Application of Constructivism Approach in the Learning of Initial Value Matter and Boundary Requirement Course

Elfis Suanto, Armis

Mathematics Education – FKIP, University of Riau
Jl. HR. Soebrantas, KM 12.5, Simpangbaru, Pekanbaru 28293, Indonesia
Email: elfissuanto17@gmail.com

Abstract. The purpose of this research is to repair the mathematic learning process of Initial Value Matter and Boundary Requirement (IVMBR) course. The variables which have been examined (1) the activities of lecturer and students in learning process, (2) the development of student grades, and (3) the completeness of student result in studying of IVBVP. These actions have been done in three cycles based on data's analysis, we get the result (1) the lecturer and students activities in learning process have been improved, (2) the development of student grades is rather the same in three of the cycles, and (3) the student who could reach the studying completely. After first cycle, these students get A or B increasing to 62,50,`4%, and after second cycle, the completeness of study has increased to 66,67%, and after third cycle, the completeness of studying have increased to 75,00%. Based on these informations, the constrctivism learning is good to use in learing of IVMBR course.

Keywords: *Constructivism, Learning process, Mathematic learning.*

1   Introduction

The Initial Value Matter and Boundary Requirement (IVMBR) course is a compulsory subject at Mathematics Education Program of PMIPA FKIP University of Riau. The emphasis of this course is not on calculations, but on logical thinking, reflective (critical and creative) and systematically reasoning in solving the real problems. The purpose of this course is to enable students to solve simple real problems such as one-dimensional wave equation, one dimensional heat flow function, two dimensional heat flow in stable state and others by converting the problem into a mathematical model or sentence in the form of IVMBR then settle it (Dikti 1991).

The global transition of mathematics learning in universities, initially emphasizing to the ability of cognitive algorithms to high-level thinking ability, has given challenges and impressions to the implementation of mathematical teaching and learning in the 21st century. Mathematical

learning should take attention in deep and meaningful learning concepts (NAEYC 2002; Noor Azlan 2000) so that the competence of high-level thinking of students can be fostered well. Thinking competence is the most basic skill that should be developed in the lecture room and is the key to achieving high learning outcomes for all students (Nessel & Graham, 2007).

The facts that is experienced in the learning of IVMBR in the odd semester of 2014/2015, for the 63 students who follow the course, only 18.35% who grade an A, 26.54% got B, and who get the grade of C, D , and E were 29.23%, 19.27%, and 6.61%, respectively. This shows that student learning outcomes are still low and unsatisfactory. Based on observation and experience of researcher who lecturing of IVMBR course, the low result of student learning caused by mostly students do less active in learning process. Mostly students rarely ask a question and the dominant activity is to record lectures given by lecturers. These fact are certainly not in accordance with how should learn math that can raise high-level thinking skill.

Several attempts have been made to enable students to be actively involved in the acquisition of knowledge, such as providing independent task of finding their own questions in the library and solving them by their self. The duty must be collected for review and returned to the student. In college students who can solve problems on the chalkboard are given additional value as a quiz value auxiliary. But the results are also not encouraging.

Based on the above description, there is a clearly gap between reality and expectation. Therefore, it is necessary to think about an active action that will create a condition to improve students' activity in the learning process of IVMBR, so that the learning result will increase. One approach of learning that can enable students in the learning process is a constructivism approach. Learning according to constructivism theory is a process of knowledge formation by the learner itself with the help of teachers, sources or other media (Glasersfeld 1989). Therefore, the student must actively engage in activities, actively think, conceptualize and give meaning to something learned. The idea of this theory causes the learner to actively build on his own knowledge.

Constructivism theory is defined as a generative learning, that is, the act of creating something meaning from what is learned. This causes a person to have knowledge and become more dynamic. The constructivism approach has some general concepts:

1. Learners raise knowledge actively based on existing experience.
2. In the context of learning, learners should develop their own knowledge.

3. The importance of fostering knowledge actively by the learners themselves through a process of interplay between past learning with the latest learning.
4. The most important element in this theory is that one develops one's own knowledge actively by comparing new information with its existing understanding.
5. Teaching materials should be related to the student's experience to attract the interest of the learner (Center for the Development of Curriculum 2001).

Herlina (2003) studied the application of constructivism approach to students of Physics Study Program at FKIP UNILA, among others state that (1) after learning using constructivism approach for the topic of Series, Complex Number, Matrix, Determinant, and Linear Equation, the students whose conception is not in accordance with the conception of the scientists, (2) Student activity during the learning by applying constructivism approach seems more active, during the learning process, the activities are increasing and in general the students are very enthusiastic.

