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Research Article

Apposite Model to Improve Mastery of Kinematic Motion Concept for Physics Education Student

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Abstract: Physics is a subject that is considered difficult for students and this often leads to misconceptions. One of the factors causing difficulties is the complexity of both abstract and real physics so it requires mastery of mathematical concepts and creative thinking. In relation to the problem, this study aims to examine and develop Apposite Model (Application step instruction and elaboration) to improve the ability of physics concept, on kinematics motion material. Validation results of both content validation and the Apposite Model construct are feasible to use. The research design used pre test - post test one group design. The sample in this research is Physic students at Departement of Physics Education, University of Jember year 2015/2016. Data were analyzed using gain score (Hake) and Anova test. The results of data analysis show that the effectiveness of the model is a moderate category, but the improvement of learning ability is significant. The conclusion of this research, Apposite Model can improve mastery of physics concept of student on kinematics motion material.

Keywords: Apposite Model, mastery of concept, kinematic motion.

I. INTRODUCTION

The rapid development of technology in the XXI century has greatly simplified the life of human. Physics as one branch of science is a fundamental science that became the basis of science and technology, considering the importance of the role of science. Physics should be well understood by students because the reality of science achievement of Indonesian students is still not satisfactory. International survey results from the Trends International Mathematics and Science Study (TIMSS) in science in the last few years (Gonzales, 2009) of 2007 are on the order of 35 out of 47 participating countries, in 2011 the order of 40 of 42 participating countries and in 2015 still ranked 45 out of 48 participating countries (Rahmawati, 2015).

The data presented above shows that understanding of science subject for students is still a serious problem. One of the factors causing it is because students in Indonesia are poorly trained in solving contextual problems, demanding reasoning and creativity in solving them. Based on the results of observation through direct interviews on the students of Physics Education program in University of Jember, students often encounter obstacles in studying physics because of some reasons. The problems encountered in the early semester on the subject of Basic Physics especially on mechanics, waves and electric magnets. This will certainly hamper the length of study of students who average is still above 4.5 years, half a year longer than normal undergraduate time.

Apposite Model is a development of new learning model that shows the interaction between lecturers and students based on the ability of thinking and response from students. Apposite Model implementation flow in Physics learning covers 7 stages that can be done as presented in Figure 1:

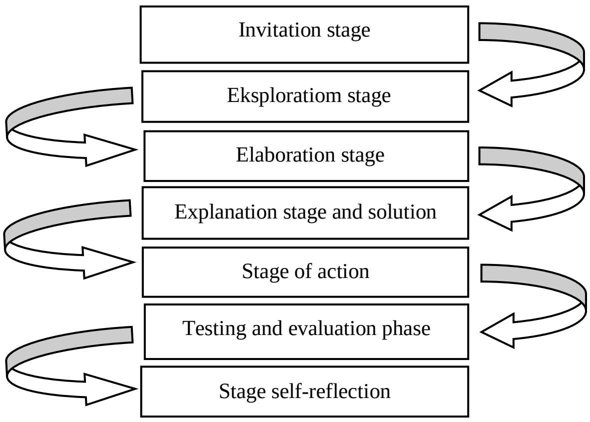

Figure 1: Apposite Model Implementation Flow

The Apposite model emphasizes the interaction of teachers / lecturers and students in learning using a contextual approach and is the development of 5E model which is expected to be able to control students' cognitive process on an on going basis.

Underlying the above background there needs to be an application of metacognition-based interaction learning model to improve the mastery of student concepts in Physics learning: 1) How is the implementation of learning tools Physics concept of kinematika motion using Apposite Model? 2) How to improve the mastery of physics concept of student kinematic motion through Apposite Model?

