles reaching 83.92 higher than the average value of the final-test Field Independent cognitive styles of 75.76. This is in line based on research by (Prabawa & Zaenuri, 2017) concluded that student with Field Independent cognitive style students tend to have problem solving abilities better that Field Dependent cognitive style students. This is reinforced by (Dwi Susandi, Sa'dijah, Rahman As'ari & Susiswo, 2019), students who have dependent cognitive styles and Independent cognitive styles have good critical thinking skills.

In this section, the prerequisite test is carried out to determine the feasibility of parameterization before hypothesis testing. The analysis prerequisite test for univariate or multivariate analysis consists of a normality test and a homogeneity test. The normality Kolmogorov-Smirnov test and homogeneity test of critical thinking skills score (post-test) and student retention score in mathematics learning with multimedia-assisted direct instruction (DI) learning model and problem-based learning (PBL) learning model are presented in Table 9 and 10 respectively.

		Critical Thinking PBL	Critical Thinking DI	Student Retention PBL	Student Retention DI
N		97	102	97	102
Normal Parameters	Mean	79.0763	79.9627	72.6459	72.0585
	Std. Deviation	7.15760	7.54578	7.27983	8.58631
Most Extreme	Absolute	.133	.129	.125	.117
Differences	Positive	.093	.105	.075	.105
	Negative	-.133	-.129	-.125	-.117
		1.308	1.307	1.232	1.178
Kolmogorov-Smirnov Z		.065	.066	.096	.125
Asymp. Sig. (2-tailed)					

Table 9. One-Sample Kolmogorov-Smirnov Test

Referring to Table 9 of the results of calculating the value of the Kolmogorov-Smirnov Test of Normality, it can be concluded that the value of critical thinking skills (post-test) in groups of students learning with problem-based learning (PBL) learning model and groups of students learning with strategies multimedia-assisted Direct instruction (DI) learning model shows a significance value (probability) of 0.065 and 0.066 which is greater than 0.05.

Likewise, student retention scores, from the output tables the statistical test results with SPSS show that the significance value (probability) for problem-based learning (PBL) model learning strategies is 0.096 ($p > 0.05$) and the significance value of the Direct instruction model learning strategies (DI) multimedia assisted by 0.125 ($p > 0.05$). The meaning is that both the data value of learning outcomes and student retention in mathematics learning (post-test) in the experimental class and the control class have a normal distribution, so that further testing can be done using multivariate analysis.

	F	df1	df2	Sig
Critical Thinking Skill	.601	3	195	.615
Student Retention	.947	3	195	.419

Table 10. Levene's Test of Equality of Error Variance

Based on the Table 10, Levene's test showing the significance value for critical thinking skills has a significance value of 0.615 which is greater than alpha 0.05 ($p > 0.05$), it means that the variance of critical thinking skills value is homogeneous. Likewise, for student retention has a significance value of 0.419 which is greater than alpha 0.05 ($p > 0.05$), it means that the variance of student retention value is homogeneous. Because of the data are normally distributed and homogeneous, the data analysis was continued using parametric statistical method with Multivariate Analysis of Covariance (MANCOVA).

In the line of Table 11, critical thinking (in initial test) has significance values refers to Pillai's, Wilk's Lambda, Hotelling and Roy's procedures. All procedures showed a significance value of 0.047 and smaller than alpha 0.05 ($p < 0.05$). It means that the concomitant variables (initial test of critical thinking) affect the dependent variable (final test of critical thinking and student retention) significantly. The learning model and cognitive style have significance values refers to Pillai's, Wilk's Lambda, Hotelling and Roy's procedures. All procedures showed a significance value of 0.000 and smaller than alpha 0.05, ($p < 0.05$). Thus, it means that the value of final test of critical thinking skills and student retention in mathematics learning together showed a significant difference in both Problem Based Learning model and multimedia assisted Direct Instruction learning model.

Variable	Statistic test	Value	F	Sig.	Explanation
Critical Thinking	Pillai's Trace	0.031	3.113	0.047	Significant
	Wilks' Lambda	0.969	3.113	0.047	Significant
	Hotelling's Trace	0.032	3.113	0.047	Significant
	Roy's Largest Root	0.032	3.113	0.047	Significant
Learning Model	Pillai's Trace	0.181	21.332	0.000	Significant
	Wilks' Lambda	0.819	21.332	0.000	Significant
	Hotelling's Trace	0.221	21.332	0.000	Significant
	Roy's Largest Root	0.221	21.332	0.000	Significant
Cognitive Style	Pillai's Trace	0.367	55.948	0.000	Significant
	Wilks' Lambda	0.633	55.948	0.000	Significant
	Hotelling's Trace	0.580	55.948	0.000	Significant
	Roy's Largest Root	0.580	55.948	0.000	Significant
Learning Model* Cognitive Style	Pillai's Trace	0.075	7.842	0.001	Significant
	Wilks' Lambda	0.925	7.842	0.001	Significant
	Hotelling's Trace	0.081	7.842	0.001	Significant
	Roy's Largest Root	0.081	7.842	0.001	Significant

Table 11. Multivariate Tests

Likewise, for the interaction, both learning models and cognitive styles have a significance value of 0.001 and smaller than alpha 0.05, ($p < 0.05$). It means that the final test of critical thinking skills and student retention of mathematics learning together showed there are significant differences in the interaction both learning model (Problem Based Learning and Direct Instruction) with cognitive styles (Fields Dependent and Fields Independent).

