The effect of using bilingual basic mathematics textbooks with constructivism approach

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Abstract. This research aims to look at the effectiveness of using bilingual basic mathematics textbooks with constructivism approach to conceptual understanding and activities. This research was experimental research with the type of the one-group pre-test-post-test design, the subject of this research was the college students of biology education program STKIP PGRI Sumatra Barat in the odd semester of 2018/2019 as many as 30 students consisting of 4 men and 26 women, as are sample chosen by purposive sampling. The instrument of this research is pre-test post-test questions, observation sheets and questionnaire of student activities. The results of this study stated that the basic mathematics bilingual textbook with constructivism approach was effective on conceptual understanding and less effective in activities than basic mathematics learning for college students of biology education department in STKIP PGRI Sumatera Barat.

1. Introduction  
Mathematics as science has an important role and is always studied at every level of education, both in elementary school and university level in Indonesia. STKIP PGRI Sumatera Barat is one of the private teacher training schools in Indonesia which requires basic mathematics subject, not only in mathematics education study programs but also in biology education study programs. This phenomenon is in line with the opinion of the National Council of Teacher of Mathematics in the USA which states that mathematics is used in science, the social science, medicine and commerce [1, 2]. The role of mathematics in the national curriculum in every country is a very important. It aims to form, namely development of concentration, the art of economical living, the power of expression, self-reliance, the attitude of discovery, understanding of popular literature, and quality of hard work.

The real number system is one of the materials in basic mathematics subject in the biology education program of STKIP PGRI Sumatera Barat. Many students in the biology education department failed to learn the concept of the real number system. Many studies also found the same phenomenon [3] — the failure of students in studying basic mathematics course constituted by various facts. First, the students tend to memorize the concepts learned without truly understand the concept. Second, they lack motivation in re-learning the material at home. When the lecturer gives a different problem with the examples in the class, most of the students cannot solve it. They also lacked confidence in solving the problems, and the learning approach could not develop the students’
reasoning and affective skills. The phenomena confirmed the final score of the students who scored more than 66 was only 34.3%. This percentage has not met the achievement standards set by the, which is 70%. Therefore, we could say that students have not understood the concept well.

Referring to the international standards, both PISA and TIMSS, Indonesia is a country that has renewed its mathematics lessons by renewing the curriculum which accommodates the findings in TIMSS and PISA. One of the concerns in the curriculum is the students' understanding of mathematics. To support the understanding, the renewed curriculum, which is known as the 2013 curriculum, recommend the use of constructivism approach. In the 2013 curriculum, this approach is known as the scientific approach, which is an implementation of constructivism learning theory. The principles of constructivism include: (1) the students build the knowledge by themselves, (2) the knowledge cannot be transferred from teacher to student, (3) students actively construct continuously, so that there is always a change in scientific concepts, and (4) teachers simply help to provide facilities and situations so that the construction process runs smoothly. With the existence of basic mathematics learning with a constructivism approach, students are expected to be able to understand the material well and be able to improve their mathematical abilities [4].

The role of the teachers in improving the quality of education becomes more significant when they could carry out meaningful learning. Meaningful learning becomes a demand along with the development of the paradigm from behaviourism to constructivism. Furthermore, explained that teachers' role changes from "transferring knowledge in the learning process" to "giving experience, and developing students' thinking (cognition)". The constructivist model of learning contends that students have to build their understanding [5]. In such a process, understanding can never be completed. Each student must work through his understanding of skills. The general perspective of constructivism is the construction of students' knowledge which is a learning process that involves changes [6]. Since construction is a learning process, teachers have an important role to play, namely (1) to influence, or to create motivational conditions for students, (2) to take responsibility for creating problem situations, (3) to foster acquisition and retrieve prior knowledge, and (4) to make a learning process, not a learning product. The constructivism teaching method demands student-centred learning activity [7]. It has a positive effect of changing the traditional teaching mode, which is the passive acceptance, simple imparted and it contributes to give full play to the initiative in the students’ learning activities and team spirit.

Some research stated that the use of student-centered approach could improve students' thinking skills [8]. The implementation of the student-centered approach to encourage students to actively participate in the discovery of knowledge, where this study used 70 students as samples who were chosen by purposive and matching sampling. A total of 35 students were chosen as the treatment group and the rest as the control group. The other research conducted observation and in-depth interview with students and showed that the construction of the mathematical power of students has an understanding of students' problem-solving [9]. In this present article, we want to see the effectiveness of using bilingual textbooks with constructivism approach towards the students’ conceptual understanding and learning activities in the material of real number systems.

2. Method

2.1. Subject and steps
This research was conducted for students in the biology education department, with a sample of 30 students consisting of 4 men and 26 women. At the beginning of this study, the students were given
pre-test questions in the form of essay to measure their ability to understand the real number system. Then, a learning process using bilingual textbooks with a constructivism approach was given. After the learning process was complete, they were given a post-test with different questions, yet the tests have the same indicators as in the pre-test. Besides giving a pre-test and post-test, we also observed the students’ activities during the learning process. The activities observed were (1) expressing opinions, (2) asking questions, (3) responding to the other students’ opinions, (4) doing assignments well, and (5) encouraged to perform in the class.

2.2. Research design
This research is an experiment with one-group pretest-posttest design. The design is illustrated in Figure 1.

![Figure 1. One-group pretest-posttest research design](image)

In Figure 1, O represents the pre-test which aimed to measure the students’ ability to understand mathematical concepts. The X represents the learning process by using bilingual textbooks with a constructivism approach, while the second O represents the post-test to measure the students’ ability to understand mathematical concepts after learning by using the constructivism approach.

