The Implementation of Learning Cycle 5E to Improve Learning Outcomes of Number Theory of Mathematics Education Study Program Students of Riau University

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Abstract: This research is a classroom action research that aims to improve the learning process and improve student learning outcomes in Number Theory course. The improvements made were by applying the 5E Learning Cycle learning model. Learning Cycle 5E is based on constructivist learning theory. According to constructivist theory one must build his own knowledge. This 5E Learning Cycle Learning follows 5 stages: 1.Engagement, 2 Exploration, 3.Explanation, 4. Elaboration, 5. Evaluation. This research was conducted in 2 cycles, with sequences of activities, initial reflection, action planning, and implementation of actions, observation and reflection. At the end of each cycle a quiz is carried out, which is useful to observe the development of student learning outcomes from conventional learning to learning by applying the 5E Learning Cycle. The results of observations show improvements in student activities and interactive learning. Analysis of student learning outcomes data also showed an increase in average learning outcomes, namely 57.8 in conventional learning to 64 at the end of cycle 1 by implementing 5E Learning Cycle and becoming 70.8 at the end of the second cycle.

Keywords: Engagement /Classroom Action Exploration /Research

1. Introduction

Teaching is the main function and task of every lecturer in a university. Indeed there are other functions and tasks such as research, community service, administration and others, but the most important for most lecturers' activities is teaching. Therefore, lecturers should savvy the principles of teaching, so that with their knowledge the lecturers will be able to improvise their teaching in order to achieve the best learning outcomes. Teaching is not a mechanistic work that has certain steps by default, yet teaching is an art, in the sense that the perpetrator must be able to carry out what is needed at a time and be able to do the right teaching or learning according to the needs of the time. In addition to the principles of teaching, each lecturer also needs to have adequate knowledge about the principles of learning. How the learning process takes place in a person, and how learning behavior occurs, and what factors influence the learning process, (Margono; 1999: 125).

The main task of lecturers towards students is learning, meaning that lecturers must try to teach students, make students experience the learning process. There are so many ways to make students learn, but there is no best way for all situations. All good learning as long as it is used is in accordance with the situation at hand so that the lecturer can choose the appropriate learning method, even able to improvise in teaching students. Lecturers need to equip themselves with the principles of teaching and learning which will be presented as follow.

To be able to teach students well, first of all the lecturers must be able to manage the class. What is meant by class is the place where learning occurs. The purpose is: to make the class truly a place of learning for students; meaning that students are in class and really experience the learning process. Creating a learning process occurs in the classroom, creating a classroom atmosphere that is conducive to the learning process, always trying to make students truly active in learning, striving for means that help the learning process become more effective and efficient.

Learning must be able to provide experience to students so that they actively carry out activities to recognize and interact with the learning subject. By managing the class well as aforementioned, it means that the lecturer has tried to teach students.

Mathematics Education Study Program is one of the study programs in the Department of Mathematics and Natural Sciences (PMIPA) in the Teaching and Education Faculty at the University of Riau, which job is to educate prospective secondary school mathematics teachers in a professional manner. The Number Theory course is one of the compulsory courses that must be taken by all students of Mathematics Education study program. This course is a basic subject, which the emphasis is not on calculations but on the ability to think logically and reason systematically in problem solving. Jhon B. Fraleig (1989; 1) in his book says that "playing business of mathematics is proving theorem". Problem solving as the main goal in mathematics is trained by proofing the theorem. Proof of theorem and problem solving in mathematics, will train logical thinking, critical, creative, systematic, effective and efficient (Syofni; 2009: 1).

The author,the lecturer in number theory course, feels some problems in learning. Namely, most students are passive and very passive in learning activities. They are rarely even never asking questions or responding toward their classmates' opinions. The dominant activity only records. Only about 10% of students are actively involved in constructing their knowledge. Conditions like this are certainly not in accordance with those who are supposed to learn mathematics.

Based on the reflection that the author did on the learning that had been carried out, the cause of the student's lack of active learning in addition to coming from students and other factors, which was no less the cause was from the author himself. The author was impatient to guide and train students in scaffolding and did not consistently apply a learning model so that students can construct their own knowledge. This is due to limited time and many lecture materials to catch up.

