113

IMPROVING AUTONOMOUS LEARNING AND LEARNING OUTCOMES OF STUDENT THROUGH GENERATIVE LEARNING ON LINEAR ALGEBRA SUBJECT

Zuhri, D
Mathematics Education Program
Faculty of Education Riau University
Email: zuhri.daim@yahoo.com

Abstract

The real condition on activity learning of linear algebra subject showed that the autonomous learning of students were not optimal yet. It was observed from their activities on learning, such as exploration, elaboration, confirmation and problem solving which they were still doubt and not having the ability. According to the researcher who having experience as the lecturer of linear algebra subject, that conditions were the source of difficulty for students on building their knowledge. Based on that, the researcher tried to develop the new innovation of learning to build the knowledge through the building of impression, the construction of knowledge and generalized it by implementing the model of generative learning. The problem of this study is whether the implementation of generative learning model can improve the autonomous learning and learning outcomes of students. Despitefully, the researcher also observed the quality of learning during the implementation of this learning model. This study was action research with the subject was the students who attended the linear algebra subject on odd semester academic year 2011/2012. The statistic test used Wilcoxon test because the data of this study was not distribution normal. The result showed that the implementation of generative learning model gave the positive impact to the learning quality, autonomous learning and learning outcomes of students on linear algebra subject

Keywords: Generative Learning, Autonomous Learning, Learning Outcomes

1. INTRODUCTION

On process of learning, a teacher/lecturer does not only convey the teaching materials well, but also it requires the changes which can set the environment and empower all potential of students to be able to master the studied material. To empower all potential of students on mathematics learning, the learning innovations concerning three things, namely how to understand mathematics, how to teach mathematics, and how to access the understanding of mathematics. The students must have five skills and be able to do that, namely: problem solving, reasoning, communication, connection, and representation (NCTM, 2000).

To realize the mathematical abilities of students, the paradigm of mathematics learning should be based on learning to do, learning to know, learning to be and learning to live together in peace and harmony. Through the process of leaning to do, students are encouraged to implement mathematical processes (doing the math) actively

to increase their intellectual development. Through the process of learning to be, students appreciate the values and beauty of products and mathematics process, which are shown by the attitude of happy, hard-working, tenacious, patient, disciplined, honest, and have a high achievement motif, and confidence. Furthermore, through the learning process to live together in peace and harmony, students socialize and communicate in mathematics. This is done through work and learn together in small groups (cooperative learning).

The fact that students tend to understand the concept through the explanation of lecturer, while the autonomous learning of students are expected 70% on process standards. This condition indicates that the learning process of students will not increase the high level of mathematical thinking skills. The high level capabilities will emerge and develop when students are given the opportunity to play an active role on building their knowledge, not only receiving information from the lecturer.

Based on the purpose of mathematics learning and the real conditions on learning process, it needs a learning innovation that emphasizes the empowerment of students on learning to optimize the autonomous learning of students. The learning innovation which is meant is applying the generative learning approach. The generative learning approach through six phases: orientation, expressing the ideas, challenges and restructuring, implementation, looking back and generalization. The generative learning based on constructivism understanding, with the basic assumption that knowledge is constructed on the mind of the student.

The Formulation of Problem

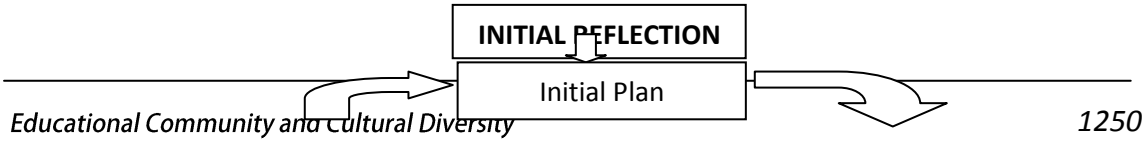
The formulation of problem in this research are:

