



# IDEAS FOR 21ST CENTURY EDUCATION



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# Ideas for 21st Century Education

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## The implementation of 5E learning cycle model-based inquiry to improve students' learning achievements

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**ABSTRACT:** The research aimed at implementing the 5E learning cycle model-based inquiry to improve students' learning achievements on static fluid. This study used a pre-experimental research method promoting one group pre-test and post-test design. The samples were 30 students from a senior high school, using a purposive sampling technique. The data were collected by measuring the cognitive using essays, measuring for affective by using the Likert scale, and by using observation for psychometrics. The results showed that the means for teachers' and students' activities were 91% and 87%, respectively, which were classified as really good categories. The increase in the students' learning achievements was shown for cognitive with n-gain of 0.41 (medium category), for cognitive: 76% (good category), and psycho-motor: 71% (good category). The study used the statistical t-test: Paired Two Sample for Means with  $t_{\text{count}} > t_{\text{table}}$  ( $15.529 > 2.042$ ). Thus, the study concluded that the 5E learning cycle model-based inquiry can be used as an alternative choice to improve students' learning achievements on static fluid.

### 1 INTRODUCTION

Tiberghien (1998) discussed the role of teachers, particularly of physics, with a role of a physics scholar. This means that physics teachers need to be able to transfer their knowledge into an easy-to-understand learning materials so that students are not demotivated, but formulated to an easier material to learn.

The facts showed that physics is still considered to be a difficult subject for some students. According to Yesilyurt (2004), more explanations of the research have been provided to overcome the difficulties in science (physics, biology, and chemistry). Based on the research, Arief and Khoerul (2012) confirmed that the difficulties in understanding physics were due to factors of interests, abilities, motivation, facilities, supports, and activities.

The preliminary studies conducted in MAN (Madrasah Aliyah Negeri Islamic Senior High School) Subang concluded that almost all of the physics materials were difficult to understand for most students, in particular for those students who were less active and less enthusiastic in the classroom. However, the teacher had actually sought to apply various methods with the aim of the more active students understanding what was described by the teacher. In line with the declaration of the teachers, students also stated that they were less interested in the subject of physics. Further, students said that physics seemed abstract and they only memorized the concepts. This was consistent

with the student value, which was quite low. Direct observations made by the author while in the classroom also captured the same thing. Some students were not enthusiastic and not directly involved in the learning process. In addition, the teacher was still the center of learning and used the lecture method to deliver the subject, so that learning in the classroom became passive. What was said by physics teachers and students in MAN Subang was in compliance with what was happening in the classroom. The average value of students' achievements on the static fluid topic was the lowest compared to other topics. Thus, there was a need for a model of learning that could make students more involved in the classroom and obtain satisfactory academic results.

The 5E learning cycle model-based inquiry is a learning model centered on the student. The 5E learning cycle model is a realistic and constructivist method of leading students through a learning sequence where students were engaged in a topic, explored the topic, were given an explanation for their experiences, elaborated on what they have learned, and evaluated (Wilder & Shuttleworth, 2005).

Some research on the application of the 5E learning cycle model can improve the learning of concepts and the ability to apply concepts, students' achievement, students' understanding, learning outcomes, attitude of the students, students' academic achievement and the permanence of their knowledge (Piyayodilokchai et al., 2013;

Tuna & Kacar, 2013; Yadigaroglu & Demircioglu, 2012; Cepni, & Sahin, 2012; Uzunöz, 2011; Kaynar et. al., 2009).

## 2 LITERATURE REVIEW

### 2.1 5E learning cycle model-based inquiry

The 5E learning cycle model has five instructional stages, which are engage (intriguing), explore (exploration), explain (explain), elaborate (elaboration/develop), and evaluate (evaluation) (Bybee, 2004). Duran and Duran (2004) state that using a learning cycle approach in the classroom helps to facilitate inquiry practices because learning cycles focus on constructivist principles and emphasize the explanation and investigation of phenomena, the use of evidence to back up conclusions, and experimental design. The 5E instructional model (Bybee & Landes, 1990) can be used to design a science lesson, and is based upon cognitive psychology, constructivist learning theory, and best practices in science teaching.

### 2.2 Learning achievement

Learning achievement indicators for cognitive in this study were based on Krathwohl (2002), with domains of  $C_1$  (remembering),  $C_2$  (understanding),  $C_3$  (applying), and  $C_4$  (analyzing). Meanwhile, learning achievement indicators for affective and psychomotor were based on Bloom. Affective indicators were receiving, responding, valuing, organization, and characterization, whereas psychomotor indicators were imitation, manipulation, precision, articulation, and naturalization.

## 3 RESEARCH METHODS

The research method administered in this study was a pre-experimental method using one group pre-test post-test design. This research involved students in grade 11 who were in the science program (IPA) of MAN Subang.

The instrument used was an observation sheet to record the activities of teachers and students during the implementation of the 5E learning cycle model-based inquiry. For measuring the cognitive, affective, and psychomotor aspects, this study used an essay test, the Likert scale, and an observation sheet, respectively.

The data analysis of implementing the 5E learning cycle model-based inquiry was based on the percentage of teachers' and students' activities in every cycle rated by the observer. The increase rate of the students' learning achievements for cognitive was

based on the n-gain (Cheng et al., 2004). The analysis of the affective was based on the interpretation of the percentage, and for psychomotor, it was based on the percentage of each psychomotor indicator shown by the students in the observation sheets.