Learning Cycle 5E (LC 5E) is a student-centered learning model with a constructivism approach. LC 5E is a series of activity phases organized in such a way that students can master the competencies that must be achieved in learning by playing an active role. This learning model suggests that the learning process can involve students in active learning activities so that the process of assimilation, accommodation and organization in the cognitive structure of students. If there is a process of constructing knowledge well, students will be able to improve their understanding of the material being studied (Fajaroh and Dasna, 2008).

The application of the Learning Cycle 5E Learning Model in learning is expected to solve the problem of underactive students in the learning process and low learning outcomes.Learning is an active effort from someone who is done consciously to change his own behavior. Learning is a change in behavior or behavior (knowledge, skills, mental attitude) as a result of experiencing. Learning is the process of improving knowledge and skills by experiencing it yourself. Learning

is changing actions, knowledge and skills, the results of which can be true or false. Learning is a process to gain the ability to replace bad behavior to be good.

Based on several learning definitions as mentioned above, it can be concluded that learning is an active activity that is carried out in an existing way to gain new abilities through the experience of getting acquainted and interacting with objects or material being studied. Students need to think about how to provide experience so that they can effectively engage to recognize and interact with learning subject to gain new abilities.

Active student involvement in the teaching and learning process is vital for effective learning. This means that students must be made active in the process (Margono Slamet 1999; 145). In Bruner's opinion, children must play an active role in learning. This active role will be achieved if a process is carried out through the invention (Hudoyono, 1983; 17). By trying to find the feeling of satisfaction will accompany it. Satisfaction that accompanies the success of students, will be a driving force to try to find the solution to the problem itself, and will be an effective provision for the next task.

The results of Soedijarto's research show that the only significant school variable that determines student learning success is the level of student participation in teaching and learning activities, students need to be actively involved (Soedijarto, 1981; 318). In accordance with the understanding of learning in quality learning books in tertiary education, learning is an active effort from someone who is done consciously to change his own behavior (Margono Slamet, 1999; 127).

Learning Based on Constructivism View

Constructivists come from the word "to construct" which means to build. According to the theory of constructivism, one must build his own knowledge. Knowledge cannot be transferred just transferred to others, but must be interpreted by themselves (Baharudin and Nur, 2007).

Learning must be packaged into a process that constructs the knowledge created in the minds of students, as a result of the interaction of the five senses of the students with their world, so that knowledge is not solely transferred by lecturers to students. Students need to be accustomed to solving problems, finding something useful for themselves and struggling with ideas, because lecturers will not be able to provide all knowledge to students. Active student involvement in lecturing supports students to build their own knowledge, so that learning will be centered on students. (Baharudin and Nur, 2007).

Piaget and Vigotsky (in Baharudin dn Nur, 2007) emphasized the existence of social luster in learning, and both suggested using study groups. Arting students collaborate in groups. Solve problems by discussing in the group to construct knowledge in him.

The principles in constructivism according to Mudjiman (in Fajaroh and Dasna, 2008) are as follows. Active knowledge is built by students, pressure in the learning process lies within students, teaching is the process of helping students, the pressure in the learning process is more on the process not only on the final results, the curriculum must emphasize student participation and the teacher is a facilitator.

Learning Cycle 5E (LC 5E) Model

Learning Cycle 5E (LC 5E) is a student-centered learning model with a constructivism approach. LC 5E is a series of activities phases (phases) organized in such a way that students can master the competencies that must be achieved in learning by playing an active role. This learning model suggests that the learning process can involve students in active learning activities so that the process of assimilation, accommodation and organization in the cognitive structure of students. If there is a process of constructing knowledge well, students will be able to improve their understanding of the material being studied (Fajaroh and Dasna, 2008).

Lorsbach (in Made Wena, 2009) said that LC 5E consists of 5 phases, namely:

1. Engagement (Generating Interest)

   In this phase the lecturer tries to arouse and develop students' interest and curiosity (curiosity) about the topic being taught. This is done by asking questions about factual processes in everyday life (which relate to the topic of discussion). Thus, students will give a response or answer, then the student's answer can be used as a foothold by the lecturer to find out the students' initial knowledge about the subject matter. Then the lecturer needs to identify the presence or absence of misconceptions in students. In this case the lecturer must establish a link between the students' daily experiences and the learning topics to be discussed.