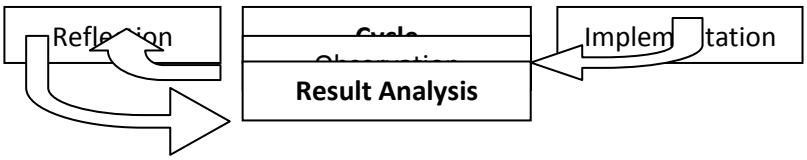
1) How is the illustration of learning process on the subject Linear Algebra by applying generative learning?
2) Is there an increase of autonomous learning of student after attending the learning which use generative approach?
3) Is there a learning outcome Linear Algebra of students after attending learning which use generative approach?
4) How much is the contributes of autonomous learning to the learning outcomes of students on the subject Linear Algebra

2. RESEARCH METHOD

This study based on the problems which is faced by researcher in a class that the autonomous learning and learning outcomes of students on subject Linear Algebra is not optimal. The improvement of the learning quality is needed to increase the autonomous learning of students by doing classroom action research (PTK) by applying generative learning. The subjects were the students who attended the subject Linear Algebra in the first semester academic year 2011/2012 in mathematics education program FKIP Riau University.

The innovative learning model which was implemented followed the flow chart-1





Flow Chart-1. The Implementation of learning activities

3. The Result of Research

The main goal of action research is the improvement of the learning process. Therefore, the results of this study described learning process and improvements from the first cycle to the second cycle and the impact of the improvement of learning which is done briefly. The following table will describe briefly about overview of the learning process in the first cycle and the second cycle.

Table 1. Overview of Learning Process on Each Phase Cycle I and Cycle II

Phase	Cycle I	Cycle 2
Orientation	The activity of lecturer on building an impression at the first meeting was not go well, because there is no relation with the material of daily life (lecturer forget it is written in the RPP), so that students do not have the impression that meaningful about the material which is learned, the preparedness of students on accepting the lessons are not optimal. At the second meeting, the lecturer has made improvements, but it was not empower the students on building that impression. Activity of building an impression at the third meeting had seen empower students.	Activity lecturer on building an impression at the first meeting on the second cycle is done well. Based on the suggestions on the reflection first cycle, learning activities begins with questions related to the material application which will be studied. Then the students were asked to provide answers and mention another example. Based on observations, there are not many students are able to build impressions and answering application of the material being studied. Nevertheless, there has been an increase courage of student on expressing their ideas, but not optimal. In general, in the second cycle, students are already active on expressing the things which they knew about the application of the material which will be studied.
Expressing Idea	The first meeting of the expressing idea is not going well. The question of lecturer about expressing idea is not responded by the students well. This may be caused becaus the student does not understand the question at all. In the second and third meetings, it is done repair by asking questions of the easiest so that the student can be responded. The second and third meetings, the learning activities carried out in groups to facilitate students. This effort is done in order to make students can respond the expressing idea which is proposed by lecturer in question.	Learning activities on phase of expressing ideas in the second cycle in accordance with the recommended, asking the student to complete the tasks as prior knowledge are required to understand the material that will be studied. These tasks are done in groups, and to the representatives of each group asked to present their work in turn. The other students were asked to give comment of the work results of the other groups. Student activity in the learning activities are already starting to be looked. In the discussion of the duties of expressing idea, lecturer emphasizes ideas which are required in order to make the students are ready on entering the restructuring phase