## 4 RESULTS AND DISCUSSION

### 4.1 Implementation of 5E learning cycle model-based inquiry

The implementation of the 5E learning cycle model-based inquiry increased the activity of teachers and students in learning. After the first implementation, the average percentage of teachers' and students' activities reached 79% and 87%, respectively. These percentages increased even more after the second implementation of the 5E learning cycle model, after which the average percentage of teachers' and students' activities reached 96% and 92%, respectively, and classified as a really good category. After the third cycle, the average percentage of teachers' and students' activities reached 99% and 97%, respectively, and classified as a really good category.

It can be seen that there was an increase at every meeting, especially for students' activities. However, the increase was insufficient in the case of teachers' activity. This was due to the teachers being less able to manage the time. In general, the 5E learning cycle is considered as a "guided inquiry", where the teacher provides only the materials and problems to investigate and the students execute their own procedures to solve the problem under the guidance of the teachers (Martin-Hauser, 2002; Windschitl, 2003).

The interpretation of the teachers' and students' activities at every step of the model is summarized in Table 1.

Table 1. Mean implementation at every stage of the 5E learning cycle model-based inquiry.

5E learning cycle model-based inquiry	Mean activity		Interpretation	
	Teacher (%)	Student (%)	Teacher	Student
Engagement	92	88	Very Good	Very Good
Exploration	90	87	Very Good	Very Good
Explanation	92	83	Very Good	Very Good
Elaboration	91	90	Very Good	Very Good
Evaluation	93	89	Very Good	Good
Cover	96	88	Good	Good
Mean	91	87		

It can be concluded that the implementation of the 5E learning cycle model-based inquiry on the teacher's and students' activities was in the very good category. To optimize this model, time management became the most important point. Moreover, since the phase elaboration on this research category was still low, the teacher should be able to explain the theory associated with everyday life so that the concept is understood by the students.

#### 4.2 Improved learning achievements of students

The students' learning achievements were improved by the implementation of the 5E learning cycle model-based inquiry, from a mean value of 12.33 (pretest) to 33.67 (posttest), with an overall n-gain value equal to 0.41 with moderate interpretation. Based on the analysis of the overall n-gain, the increase in the learning achievements of the students was better after learning with the 5E learning cycle model-based inquiry. This condition was caused by the 5E learning cycle model-based inquiry having associated significantly with the indicators of cognitive, affective, and psychomotor. From the total of 30 students who took part pretest and posttest, there were 3% of students with n-gain categorized as high, 77% of students with n-gain categorized as medium, and 20% of students with n-gain categorized as low.

With regards to the affective aspects, each indicator was improved after the implementation of the 5E learning cycle model-based inquiry at each meeting. The indicators of happy to follow learning process and writing important things obtained the highest mean value of 80%, with a good category, while the indicator of easily answered question became the lowest value compared to the others. It might be that the ability of students on mathematical operations was low. However, when viewed as a whole, the mean of the affective learning outcomes of the students increased and reached 76% with both categories.

With regards to the psychomotor aspect, each indicator was improved after the implementation

of the 5E learning cycle model-based inquiry at each meeting. The indicator of capable in designing lab results into practical reports obtained the highest mean value, which was equal to 76% with both categories, while the indicator of can perform lab activities earned the lowest mean value, which was equal to 69% with both categories. This was due to, at the first meeting, the students' still having difficulty in doing practicals so that the psychomotor value had very little impact on the mean value. However, when viewed as a whole, the mean of the psychomotor aspect increased and reached 71% with both categories.

Based on the results of hypothesis test,  $t_{\text{count}}$  was 15.53 at the significance level of 0.05 and the  $t_{\text{table}}$  was 2.042. Thus, since the  $t_{\text{count}}$  is bigger than the  $t_{\text{table}}$ ,  $H_0$  was rejected and  $H_a$  was accepted. This indicates that the implementation of the 5E learning cycle model-based inquiry can improve the learning achievement of students in a static fluid material at the subject case (class XI IPA 1 MAN Subang). Based on the data analysis, the cognitive domain of students in this study was placed in "medium" category, their affective domain was in "good" category and their psycho-motor domain was both in "medium" and "good".

The achievement of some indicators was still low, in particular in the aspects of analyzing (cognitive aspect), easily answer the question (affective indicator), and follow the practicum instructions (psychomotor indicator). To improve these three indicators, the teacher should be able to provide concrete experiences that correspond to daily life associated with an existing concept or theory that cognitive, affective, and psycho-motor should go hand in hand. The higher one aspect gets, the higher the others get, too. This was consistent with various studies that advocated the correct use of the 5E learning cycle instruction effectiveness for improving students' achievement in cell concept and scientific epistemological beliefs (Kaynar et al., 2009). In addition, Dorji et al., (2015) stated that a learning cycle approach can improve students' learning and awareness.

## 5 CONCLUSION

The implementation of the 5E learning cycle model-based inquiry was categorized as really good. The study confirmed that the implementation of the 5E learning cycle model-based inquiry improved the students' learning achievements in the cognitive domain, shown by normal gain index at a medium level; in the affective domain, shown with a good category; and in the psychomotor domain, shown by the means of observed rate for each session to the good category.

Table 2. Mean score and n-gain of cognitive aspects on pre-test and post-test.

Aspect	Item number	Average score			N-Gain	Interpretation
		Pretest	Posttest	Gain		
C <sub>1</sub>	1,5,7,11	3.63	9.63	0.49	Moderate	
C <sub>2</sub>	2,8,12,16	3.73	9.23	0.45	Moderate	
C <sub>3</sub>	3,10,13,15	2.43	7.50	0.37	Moderate	
C <sub>4</sub>	4,6,9,14	2.43	7.30	0.36	Moderate	
Means		3.05	8.42	0.42	Moderate	

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