2. Exploration

   At this stage small groups consisting of 2-4 students were formed, then given the opportunity to work together in small groups without learning directly from lecturers, students did and recorded observations and ideas through activities. At this stage the teacher acts as a facilitator and motivator.

3. Explanation

   At this stage the lecturer is required to encourage students to explain a concept with their own sentences, to ask for proof and clarification of the students' explanations, and to listen critically to each other's explanations between students. With the discussion, the teacher gives definitions and explanations of the concepts discussed using the explanations of previous students as a basis for discussion.

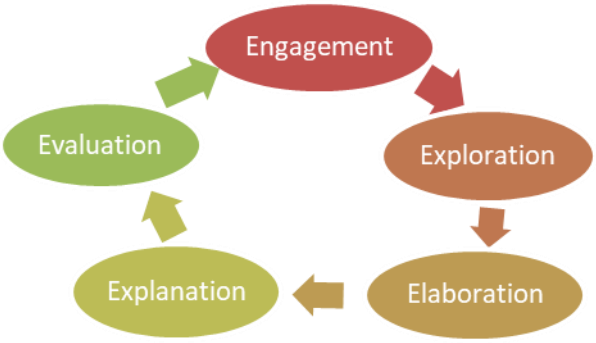
4. Elaboration

   At the elaboration stage students apply concepts and skills that have been learned in new situations or different contexts. Thus, students will be able to learn meaningfully, because they have been able to apply or apply new concepts learned in new situations.

5. Evaluation

   In this phase, an evaluation of students' knowledge, competencies or understanding of students in implementing new concepts and evaluating the effectiveness of previous phases is carried out. At this stage students can do self-evaluation by asking questions and looking for answers using observations, evidence and explanations obtained previously. The results

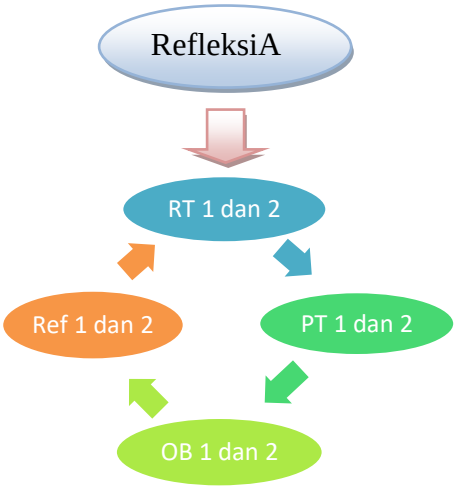
of this evaluation can be used as a lecturer as an evaluation material on the implementation process of LC 5E that is being implemented, whether it is going well, is good enough or still lacking. Likewise in self-evaluation, students will be able to find out the shortcomings and progress in the learning process that has been done. The following are the design of learning models planned to be implemented in learning.



2. Methodology

2.1. Type of Research

Research is a classroom action research, planned two cycles, namely Cycle 1 and Cycle 2, as follows, the design planned for each cycle can be presented in the following diagram.



Initial Reflection → Action Plan 1 → Implementation of Action 1 → Observation 1 → Reflection 1 → Action Plan 2 → Implementation of Action 2 → Observation 2 → Reflection 2 → further improvement.

2.2. Data Analysis

For the purpose of answering questions on problem formulation, there are two types of data analysis carried out, namely quantitative data analysis and qualitative data analysis.

Quantitative data analysis is intended to answer the formulation of the first problem and see the success of the action. Data analysis was done by: 1. Comparing the number of students who experienced an increase in learning outcomes with those who experienced a decrease in learning outcomes, 2. Comparing the average score of Quiz 1, 2 and 3. 3. Comparing the number of students with low scores in each cycle and comparing the number of students with high scores in each cycle by presenting data in the frequency distribution table.

Qualitative data analysis, carried out on observations and student responses to learning. The results of observations and responses from students were recapitulated and then concluded to be then reflected and used for consideration of improving the performance of lecturers in carrying out learning in the next cycle.

3. Result and Discussion

For the purpose of answering questions in the problem formulation, there are two types of analysis carried out.

Analysis of Learning Outcomes on Quiz 1 Quiz 2 and Quiz 3

To see the improvement of student learning outcomes from before action to after action, by comparing the number of students who experienced an increase in scores with those who experienced a decline. If the number of students increases more than the fixed and decreasing numbers, it is concluded that there is an increase in student learning outcomes. The following is a table about the number of students who experienced an increase, fixed and decreased scores from quiz 1, quiz 2 and quiz 3.