Challenges and Restructuring	Entering the phase of challenges and restructuring the new knowledge, the lecturer explains the material briefly on the first meeting, then students are given exercises. Students can respond the explanation of lecturer, but only a small part. The students are expected that they were not empowered to build their knowledge. The researcher and observer agreed for the second and third meetings, carried out repairs learning by groups. To facilitate the work of students in groups, the researcher designed the learning tasks which are in line with the material presented. The results showed that this method gives an active learning for students in building knowledge.	In accordance with the result of reflections on the first cycle, the second cycle at the phase of challenges and restructuring the new knowledge, researchers empower the students to structure their knowledge through the tasks undertaken guided in the group. During the students work in groups, the lecturer facilitates and provides to students who need it. Based on observations during four meetings in the second cycle, the lecturer has been empowering students optimally in building their knowledge. Students have been given the opportunity to restructure their knowledge about the studied materials. Activities working in heterogeneous groups of students are looked more active on building their knowledge. This atmosphere shows that the students have started to build their knowledge personally.
Implementation	The learning Implementation at this stage, students are given the opportunity to practice setting the concept on the previous phrase. At this phrase, the students were given a guided practice by applying the principle of scoffolding. The results showed that in the first meeting, students are reluctant to express the results of their thinking on solving exercises. In the second and third meetings, the implementation activities carried out in the group, and a representative group was asked to present their work. But there are some students who are waiting for the work results of their friends.	In line with the restructuring phase of new knowledge, learning activities are given in the form of tasks done in groups. Students are given the full opportunity to develop their ideas to accomplish tasks without the help of the lecturer. it is done to see whether students can apply their learning experiences gained in the restructuring phase. The results showed that in the second cycle, the confidence of students in developing knowledge already better than in the first cycle. It can be seen from the persistence, the number of questions to the lecturers during the implementation of activities, and they are more focused with the task of learning.
Looking Back	Learning activities at this phase is reflecting the work of the students on building knowledge through the development of a concept or through exercises. At the first meeting, the reflection still many shortcomings because students are still working individually. Only a small proportion of students who can present their work to be discussed together. In The response of the work of their friends were not many students volunteer response. Researcher and observer suspect, this occurs because students feel their work is not optimal or wrong so feeling reluctant on expressing ideas. The second and third meetings, activities performed on lesson grooup, some students has started to looked to	The reflection of the knowledge which is built by students through the completion of learning tasks has begun to focus on the student, although not optimal yet. At this second cycle, students has been empowered by lecturer optimally on reflection their knowledge through presentations the learning tasks at phase of restructuring and implementation. Representatives of students in the group are required to present their result and the other students responded. Through this reflection the students are given the opportunity to see and match ideas on building knowledge. The questions of students already seen increased frequency compared to the first cycle. This shows that the students already have better confidence in building knowledge. In other words, the autonomous learning on building their knowledge through discussions and group tasks is getting better. Nevertheless, there are still some students

	express their ideas though it have to be asked.	who are still reluctant to express their ideas.
Generalization	At the first meeting in accordance with the observation sheet, lecturers do not empower the students. Supposedly students are asked to create conclusions (essence) of the material being studied. At the suggestion of the observer, the second and third meeting of lecturers has empowered students to make inferences material being studied. Based on observation, generalization activities showed there is only a small percentage of students who can express it, and even they are not entirely true.	In the second cycle, a lecturer from the beginning asked the students to write the important things (concepts) that they can see from the material being studied. Furthermore, the students in turn asked to present important concepts and another student are asked to give feedback to the results of the presentation of their friends. Empowerment of students in this activity, is good enough. Students take turns giving response to his ideas, and with consciousness itself reveals the things which they know and things that are not in line with their ideas.

Based on the observation to the learning process in the first cycle, then for next learning, there are some improvements as follows.

1) On the orientation phase, not much connection between the material being studied with real things in life of a student. On the second cycle, the application materials are related with other fields such as science and others, and ask a few simple questions to be answered by the students.
2) On phase of expressing idea, the weakness on the first cycle is in empowering students to build the prior knowledge. In the second cycle, the researcher designed the phase of expressing the ideas in the form of apperception tasks. This task was completed by the students in groups, and they were asked to present their work results.
3) On phase of challenges and restructuring, the weakness in the first cycle is lack of active participation of students in building knowledge autonomously. On doing the tasks in a group, the work of students is not optimal because the member of group is homogeneous. On the second cycle, it is needed to form a heterogeneous group of members in order to discuss with the other group well.
4) On the implementation phase, all students work, but just some students completed their work. In the first cycle, the task is done in groups so that some students waiting for the results of their friends. In the second cycle, the tasks laid out from a simple application, performing tasks done individually. Individual activities can have confidence in presenting their work, and can be used as experience on reflection and making generalizations.
5) The learning activities on generalization phrase, the weakness on the first cycle that students are less empowered. From the observation, the students are not active on making generalizations, because they do not understand well the material being studied. In the second cycle, students are asked to write down the things that they know about the material being studied, then express it in front of the class in order to increase the active participation of students.