II. Methods

This research is a research development of learning model at the level of action research and aims to find the effectiveness of learning model. The subject involves first semester students who generally have studied Physics concepts in high school and are taking Basic Physics courses. The research design uses pretest-postest one group design (Fraenkel, 2012) as follows:

O	X	O
Pretes	*Treatment*	*Postest*

Information:

X: learning with developed model (Apposite Model)

O: learning outcomes and creative thinking skills

The data were collected using conceptual questions, written test (pre test and post test) based on conception mastering indicator and performance appraisal and inventory of contextual approach to improve concept mastery and develop creative thinking ability. To analyze the data collected using the following stages:

1) Documentation data about the existence of students, learning tools covering unit of lecture planning, semester test questions that have been used in Physics Program, University of Jember,

2) Data results FGD activities and validation model of learning by experts Analyzed descriptively qualitatively based on intergraph agreement with statistical analysis Percentage of agreement (R) (Borich, 2011)

$$R = [\,1- \{\frac{(A-B)}{(A+B)}\}]\ x\ 100\%$$

3) Data on learning device validation results to support model execution analyzed with descriptive statistics, mean score, proportion and percentage,

4) To see improvement of learning outcome and creative thinking ability.

The gain score calculation underlies the Hake formula (1998):

$$(g) = \left[\frac{Of-Oi}{1-Oi}\right] x\ 100\%$$

With:

(g) = normalized gain

Oi = pre-testvalue

Of = post-testvalue

The effectiveness criteria for improving learning outcomes and creative thinking ability are based on the provisions as shown in table 1:

Table: 1 Criteria of Effectiveness Improvement of Learning Outcomes andAability to Think Creatively

Gain Normalized	Criteria Creative Thinking
$(g) \geq 0,7$	High
$0,3 \leq (g) < 0,7$	Medium
$(g) < 0,3$	Low

5) Linear regression test is used to determine the effect of learning model developed to improve learning outcome, misconception and creative thinking ability

III. result and discussion

The development of the Apposite learning model has been validated in both content and constructs carried out by 3 (three) validators, all of whom are experts in the field of Physics Education. A summary of the results of its validation analysis can be shown in table 2.

Table 2: The Summary of Validation Results of the Apposite Model

Component Model	Score	Criteria	Coef.	Instrument
Rational	3,33	Valid	92,90%	Reliabel
Theori and Empirical Support	3,73	Very valid	97,10%	Reliabel
Sintak Learning	3,83	Very valid	96,1	Reliabel
Social System	3,56	Very valid	93,70%	Reliabel
Principles of Learning reakction	3,67	Very valid	94,30%	Reliabel
Support System	3,81	Very valid	95,50%	Reliabel
Impact of Learning	3,67	Very valid	91,10%	Reliabel
Average	3,66	Very valid		

Data in table 2 shows that the validation score for each component is in the range of values from 3.33 to 3.83. Rational model, theory support, learning syntax, social system, learning system reaction principle and impact of learning with each score in the category is very valid

In the implementation of learning begins with the pretest every meeting (2 x 50 minutes) followed by face-to-face learning for 3 times meeting (6 x 50 min). At the end of the meeting conducted the postest for kinematics motion study materials. During the learning *process, two observers were observed. The results of* observation of the overall learning implementation in each meeting and summary of observations are shown in table 3.

Table: 3 Implementation of Motion Material Study Lesson (kinematic motion)

No	Stage	Average Meeting I	Average Meeting II	Average Meeting III	Average Meeting IV
1	Invitation	3,17	3,67	3,3	3,17
2	Eksploration	3,33	3,5	3,5	3,5
3	Elaboration	3,25	3,5	3,5	3,5
4	Explanation and solution	3,33	3,5	3,5	3,5
5	Action	3,17	3,33	3,33	3,33

6	Testing and evaluation	3,33	2,83	3,0	3,5
7	Self Reflektion	3,36	3,4	3,5	3,5
	Average	3,2	3,37	3,38	3,43

Note: Score (2,8-3,2: Good); (3,3 -3,5: Very Good)

Based on the data in table 3 it appears that all learning steps on motion materials (motion kinematics) that have been designed on learning plan can be implemented by lecturers. At the first meeting in both categories and in the second to fourth meetings are generally in very good category. Only at the second and third meetings at the evaluation stage in both categories and the fourth meeting at the invitation stage in either category.