Table 1. Frequency of Students Changing Scores

	D_1	D_2
Increase	32	33
Still	3	5
Decrease	12	9

D1 is the number of students who experienced a change in score from quiz 1 to quiz 2,
D2 is the number of students who experienced a change in score from quiz 2 to quiz 3
Table 1 above informs that the number of students who experienced a good score increase in column D1 or column D2 was more than the number of students who experienced a decrease in scores, so it can be concluded that there was an increase in learning outcomes of Number Theory.

The following is a table of basic statistics on learning outcomes of Numbers Theory based on score quiz 1, 2 and 3.

Table 2. Basic Statistics Score Quiz 1 (X_1) and Score Quiz 2 (X_2) and Score Quiz 3 (X_3)

No.	Statistic	X_1	X_2	X_3
1.	Highest score	100	100	100
2.	Lowest score	30	37	46

3.	Average	57,8	64	70,8

Table 2 above shows the improved changes in quiz score 1 to quiz score 2 and quiz 3, namely by increasing the lowest score and average score. The highest score for all three scores has reached the maximum score.
If the data on learning outcome scores are presented in the form of frequency distribution, then the following table 3 will be obtained.

Table 3 Frequency Distribution of Quiz 1, Quiz 2 and Quiz 3

No.	Interval Score	fX_1	fX_2	fX_3	Category
1.	29 --- 40	8	4	0	Very low
2.	41 --- 52	9	11	7	Low
3.	53 --- 64	16	7	8	Medium
4.	65 --- 76	9	16	18	
5.	77 --- 88	4	4	7	High
6.	89 --- 100	1	5	7	Very High
	Total	47	47	47	

Table 3 above shows a reduction (decrease) in the number of students who have a score at low and very low intervals which is from 17 people to 15 people at the end of cycle 1 and decreased to 7 people at the end of cycle 2 with no one having a very low score. This shows that there are 10 students with low and very low scores who have moved to have a moderate score. On the other hand, the number of students who have high and very high scores increases in number at the end of cycle 1 and increases again at the end of cycle 2, which is from 5 people to 9 people and becomes 14 people at the end of cycle 2. Based on the above description can be concluded, there is an increase in student learning outcomes , after the 5 E Learning Cycle Implementation was carried out in learning the Number Theory course.

Analysis of Learning Reflection Results by Students

Reflections on learning by students were carried out at the end of cycle 1. The results of student reflection on learning can be explained as follows.

From 47 students, only 45 people collected observation sheets. Forty (40) of them stated that they agreed, strongly agreed and very good learning was carried out, only five (5) people stated that they did not agree. Almost all students said that learning in the second cycle was better than learning in the first cycle. There were 10 students who stated that they were happy with the learning that was carried out and still hoped that the demonstration of the proofing of the theorems directly by the lecturers would be increased.

The reasons given by students showed that they were very aware that involvement and constructivists in learning were very important. Reasons given include;
1) Improve learning readiness and responsibility
2) Learning can be done to train students to be more independent.
3) Study seriously and earnestly, diligently and actively. Increase interaction between students and lecturer students
4) Train to be brave to appear, which will be very useful for being a teacher and taking part in the PPL that will be implemented in the following semester.
5) Reducing dependence on lecturers.

4. Conclusion

Based on the analysis and discussion above it can be concluded that, there is an increase in student learning outcomes with the implementation of LC 5E in the Number Theory course. The following are things that can be concluded from the reflection of learning by students.

1. Positive things that students feel during the action; can increase independence, liveliness, readiness, interaction between student and student lecturers, train courage to appear and express opinions and be very supportive for PPL.
2. The constraints felt by students during the action process include; feel less confident (hesitant) and less able to master the material, lazy to discuss before learning because it is less ordinary, some group members are less responsible, it takes longer, the impression that questions from other friends are perceived as difficult and dropped friends who are presentation, or who will ask or respond.
3. Suggestions for learning improvement expressed by students are increase examples of application of concepts in creating Student Worksheets (MFIs) as a guide, improve guidance from lecturers, students improve themselves by positive thinking towards other students who respond or ask questions, students improve cooperation and activity, students divide their time well

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