6) Student activity in the learning activities on the first cycle has generally been focused on the tasks of learning, but not optimal yet because until the third meeting, there are students who rely on the answers of their friends to complete tasks.
7) The active role of students on building the knowledge from the first meeting until the third meeting generally increased. However there are weaknesses, there is a group that can not work together because in this group there are no students as peers who can serve as a place to ask.

Activities in the second cycle was carried out by SAP that has been arranged and managed by watching the suggestions in the first cycle. Referring to the observations, the learning activities on the second cycle have few important things to note as follows.

1) Student learning activities in the orientation phase is not optimal yet, because generally students have not been able to see the relation the material studied with their real world or its application in other fields. This situation shows that the students' learning experience about the subject matter has not been built before the following study.
2) Learning activities on expressing ideas on the second cycle have been better than the first cycle. It is characterized by increasing the ability of the beginning student, as a bridge to build their knowledge through restructuring activities. They are seen more quickly understand the material and the autonomous learning of them is also better.
3) The implementation of heterogeneous group learning approach can help students to restructure the learning experience well, and through the work of the group on the phrase of restructuring the new knowledge, students can enhance their active role, increased confidence and autonomous learning in building knowledge.
4) On reflection activities, group learning approach can encourage self-confidence and courage students to have reflection of their work. On the second cycle, the courage of students on expressing their ideas through this reflection is much better than the first cycle.
5) Implementation of learning activities, at the phrase of generalization by asking students to write the important concepts. This method is considered very effective in organizing student makes generalizations the studied material.

Test of Learning Autonomous Difference

Based on data of autonomous learning of research subjects in the first cycle and the second cycle, the fact of autonomous learning as follows.

Table 2. Summary Data of Autonomous Learning on Cycle I and Cycle II

Subject Code	The Score of Autonomous Learning	
	Cycle I	Cycle II
ALE1	142	170
ALE2	177	175
ALE3	157	169
ALE4	161	169
ALE5	159	172
ALE6	162	166
ALE7	152	173
ALE8	152	160

ALE9	155	166
ALE10	169	174
ALE11	152	161
ALE12	148	164
ALE13	148	167
ALE14	154	165
ALE15	152	170

Because the number of subjects was 15 then to examine differences of autonomous learning of students on the first cycle and the second cycle used the Wilcoxon test. The research hypotheses tested were:

H_0. There is no level difference between KMB_1 with KMB_2

H_1. The higher level between KMB_1 with KMB_2 is caused because the learning improvement in cycle 2.

The criteria of testing H_0 is rejected if $J_{calculated} < J_{table}$

Note: *KMB_1. Autonomous Learning Cycle 1*
KMB_2. Autonomous Learning Cycle 2

The summary of Wilcoxon Test Analysis in following table.

Table 3. The Summary of Wilcoxon Test of Autonomous Leaning Cycle of Students on Cycle I and Cycle II

	Autonomous Learning	
Calculated Object	**Cycle 1**	**Cycle 2**
N	**15**	**15**
Average	156	168
Total J_+	119	
Total J_-	1	
Nilai $J_{Calculated}$	1	
α	0,1	
J_{table}	30	
The result of Statistic Test	$J_{calculated} < J_{table}$	
Conclusion	Ho is rejected	

Based on the fact that the results of the study, the hypothesis is rejected Ho, it can be concluded that the higher level is caused by the improvement of learning on the second cycle. Furthermore, the increaseing average of autonomous learning of students in the first cycle is 156 and the second cycle is 168, it is indicated that the improvement of learning by applying the generative learning model can improve autonomous learning of students.