Analysis of learning outcomes for the ability of the concept of kinematics motion material can be seen in table 4.

Table 4: Test the Effectiveness of Kinematics Motion Materials

No. Resp	**PRE TEST I (x1)**	**POST TEST I (x2)**	**Δ X (x1-X2)**	**N-GAIN**
1	45	78	33	60.00%
2	60	82	22	55.00%
3	42	73	31	53.45%
4	63	85	22	59.46%
5	51	80	29	59.18%
6	53	74	21	44.68%
7	48	76	28	53.85%
8	48	74	26	50.00%
9	58	84	26	61.90%
10	60	80	20	50.00%
11	54	74	20	43.48%
12	57	80	23	53.49%
13	55	77	22	48.89%
14	51	78	27	55.10%
15	63	80	17	45.95%
16	68	86	18	56.25%
17	52	85	33	68.75%
18	50	81	31	62.00%
19	52	82	30	62.50%
20	40	72	32	53.33%
Summary	1070	1581	511	
Average	53.5	79.05	25.55	54.95%

Based on the calculation of gain score (G) according to Hake (1988) then effectivenesss student learning outcomes on motion materials and students' creative thinking skills in the enough category

Homogeneity and normality test of kinematic motion data is shown in Table 5.

Table 5: Homogeneity Test of Fisher Motion Material (Motion Kinematics)

No Resp	Pre Test (X1)	(X1-Xavg)	$(X1-X1avg)^2$	Post Test (X2)	(X2-X2avg)	$(X2-Xavg)^2$
1	45	-8.5	72.25	78	-1.05	1.1025
2	60	6.5	42.25	82	2.95	8.7025
3	42	-11.5	132.25	73	-6.05	36.6025
4	63	9.5	90.25	85	5.95	35.4025
5	51	-2.5	6.25	80	0.95	0.9025
6	53	-0.5	0.25	74	-5.05	25.5025
7	48	-5.5	30.25	76	-3.05	9.3025
8	48	-5.5	30.25	74	-5.05	25.5025
9	58	4.5	20.25	84	4.95	24.5025
10	60	6.5	42.25	80	0.95	0.9025
11	54	0.5	0.25	74	-5.05	25.5025
12	57	3.5	12.25	80	0.95	0.9025
13	55	1.5	2.25	77	-2.05	4.2025
14	51	-2.5	6.25	78	-1.05	1.1025
15	63	9.5	90.25	80	0.95	0.9025
16	68	14.5	210.25	86	6.95	48.3025
17	52	-1.5	2.25	85	5.95	35.4025
18	50	-3.5	12.25	81	1.95	3.8025
19	52	-1.5	2.25	82	2.95	8.7025
20	40	-13.5	182.25	72	-7.05	49.7025
		$\Sigma(X1-X1avg)^2$ =	987		$\Sigma(X2-Xavg)^2$ =	346.95

Large variant = Σ $(x2\text{-}x2avg)^2$ / ((n-1)) = 18, 2605 and Small variance Σ $(x1\text{-}x1avg)^2$ / ((n-1)) = 51.9473 F_{cal} = (large variant) / (small variant) = 0.35151 , from table F significance level 5% db numerator = 19 and db denominator = 19. Then F table = 2.16 so it can be stated that $F_{cal} = 0.35151 < F_{tabel}$. It concluded that both of groups have a homogeneous variant

Normality Test of Motion Material.

The normality data is analysed using SPSS to find out whether the sample is normally distributed. The analysed resultd is showed in table 6.

Table 6: Result of Normality Test of Motion Material.

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		20
Normal Parameters	Mean	1.4877E-15
	Std.	3.031002818
Most Extreme Differences	Absolute	0.093163379
	Positive	0.069305548
	Negative	-0.093163379
Kolmogorov-Smirnov Z		0.416639298
Asymp. Sig. (2-tailed)		0.995070786
The data is normally distributed		

Based on normality and homogeneity analysis as described previously, the data is homogeneous and normally distributed. Furthermore, the analysis of the difference between pre test and post test using T test paired two sample for means as presented in table 7.