2.3. Research instrument and data analysis technique
The research instrument used to measure the ability of students in understanding the concepts was the ability to comprehend the concept that has some indicators, namely: restating a concept and applying the concept or algorithm in problem-solving. Furthermore, the instrument used to view student activities was the observation sheet and questionnaire. Data analysis used for students’ concept understanding ability was an N-gain calculation using the Equation (1) [10].

\[
\langle g \rangle = \frac{S_f - S_i}{S_{\text{max}} - S_i}
\]  

In Equation (1), we see that \( \langle g \rangle \) is the N-gain score, \( S_f \) is the final post-test score, \( S_i \) is the initial pre-test score, while \( S_{\text{max}} \) is the maximum score the students could achieve in the test. After calculating the N-gain score, we compared them to the criteria described in Table 1.

| N-Gain Score Criteria | Predicate |
|-----------------------|-----------|
| \( \langle g \rangle \geq 0.7 \) | High      |
| \( 0.3 < \langle g \rangle < 0.7 \) | Moderate  |
| \( \langle g \rangle \leq 0.3 \)   | Low       |

The N-gain score represents the improvement of the students’ performance between their post-test and pre-test. In Table 1, the gradation of the N-gain score varies from high which means that the subject performs very good to low which means the contrary.

Furthermore, the data analysis used for the students’ activity is illustrated in Equation (2).

\[
P = \frac{A}{n} \times 100\%
\]
Equation (2) is a simple calculation of percentage. \( P \) represents the percentage of the observed activity, \( A \) represents the number of observed activity performed during the learning process, and \( n \) represents the total number of the students joined the learning. The indicators of the assigned activities achievement in this study were 70\% of students who had done positive activities. If the students’ activity had reached 70\%, then the activity was said to be good, but if the student’s activity was less than 70\%, then the activity was still said to be deficient.

3. Result and Discussion
The following is the results from the achievement of students' conceptual understanding analysis using N-gain score as presented in Table 2.

Table 2. The percentage of the number of students’ having conceptual understanding ability based on the N-gain criteria

| Predicate   | Percentage |
|-------------|------------|
| High        | 47         |
| Moderate    | 23         |
| Low         | 30         |

Based on Table 2 the achievement of students' conceptual understanding ability in the high criteria is 47\%, moderate 23\% and low 30\%. This result shows that bilingual textbooks with a constructivism approach contribute to high-ability students, but the percentage of achievement of low-ability students is also almost offset. Most of students’ misinterpretation to the questions made in English. A study which examined 22 elementary students in working on the assignments given in English resulted that 68\% of students experienced errors in interpreting/reading the questions presented [11]. Students' weaknesses in understanding English-language problems can be assisted by learning models using the constructivism approach so that the percentage of students who are in the high criteria is still much better than students with moderate and low criteria. This is in line with a research which stated that the learning evaluation module developed using constructivism theory showed students' development in understanding the concept of learning evaluation material that can be seen in students' ability in developing assessment materials, questions and rubrics about both essay and objective problems and get experience in testing instruments developed by students [12]. It is also in line with the results of a study which stated that the learning tools developed by following the CIRC type cooperative model with this constructivism approach could improve students’ mathematical connection ability so that the learning achievement of students improve [13].

Moreover, the results of students’ activity observation are presented in Table 3.

Table 3. Results of activity observation

| Indikator                                               | Percentage |
|--------------------------------------------------------|------------|
| Expressing opinions                                    | 20         |
| Asking questions                                       | 23         |
| Responding to other student's opinions                 | 30         |
| Doing assignments well                                 | 100        |
| Encouraged to perform in front of the classroom        | 13         |
In Table 3, almost all of the student activities were in the low criteria because they were still confused in understanding the problem in bilingual textbooks so that time was wasted and students were embarrassed to ask. Some other studies also reported that students have difficulty in understanding the problems presented in English [11, 14, 15]. We suspected that this factor was the main factor besides the low ability of students in understanding the concept of the real number system. Then the results of the activity questionnaire can be seen in Table 4.

| Student Activity Indicator                                      | Average |
|-----------------------------------------------------------------|---------|
| Pay attention to the explanation of the lecturer                | 3.48    |
| Understand the problem given by the lecturer                    | 2.58    |
| Actively ask questions and answer questions                     | 3.19    |
| Working together in groups                                      | 3.25    |
| Ability to express opinions                                     | 2.94    |
| Providing opinion opportunities to friends in groups            | 3.33    |
| Present the results of group work                               | 3.32    |
| Overall average                                                 | 3.16    |

Based on the results of the student activity questionnaire in Table 4, it can be seen from the average for the whole indicator is 3.16. Indicators of activities that have the highest average are indicators that pay attention to lecturers' explanations with an average of 3.48. While the lowest average is an indicator of understanding the problem given by the lecturer with an average of 2.58. It can be concluded from the results of processing the observation sheet, and student questionnaire states that the main factor besides the low ability of students in understanding the concept of the real number system.

4. Conclusion
The achievement of students' ability to understand concepts in high criteria is more than students who are in moderate and low criteria. Furthermore, student activities on almost all indicators are at a low percentage. So it can be concluded that the using of bilingual basic mathematics textbooks has been effective on conceptual understanding and less effective in activities in the basic mathematics learning for college students of biology education programs of STKIP PGRI Sumatera Barat.

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