The following table will be described the autonomous learning aspects of student before and after implementation of the action.

Table 4. Description of Autonomous Learning Development of Students Based of Its Aspects.

No	Aspect of Autonomous Learning	Total		Develop
		Before	After	ment
1	Learning initiatives	255	274	19
2	Diagnosing Learning Needs	163	184	21
3	Setting The Learning Goal	144	154	10
4	Arranging and Controling The Performance/Learning	300	336	36
5	Arranging and Controingl Cognition, Motivation, Behavior	339	368	29
6	Difficulty looked as Challenge	187	208	21
7	Searching and Using the Relevant Learning Resources	193	215	22
8	Selecting and Implementing the Learning Strategy	340	282	-58
9	Evaluating Process and Learning Outcomes	246	298	52
10	Self-eficacy	173	202	29

Based on the above data, the aspects of evaluating the process and learning outcomes is the highest aspect developmen. The other aspects which having dominant aspects development are Arranging and Controling The Performance/Learning, Arranging and Controingl Cognition, Motivation, Behavior and Self-eficacy.The high development of autonomous learning of students on aspects evaluating process and learning outcomes are not regardless of the impact of the emphasis in the learning process which has been applied. It can be observed from generative learning on phase looking back.

Furthermore, because students have habitual work on evaluating processes which they are made, giving the confidence for them. The increasing of ability of students on evaluating process and learning outcomes, not in spite of their ability to control themselves in learning. Their ability on controling their cognitive understanding as giving emphasis on the parts that are considered important (keywords) in the material, they dared to express their ideas and testing the truth of their opinion or the results of their work and has a good motivation and perseverance. It can grow and develop if the students are given the opportunity to build their knowledge by relying on concepts they already have, through cognitive problem which created by lecturer. In generative learning, the implementation of the application phase, students are given the opportunity to solve the problem or problems that varies by applying the concepts they have learned, it is expected during this process the cognitive conflict is appeared between what is owned and what is seen and demonstrated. At this phase, the students are expected have started to change their understanding of the structure (conceptual change).

Furthermore, based on the data of test scores in the first cycle and the second cycle with the number of subjects 15 and using the Wilcoxon test to test whether there are differences in both the learning outcomes. The study tested the hypothesis is
: H0. There is no difference in ratings between HB1 with HB2 H1. A higher ranking among HB1 HB2 caused by learning improvement in cycle 2. Criteria Testing H0 is rejected if Jhiutng <Jtabel

H_0. There is no level difference between HB_1 with HB_2

H_1. The higher level between HB_1 with HB_2 is caused because the improvement learning on cycle 2

Criteria Testing H_0 is rejected if $J_{calculated} < J_{table}$

Note: *HB_1. Learning Outcome Cycle 1*

HB_2. Learning Outcome Cycle 2

By using $\alpha = 0,1$ the result of calculation as summarized in the following table.

Table 5. Summary of Result Test of Learning Outcome Difference of Students on Cycle I and Cycle II

	Learning Outcome	
Calculated Object	**Cycle 1**	**Cycle 2**
Average	156	168
Total J_+	93	
Total J_-	27	
$J_{calculated}$	27	
α	0,1	
J_{table}	30	
The result of Statistic Test	$J_{calculated} < J_{table}$	
Conclusion	Ho is rejected	

Based on the fact of the results tes hypothesis in Table 5, the conclusion that Ho is rejected. Thus the results of data analysis can be concluded that higher ratings is caused because improvement of learning on the second cycle. Noting the average difference in learning outcomes of students in the first cycle is 156 and the second cycle is 168, then it is indicated that the improvement of learning by applying the generative learning model can improve student learning outcomes.