Tabel 7: T Test Paired Two Sample for Means

t-Test: Paired Two Sample for Means		
	PRE TES I (x1)	*POST TES I (x2)*
Mean	53.5	79.05
Variance	51.94736	18.26052
Observations	20	20
Pearson Correlation	0.70490	
Hypothesized Mean Difference	0	
df	19	
t Stat	-22.07725	
P(T<=t) one-tail	2.622E-15	
t Critical one-tail	1.7291327	
P(T<=t) two-tail	5.245E-15	
t Critical two-tail	2.093024	

As presented in tabel 7, the paired analysis can be interpreted as follows:

1) Hypothesis: H0 = No difference in learning outcomes before and after learning using Apposite Model when (x2pst) = (x1pre)

2) H1 = there are differences in learning outcomes before and after learning using Apposite Model (x2post> x1pre)

3) H0 accepted = If -1,729 ≤ t arithmetic ≤ 1.729 (t_{table}) and H0 rejected = If -1,729 ≥ t arithmetic ≥ 1.729. At the 5% significance level obtained t arithmetic = -22,0772 < t_{table} = -1,729 with df = 19 means this shows that H0 is rejected and H1 is accepted.

Inconclusion, there is a significant difference of learning result of Motion before and after learning using Apposite Model.

Furthermore, the regression analysis is conducted to determine the effect of learning Apposite Model. The result of regression analysis is showed in table 8.

Table 8: Result of Regression Analysis

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.704907174
R Square	0.496894124
Adjusted R Square	0.468943798
Standard Error	3.114059369
Observations	20

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	172.3974	172.3974	17.77776	0.000519
Residual	18	174.5525	9.697366		
Total	19	346.95			

	Coefficients	*Standard Error*	*t Stat*
Intercept	56.69057	5.348526	10.5992
PRE TES I (x1)	0.417933	0.099121	4.21636

	P-value	*Lower 95%*	*Upper 95%*	*Lower 95.0%*
Intercept	3.62E-09	45.4537	67.92741	45.45373
PRE TES I (x1)	0.000519	0.20968	0.626179	0.209686

Based on the above regression analysis can be interpreted as follows:

1. Hypothesis: H0 = No significant effect of using Apposite learning model on student learning outcomes
2. H1 = there is a significant influence of the use of Apposite learning model on student learning outcomes
3. H0 accepted = If t arithmetic ≤ t_{table} H0 denied = If t arithmetic> t_{table}
4. At 5% significance level obtained t count = 4.21636> t_{table} = - 1.729 with df = 19 means this shows that H0 is rejected and H1 accepted.
5. Table regression coefficient b = 0.41793 which states the average variable Y = a + bx gives the meaning that any addition of value 1 on pre test postes value will increase 0.41793

The Conclusion there is a significant influence of the use of Apposite learning model to student learning result of motion material.

Apposite Model developed in this research is used to teach Basic Physics course and train student activity in creative thinking ability. The development of this Apposite Model is based on the author's experience during lecturing which begins from the low mastery of Basic Physics materials and the creative thinking ability of the students. In developing the Apposite Model it refers to the inquiry process propounded by Palincsar et al. (1984) and supported by the constructivist theory viewing of several components for the learning process to take place which consisting of step instruction (scaffolding), Zone of Proximal Development (ZPD), cognitive appreticeship, as well as cooperative learning (Santrock, 2011). Thus, the process of constructing and reconstructing the students' understanding and thinking, both in the second and third phase of the reserach, begins with step instruction to make an elaboration step in accordance with constructivism theory. Based on the enormous role of elaboration in the process of students' understanding and thinking skills, this study modeled a lesson that emphasizes step instruction in an elaboration form called the Apples and Appraisal model (Application of step instruction and elaboration)

CONCLUSION

The conclusion of this research are as follows:

1) The developed Apposite Model meets the valid categories both in content and constructs.

2) Apposite Model developed quite effective and influential in improving the mastery of physics.

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