The Effectiveness of *Investigation Based Multi Representation* (IBMR) Model Learning with Contextual Approach to Improve Student Problem Solving Skill

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Abstract- This research aims to describe effectiveness of Investigation Based Multi Representation (IBMR) model learning device with contextual approach to improve student problem solving skill in State High School 18 Surabaya in material of Newton's Law. The learning device is being developed using 4D design with one group pre-test post-test research design. The research data is obtained from result of pre-test and post-test of problem-solving skill, student activities during learning, and student responses after learning. Result of problem-solving skill is then being analyzed using n-gain test and paired t-test. Result of research shows that IBMR learning with contextual approach is effective to improve student problem-solving skill with medium category which is supported by student activities during learning that shows a very good result and student responses after learning is very positive.

Keywords: Multi representation, contextual approach, physics problem solving, physics learning

Introduction

Education is one of the most important parts in social life. The importance of education is one of the factors to manage the education itself so that it results superior human resource. Education in Indonesia currently implements curriculum of 2013 as learning basis. Curriculum of 2013 implements learning which is focused on students so that teachers are helping in emphasizing students to be more active in the process of extracting, discovering, and creating contextual learning (Hosnan, 2014). Implementation of 2013 Curriculum is adjusted based on needs of 21st century where the aim of 2013 curriculum is to produce creative, productive, affective, and innovative Indonesian human being (Ministry of Education and Culture, 2014). Four skills that is corresponding to 21st century learning needs are *critical thinking and problem solving*, *communication*, *collaboration*, and *creativity and innovation.*

It should be known that problem solving skill owned by students in Indonesia is still in low category. Since Indonesia joined PISA in 2000, score of PISA in science aspect obtained by Indonesia have never reached the International average score (OECD). Newest result of PISA 2018 shows that Indonesia obtained score of 396 while the International average score is 500. Students skill in science problem-solving is still in the first level (OECD, 2019). Based on that information, it can be said that skill of Indonesian students in science problem-solving is still at the limit of memorizing simple knowledge (Wulandari & Solihin, 2016).

Low problem-solving skill of Indonesian students is also known based on result of observation at State High School 18 Surabaya when given student worksheet which is developed based on science process skill in physics learning. The result shows that average value obtained by students is still below 75 (minimum completeness criteria score). Student difficulties are found in determining variable, interpreting and analyzing data from one representation to other representation.

Previous research shows that the factor of low student problem solving skill is caused by the lack of student understanding towards material concept (Reddy & Panacharoensawad, 2017). Most students are not able to connect the concept and physics problems given (Ince, 2018). The lack of student concept understanding one of which is caused by the low student representation skill (Nguyen & Rebello, 2010; Siswanto, Susantini, & Jatmiko, 2016; Theasy, Wiyanto & Sujarwata, 2018). By using multi representation in physic learning can help students to focus in physics concept and effective to help students in solving problems (Maries, 2013; Hill & Sharma, 2015; Carroll, 2018). So that it needs efforts for students to become trained in using multi representation in physics learning.

Investigation Based Multiple Representation (IBMR) is one of the learning model which is developed to improve problem solving skill from result of investigation using multi representation. IBMR learning model has five syntax, which are (a) orientation, (b) investigation, (c) multi representation, (d) application, (e) evaluation (Siswanto, Susantini, & Jatmiko,

2016). Indicator of problem solving is adapted based on Polya's problem solving, which are understanding the problem, making solving plan, conducting the plan, checking and evaluating. Polya's problem solving is chosen because it can help students to solve the problems efficiently (Gopinath & Lertlit, 2017). The problem is given using contextual approach so that it can encourage students to connect concept with daily life (Kurnianingsih & Susilaningsih, 2017). Problem solving process used is adjusted based on science process skill.

Method

This research used IBMR model with contextual approach to improve physics problem solving skill. The learning device was developed using 4D design with one group pre-test post-test research design. Before being implemented, the learning device which was being developed had passed validation phase with very valid category. The learning device was then being implemented in grade X MIA 1 and X MIA 3 in State High School 18 Surabaya with total 54 students. The data was obtained from result of problem-solving skill test, student activities, and student responses. Result of student problem solving skill was analyzed using n-gain test and paired t-test.

Result and Discussion

Analysis of Problem-Solving Skill Test

Problem solving skill test is given to students before learning (pre-test) and after IBMR model learning is implemented with contextual approach (post-test). Result of pre-test and post-test analysis is presented in Table 1.

Table 1. Result of pre-test post-test and n-gain analysis

Grade	Number of students	Problem solving skill test		Criteria	N-gain	Criteria
X MIA 1	28	Pre-test Post-test	41.25 69.21	Sufficient Good	0.48	medium
X MIA 3	26	Pre-test Post-test	45.88 68.81	Sufficient good	0.42	medium

Table 1. Shows that average score of pre-test in both classes are in range of $41 \leq Sufficient \leq 60$ so that result of pre-test in both classes in in sufficient category, while average score of post-test in both classes are in range of $61 \leq Good \leq 80$ so that result of *post-test* in both classes are in good category (Arikunto, 2014). Then n-gain test was conducted to find out the improvement amount of test scores. Table 1 shows that n-gain score in both classes are in range of $0.30 \leq$ n-gain < 0.70 so that test score improvement after IBMR model learning with contextual approach is implemented is in medium category (Hake, 1998). Learning device is said as effective if in both classes which tested obtained n-gain score with minimum medium category (Meltzer, 2002).