Table 6. Summary of Analysis Result of Determination Degree

SV	**X to Y**
N	15
$\sum X^2$	546441
$\sum Y^2$	104559
$\sum XY$	237836
r_{xy}	0.163897841
r^2	0.026862502
%	**2.6**

Ket: Y : Learning Outcome

X_2 : Autonomous Learning

Based on the above data, it was obtained information that there is a relation between autonomous learning with learning outcomes Liner Algebra 2.6%. In other words, it can be said that the 2.6% Liner Algebra student learning outcomes determined by autonomous learning of them.

4. Discussion of Result

Generally, the improvement of learning processes by applying the generative learning model can improve the quality of learning. Furthermore, based on the analysis data, it can be concluded that the application of generative learning model gives a positive impact on the increasing of autonomous learning and learning outcomes in subject linear algebra. There is linear relationship between the quality of learning with autonomous learning which showed that the quality of learning influanced the learning outcomes.

Then by based of the observing on learning process of the first cycle and the second cycle , it can be obtained fact that the learning process in the second cycle is better than the first cycle. Implementation of generative learning model provides the opportunity for students to build their learning experiences through learning activities completely which started from building an impression about what will be studied until reflecting ideas used on problem solving which having impact to learning outcomes of students

If it is seen from the first phase to build an impression of the learned concepts, the difficulties of students arise when the lecturer giving a problem that led to the conflict in the cognitive on schemata of students. On one side, the cognitive conflict would lead to emergence the ideas of students on problem solving with the ability of concept introduction well in the previous phase. Thus, the introduction of the concept through the steps of building impression is very important, and generative learning emphasizes this point.

The magnitude of tasks of students on constructing their knowledge through generative learning model on early lectures bring discomfortable to students, so that learning does not go well. This may occur on the beginning lecture in this study, the used method is individual. Noting the learning conditions, then on the second meeting, the researcher and observer agree to perform learning by making group method.

They arrange the learned concepts through discussions which guided by the lecturers, so that they have experience on building the concept. It showed that the student-centered learning, and it is in line with the concept of constructivism theory in mathematics learning.

BIBLIOGRAPHY

Hulukati, E. (2005). *Mengembangkan Kemampuan Komunikasi dan Pemecahan Masalah Matematika Siswa SMP Melalui Model Pembelajaran Generatif.* Disertasi Doktor pada PPs UPI Bandung: tidak diterbitkan.

NCTM. (2000). *Principles and Standards for School Mathematics*. Virginia: Reston.

Paris, S.G. dan Winograd, P. (2004). The Role of Self-Regulated Learning in Contextual Teaching: Principles and Practices for Teacher Preparation [1[1].] [Online] Tersedia: http://www.ciera.org /library/archive/200104/0104parwin.htm [15 November 2009]

Pintrich, P.R. (1999). The Role of Motivation in Promoting and Sustaining Self-Regulated Learning. [Online]. Tersedia: www.ece.uncc.edu /succeed/journals/PDF-files/ijer-12.pdf [15 Oktober 2009]

Sudjana. (1992). *Metoda Statistika*. Bandung: Tarsito.

Suherman, *et al*. (2003). *Strategi Pembelajaran Matematika Kontemporer*. Bandung: Jica UPI.

……(2004). *Kemandirian Belajar: Apa, Mengapa, dan Bagaimana Dikembangkan pada Peserta Didik.* Makalah Disajikan pada Seminar Pendidikan Matematika di Jurusan Pendidikan Matematika FMIPA Universitas Yogyakarta Tanggal 8 Juli 2004: tidak diterbitkan.

Wolters, C. A; Pintrich, P. R; dan Karabenick, S. A. (2003). Assessing Academic Self-Regulated Learning. [Online]. Tersedia: www.childtrends.org/Files/Wolters Pintrich Karabenick Paper.pdf [November 2009]

_____0000_____