The line of learning model in Table 12, there was a significant difference between Problem Based Learning and Direct Instruction learning models for students critical thinking skills with F value of 36,174 and significance value of 0,000 which is smaller than alpha 0.05 ($p < 0.05$). There was a significant difference between Problem Based Learning and Direct Instruction learning models for student retention with F value of 42,418 and significance value 0,000 which is smaller than alpha 0.05 ($p < 0.05$). In the line of cognitive style shows there was a significant difference between the Field Dependent and the Field Independent for student critical thinking with F value of 101,967 and significance value of 0,000 which is smaller than alpha 0.05 ($p < 0.05$). There was a significant difference between the Field Dependent and the Field Independent for student retention with F value of 108,004 and significance value of 0,000 which is smaller than alpha 0.05 ($p < 0.05$). The interaction between learning model and cognitive style shows there was a significant difference for critical thinking skills with F value of 5.153 and significance value of 0.024 which is smaller than alpha 0.05 ($p < 0.05$), while for student retention shows there was no significant difference because has F value of 0.149 with a significance level of 0.700 which is greater than alpha 0.05 ($p < 0.05$).

Independent Variable	Dependent Variable	F	Sig.	Explanation
Critical Thinking	Critical Thinking (final test)	5.922	0.016	Significant
	Student Retention	5.790	0.017	Significant
Learning Model	Critical Thinking (final test)	36.174	0.000	Significant
	Student Retention	42.418	0.000	Significant
Cognitive Style	Critical Thinking (final test)	101.967	0.000	Significant
	Student Retention	108.004	0.000	Significant
Learning Model * Cognitive Style	Critical Thinking (final test)	5.153	0.024	Significant
	Student Retention	0.149	0.700	Not Significant

Table 12. Tests of Between-Subjects Effects Multivariate of Covariance

In Table 12, there are interesting finding. The result show that there is no significant difference on the interaction of learning models with cognitive styles on student retention. This is supported by the data in Table 8 above, showing that the student retention with Field Dependent and Field Independent cognitive styles in the control and experimental groups has a difference average value that is not too large. In this study we know that to improve retention result is needed learning that matches the character and learning styles of the student. In this study, it could be that the learning model has not been able to have a significant impact on retention. On the process learning must be supported with the right media can increase transfer power and knowledge retention. According to (Kurniawan, 2017), retention rate in relation with learning styles, more directed at one type of learning style is visual.

This result in line based on research by (Firdaus, 2017) proved that there was a significant difference between the increase in mathematical literacy of student who received a model of Problem-Based learning and Direct Instruction model and Problem-Based Learning was more effective in improving student mathematical literacy than the Direct Instruction Model. And another research by (Reta, 2012) concluded that there was a significant difference critical thinking between groups of students who have Field Independent cognitive styles and groups of students who have Filed Dependent cognitive styles. And there are differences in critical thinking skills between groups of students who learn using Problem-Based Learning with groups of students who learn using conventional model.

Table 13 explains the normality test of cognitive style data for critical thinking skills and student's retention using standardized residual values. Since the number of N used in the analysis is 92 or df = 92, the decision making for the normality test refers to the Kolmogorov-Smirnov sig value. Based on the Table 13, it is known that the value of standardize residual Field Dependent and Field Independent critical thinking and also the value of standardize residual Field Dependent and Field Independent student retention is 0.000 and smaller than alpha ($p < 0.05$). So, the four standardized residual variables are not normally distributed. Therefore, the data analysis was continued using non-parametric statistical methods with the Friedman test.

	Kolmogorov-Smirnov			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Standardized Residual for FD_Critical Thinking	.132	92	.000	.952	92	.002
Standardized Residual for FI_Critical Thinking	.152	92	.000	.962	92	.009
Standardized Residual for FD_Student_Retention	.137	92	.000	.967	92	.021
Standardized Residual for FI_Student_Retention	.163	92	.000	.955	92	.003

Table 13. Test of Normality

	Critical Thinking	**Student Retention**
N	92	92
Chi-Square	31.250	34.714
Df	1	1
Asymp. Sig	.000	.000

Table 14. Tests of Friedman

Based on the Table 14, it is known that the Asymp. Sig value for critical thinking skills is 0.000 and smaller than alpha 0.05 ($p < 0.05$), it means that there are differences in critical thinking skills between students who have Field Dependent cognitive style and students who have Field Independent cognitive style. While the Asymp. Sig value for student retention is 0.000 and smaller than alpha ($p < 0.05$), it means that there are differences in retention skills between students who have FD cognitive style and students who have FI cognitive style. This is supported by research of (Agoestanto & Sukestiyarno, 2017) the result showed that the ability of mathematics critical thinking students with Field Independent cognitive style is better than Field Dependent cognitive style on the ability of inference, assumption, deduction and interpretation.

4. Conclusion and Implication for Further Research

Based on the result, it can be concluded there was significant difference in student critical thinking skills and retention between groups of the student with Field Dependent (FD) and Field Independent (FI) cognitive styles. Students with Field Independent cognitive styles have better critical thinking and retention than student with Field Dependent cognitive styles. There was a significant difference in student critical thinking skills and retention between the group of students with Direct Instruction model and Problem-Based Learning model. Students who learn with Problem-Based Learning model better than students who learn with multimedia-assisted Direct Instruction learning model.

In an effort to improve student's critical thinking skills, Problem-Based Learning model can be applied because this model is able to generate problem-solving abilities through critical and creative thinking compared to the Direct Instruction learning model. But if student's retention abilities are also needed to be improved, this learning model requires combination with the right media to support the success of retention. In this case visual media because retention rate in relation with learning styles, more directed at one type of learning style is visual.

The limitation of this research is student retention tests were not conducted several times, so the impact of the learning model on increasing student retention was not seen in this study. For further research, the development of learning models is needed to improve student retention skills. Also, further analysis of other thinking skills such as creative thinking, brain organizing skills, and analytical skills are suggested to know the correlation with student retention.

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