This result is in line with research conducted by Siswanto, Susantini, & Jatmiko (2018) which shows that improvement of student representation skill after multi representation learning is implemented obtained medium category. Permadi & Setyaningsih (2017) in their research also stated that improvement of student critical thinking skill after contextual based multi representation module is implemented in material of static fluid obtained medium category. Ariandini (2019) in her research stated that improvement of problem-solving skill after IBMR learning model is implemented is in medium category. Yuliana (2019) in her research stated that implementation of IBMR model can improve student creative thinking skill in medium category.

Table 2. Result of normality test and homogeneity test

Grade	Normality Test				Homogeneity test		
	Shapiro- Wilk			Normally	F	Sig.	Homoge-neous
	Statistic	df	Sig.				
X MIA 1	.982	28	.903	Yes	.439	.920	Yes
X MIA 3	.959	26	.378				

Table 3. Result of paired t-test

Grade	Number of students	t	Sig. (2-tailed)	Decision
X MIA 1	28	-19.612	.000	Rejected H_0
X MIA 3	26	-12.634	.000	Rejected H_0

Next, normality test and homogeneity test are conducted in n-gain score as requirement of paired t-test. Result of normality test and homogeneity test are presented on Table 2. which shows that asymp.sig value in both classes is >0.05 with decision of rejected H_0 so that data in class X MIA 1 and X MIA 3 is normally distributed and homogeneous. Next, paired t-test is conducted to find out whether there is significant difference between pre-test value and post-test value. Table 3 shows the result of paired t-test which shows that asymp.sig value in both classes is <0.05 then the decision is rejected H_0 which means that there is value difference between pre-test and post-test. t value on Table 3 is negative so that it can be said that value after IBMR model learning with contextual approach is implemented is better than before it is implemented.

Table 4. N-gain average scores of each indicator of problem-solving skill in grade X MIA 1

Indicator	X MIA 1		N-gain	Criteria
	Pre-test	*Post-test*		
	Score	Score		
Understanding the problem	46.75	65.25	0.47	Medium
Making solving plan	34.00	62.17		
Conducting the plan	27.83	52.50		
Checking and evaluating	33.75	53.25		
Average score	35.58	58.29		

Table 4. N-gain average scores of each indicator of problem-solving skill in grade X MIA 3

Indicator	X MIA 3		N-gain	Criteria
	Pre-test	*Post-test*		
	Score	Score		
Understanding the problem	39.50	61.50	0.38	Medium
Making solving plan	38.17	58.33		
Conducting the plan	29.17	46.33		
Checking and evaluating	38.00	51.00		
Average score	36.21	54.29		

Table 4 and Table 5 shows N-gain average scores of each indicator of problem-solving skill in grade X MIA 1 gain<0.70 so that it can be said that improvement of each problem-solving skill indicator in both classes are in medium category (Hake, 1998). Result of post-test for several aspects in both classes there is sufficient criteria, this is caused by several factors which are students are still not familiar to implement and connect each problem-solving indicator with physics concept. In addition, it needs long time to train each problem-solving indicator to students.

Analysis of Student Activities

Table 4 and Table 5 shows n-gain result of grade X MIA 1 and X MIA 3 based on problem solving indicator where n-gain score of both classes are in range of 0.30≤N-gain<0.70 which means that the improvement in each problem solving indicator is in medium category (Hake, 1998).

Table 6. Result of student activities in grade X MIA 1 and X MIA 3

Indicator	X MIA 1			X MIA 3		
	M1	M2	M3	M1	M2	M3
Orientation	3.38	3.38	3.63	3.63	3.88	4.00
Investigation	4.00	4.00	4.00	3.67	3.67	3.83
Multi representation	3.50	3.50	3.50	3.50	3.50	3.50
Application	3.00	3.00	4.00	4.00	4.00	4.00
Evaluation	4.00	4.00	4.00	4.00	4.00	4.00
Average score	3.72			3.84		
Category	Very Good					

M= Meeting

Table 6 shows the score result of student activities which are observed during the learning process in three meetings. Score obtained in grade X MIA 1 and X MIA 3 is in range of $3.60 \leq SB \leq 4.0$ which means that student activities during learning using IBMR model with contextual approach is in very good category (Ratumanan & Laurens, 2011). One of the effectiveness indicators of a device is seen from observation process of student activities during learning (Goe, Bell, & Little, 2008; Slavin, 2009).

Result of analysis on student activities obtained supports the previous research which said that student activities during learning using IBMR model runs in very good category (Siswanto, Susanti, & Jatmiko, 2016; Ariandini, 2019). In addition, Yuliana (2019) also stated that student interaction during learning using IBMR model is well-implemented.

Analysis of Student Responses

To find out how is student responses during learning process using IBMR then students are asked to fill in the questionnaire containing several aspects in the form of how is student interest and student renewal towards learning device which is being developed. Questionnaire is given to 54 students and obtained percentage average result in each indicator of 77%. Where the percentage obtained in is range of 76≤SP≤100 amounted 0.47 and in grade X MIA 3 amounted 0.38. Where in both classes obtained average scores in range of 0.30≤N-

so that it can be said that student responses towards IBMR learning model with contextual is in very positive category (Riduwan, 2010).

Conclusion

Based on result of research obtained, it shows that IBMR model learning device with contextual approach is effective to improve student problem-solving skill with medium category. In addition, it is supported by student activity during learning is very good and student responses during learning is very positive.

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