To make this paper more focus on the specific discussion, the problems presented in this study are formulated as the following:

1. How is the level of student activeness in the learning process of IVMBR course with constructivism approach?
2. How does the student's learning outcomes in the course of the IVMBR after following the learning process with constructivism approach?
3. What is the student's opinion about the implementation of learning with the application of constructivism approach?

2.   Methodology

This research has been done with the following procedures as given in table 1.

Tabel 1: The class action design and the effect to the activeness of the student

The Lecture Number	Activity	Effect to the activeness of the student
1	Introducing lecturing strategies and planned cycles.	Good readiness to attend lecture with challenge, training and evaluation

	Explain student assignment (contract work)	
2		✓ Readiness to follow the lecture is better by learning the material first.
3		
4	Cycle I	✓ Active in the lecture with task responsibilities in the discussion
5		
6	Evaluation of mastery and learning process	✓ Attending evaluation actively
		✓ Providing consideration for further improvement of learning
7		✓ Readiness for attending lecture is increasing compared to cycle I
8		
9	Cycle II	✓ The responsibility for presenting material is increasing compared to cycle 1.
10		
11	Evaluation of mastery and learning process	✓ Attending the evaluation actively
		✓ Providing consideration for further improvement of learning
12		✓ Readiness for attending class is increasing compared to cycle II
13		
14	Cycle III	✓ The responsibility for presenting material is increased compared to cycle II.
15		
16	Evaluation of mastery and learning process	Attending evaluation actively, and filling a learning process questioner

The subjects of this study were the students of Mathematics Education Study Program, FKIP University of Riau who took the IVMBR course in the even semester of academic year 2015/2016 which amounted of 48 students consisting of two classes. Students who were the subject of this study are students who just follow the course IVMBR, excluding of students who repeat or improve the grade of previous semester.

To collect student mastery data in every cycle activity, a measuring instrument in the form of description test that was adjusted to the target of learning was developed. This data was used to answer the problem of learning outcomes. The activity during the learning process was observed in order to see the increases in student activity. While to evaluate the learning process, the opinions and views of students were collected. At the end of the lecture, the questionnaires were circulated to students to capture the opinions of students about the implementation of learning. To strengthen the findings on the implementation of learning, the message sheet to the students were also circulated.

The student activity data was processed qualitatively, that was by exposing student activity that happened at every meeting which then concluded for every cycle. The data analysis of learning outcomes was processed by comparing the scores on each evaluation, and analyzing the development of scores obtained for each cycle by presenting the data in tabular form, and bar chart. Students' learning outcomes are said to increase as the number of students who score increases from cycle to cycle, and the average student learning outcomes also increase from cycle to cycle. Questionnaire data of students' opinions about the implementation of learning with constructivism approach was processed by giving the lowest score 1, and the highest 4. The data was processed based on the following condition (Table 2).

Table 2. Learning performing criteria.

No	Average Score	Criteria
1	$1 \leq \bar{x} \leq 2$	Bad
2	$2 < \bar{x} \leq 3$	Fair
3	$3 < \bar{x} \leq 4$	Good

3. Results and Discussion

3.1. Data Analysis of Student Activity in Learning

The obtained data on student activity in learning based on the observations result for each meeting, as follows.

In the first cycle, the learning was held for four meetings and at the second, the fifth and the sixth meeting the evaluation and reflection were conducted. At the initial meeting, some smart students were still studying their own lecture materials without discussing with their friends. The students with the ability on average were discussing each other, while the weak students were not active, they just silent without participating in discussions, so, when

presenting the results of discussion in front of the group, the weak students do not seem to fully understand the material presented by their group's friends in front of the class. With the direction of the researcher, the deficiency was corrected at the next meeting, so that at the 5th meeting all members of the group were already active. At the end of the discussion for each meeting, the researcher along with the student concludes the material that has been learned at the meeting and the researcher gives direction to the material at the next meeting. Furthermore, at the 6th meeting the evaluation and reflection were conducted. Based on the reflection of the first cycle, the repairs to be done in the second cycle are as follows.

A. All students should be active in discussions.

B. Students who will present the results of discussion in front of the classroom are randomly selected by the researchers so that all students should be brave and ready to present the results of their group discussion in front of the class.

C. Students in a group should help each other who have not understood the material, so that all members of the group can understand the material.

In the second cycle, in the exchanging the group members are based on test scores obtained in the first cycle. In this second cycle, the learning was also held four times in 7th to 10th lectures, and at the 11th meeting the evaluation and reflection was carried out. At the initial meeting of the second cycle, there were still a small number of weak students who were not actively in discussing, with the direction of the researcher at every meeting, finally all the students participated in the discussion, and the weak students had dared to present the material in front of the class, though there was still a mistake some aspects of the material. The mistake occurs when the presentation in front of the classroom is directly corrected by their friends (the same group). It seems that students are more motivated to learn by constructivism approach. At the end of the discussion for each meeting, the researcher with the student concluded the material learned at the meeting and the investigator gave directions for the next meeting. Furthermore at the 11th meeting evaluation and reflection were carried out. Based on the reflection of the second cycle, there is not much improvement to be done. The improvement should be done in the third cycle especially regarding to the implementation of guidance and scaffolding on weak students.

In the third cycle, re-group members exchange based on test scores obtained in the second cycle. The implementation of the third cycle was conducted for 4 times lectures (the meeting 12 to 15) and at the 16th meeting, an evaluation and reflection of the third cycle were carried out. At each meeting in the third cycle all students were active without having to be redirected again. Researchers were only doing scaffolding for the materials that the students found being difficult. The material on the third cycle was

felt more difficult by the students. This cannot be denied because the material was an advanced material according to the material level in the IVMBR course. However, students seem to ask the researchers or other groups actively who have understood the material, so at the end of the third cycle students can discuss all assigned material. At the end of the discussion at each meeting, the researcher with the student concluded the material learned at the meeting and the investigator gave directions for the next meeting. At the 16th meeting, the evaluation and reflection were conducted.

From the three cycles above, it appears that student activity is getting better and better. If initially low-level students do not want to participate actively in discussions and intelligent learners only learn their own, however after several meetings and with the direction of researchers, these habits can change. Almost all the students participate in learning actively, and the weak students had the courage to present their group's work in front of the class.

3.2. Student Learning Outcomes Analysis

Data analysis of student learning outcomes was done by comparing the scores in each evaluation, and analyzing the progress of scores obtained for each cycle by presenting the data in the form of tables. The result of data processing in the form of data scaling about student mastery for each cycle presented in table 3.

Table 3. Score of student mastery for each cycle

| No | Score | Initial Score (before action) | | After action | | | | | |
| | | No. of student | % | Number of Student | | | Percentage | | |
				Test 1	Test 2	Test 3	Test 1	Test 2	Test 3
1.	81,0-100,0	17	26,98	30	32	36	62,5	66,7	75,0
2.	0,0-81,0	46	73,02	18	16	12	37,5	33,3	25,0

Refer to table 3, it can be seen that the percentage of students who get high scores increases from test 1 to test 2, as well as from test 2 to test 3. In other words the mastery of the students is increased after learning with constructivism approach. Furthermore, the average score and percentage of students mastery for three evaluations is given in table 4.

Table 4 Average score and percentage of student mastery for each cycle

| | Average score | | |
	Test 1	Test 2	Test 3
Average	72,03	72,35	73,07

From table 4, it can be seen that the average score increases from test 1 to test 2, as well as from test 2 to test 3. That means the average score of the student increases from the first cycle to the second cycle, also from the second cycle to the third cycle. It can be concluded that student proficiency increases after the constructivism approach that is applied in the study of IVMBR course in Mathematics Education Studies students majoring in PMIPA FKIP UNRI.

3.3 Analysis of student opinion data on learning implementation

To assess students' opinions on the implementation of learning by applying constructivism (teaching ability of lecturers) is distributing questionnaires to students. The results of the questionnaire are presented in table 5.

Table 5. Learning Performing

Learning quality : $\rightarrow$	$\sum xi$	$\bar{x}$
A. Planning Quality		
1. Clearness of lecture contracts with students at the beginning of the course, regarding: objectives, schedule and course materials, teaching materials, attendance and evaluation system (task, quiz, UTS and UAS)	75	3.75
B. Learning Performance		
2. The accuracy of lecture schedule includes the timeliness of starting and ending of lectures	70	3.50
3. Mastery of lecturers on lecture materials	75	3.75
4. The ability of lecturers to explain the lecture material	73	3.65
5. The lecturer's technique in asking and answering in the class	67	3.35
6. Technique of lecturers to motivate students in study harder	63	3.15
7. The ability of lecturers to create an orderly and active class	64	3,2
8. The willingness of the lecturer to spend time out of class normal time for consultation	60	3,0
9. Utilization of teaching aids and lecturers 'skills in their use to improve students' understanding	55	2.75
10. The suitability of lecture material with daily life and work demand	75	3,75
11. The content of moral messages, ethics, and discipline delivered by lecturers in lectures	62	3,1
C. Quality of Learning Evaluation		
12. Conformity of questions (quizzes, exams, and assignments) with course materials	74	3,7
13. The objectivity of lecturers in assessing quizzes, exams, and assignments	69	3,45
14. Returning of quiz, test, and duty result files by lecturers	60	3,0

Based on table 5, the average teaching ability of lecturers is 3,364 (good category). To further reinforce the findings of the study, it was also requested that the impressions and messages of 10 randomly selected students be sought. Below are presented by two students:

Impressions of student 1

Tanggapan / Kesan Selama pembelajaran :
- Metode mengajarnya bagus, karena menuntut Mahasiswa untuk belajar Mandiri
- Cara menjelaskan kepada Mahasiswa jelas.

Pesan.
1. Tulisan Ibu, untuk lebih di besarkan karena tidak jelas jika dilihat dari belakang. Dan Waktu untuk membahas soal yang tidak dpt dijawab mahasiswa lebih di perbanyak.
2. Suara Ibu pd saat mengajar, klu bisa di perbesar sedikit

Impression of student 2

Kesan dan pesan ①

Kesan : 1. Metode Pengajaran bagus karena membuat mahasiswa lebih Mandiri
2. Pelajarannya mudah dipahami dan didukung dengan metode mengajar Ibu yang bagus.

Pesan : Semoga belajar kedepannya Ibu mengajar dengan Suara yang agak besar karena yang dibelakang kurang kedengaran.

Based on the results of data analysis of student activities in learning, it can be seen that from the three cycles, the longer student activity is better. Initially low-skilled students do not want to participate actively in discussions and smart students only learn by themselves, after several meetings and with the direction of the researcher, the student behavior can be changed so that all students participate actively in learning. Weak students have dared to present their group work in front of the class even though there is still a mistake. The errors are corrected by the rest of the group so it appears that learning is really meaningful for the students. Judging from student learning outcomes for three evaluations, it appears that the percentage of students who score high increases from the first cycle

to the second cycle, as well as from the second cycle to the third cycle. The average student learning outcomes also increase from cycle to next cycle.

Based on the results of questionnaires that is distributed to the students, and from the impression of students during the lectures, the students respond very positive about the implementation of learning problems of IVMBR course by applying constructivism approach, and states that the teaching ability of lecturers is categorized well. Nevertheless, the voice of lecturers in teaching is still categorized as less harsh so that the students who sit in the back less heard because the total of student is more than 40 people and the capacity of the room only 30 people.

4   Conclusion

Based on data analysis and discussion, it can be concluded as follows.
A. Student activities in the learning process of IVMBR course increase after applying constructivism approach.

B. The study results of students are increased after the applied constructivism   approach.
C. On average, students who attended the IVMBR course responded very positive about the implementation of learning by applying constructivism and the average teaching ability of a lecturer was categorized as good.

References

Arikunto. 2008. *Penelitian Tindakan Kelas.* Jakarta : Bumi Aksara

Depdiknas. 2006. *Panduan Penyusunan Usulan dan Laporan Pengembangan dan Peningkatan Kualitas Pembelajaran di LPTK (PPKP).* Jakarta : Dirjen Dikti.

Herlina, Kartini. 2003. *Penggunaan Pendekatan Konstruktivisme untuk Meningkatkan Aktivitas dan Konsepsi Mahasiswa pada Matakuliah Fisika Matematika (Studi Kasus pada Mahasiswa PS Fisika FKIP UNILA).* Laporan Penelitian. FKIP Universitas Lampung.

Kozulin, A. 1995. *Mediated Learning Experience and Psychologist tools; Vygotsky"s and Feuerstein"s perspectives in astudy of student learning, Educational Psychologist.*

Mullis, I. V. S., Martin, M. O., Foy, P., and Arora, A. 2011. *TIMSS:Trends Internasional Mathematics and Science Study: TIMSS 2011 Internasional results in mathematics.* Boston: TIMSS & PIRLS Internasional Study Center.

Nessel, D. D., & Graham, J.M. 2007. *Thinking Strategies for student achievement: improving learning a cross the curriculum, K-12*. (2nd ed). Thousand oaks, California: Corwin Press. A SAGE Publication Company.

Nur, Mohamad, dkk. 2000. *Pengajaran berpusat Kepada Siswa dan Pendekatan Konstruktivis dalam Pengajaran.* Pusat Studi Matematika dan IPA Sekolah Universitas Negeri Surabaya.

Pusat Perkembangan Kurikulum. 2001. *Pembelajaran secara Konstruktivisme.* Kuala Lumpur: Kementerian Pendidikan Malaysia.

Resnick, L. B. 1987. *Education and Learning to Think*. Washington DC: National Academy Press.

Slamet, Margono. 1999, *Pembelajaran Bermutu di Perguruan Tinggi*. Jakarta: Dirjen Dikti.

Wardani, I.G.A.K. 2003. *Penelitian Tindakan Kelas*. Jakarta : Universitas Terbuka.

Wikipedia Bahasa Indonesia, ensiklopedi bebas. 2008. *"http://id.wikipedia.org/wiki/ Konstruktivisme"*.