

The Use of Mathematical Module Based on Constructivism Approach as Media to Implant the Concept of Algebra Operation

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ABSTRACT

Mathematical learning to implant the concept of algebra operation using constructivism approach is very important. Students should be actively involved in the process of building their understanding, so meaningful learning experiences can be to gained. This research was an experimental research involving 91 students of grade 8. This research applied constructivism-based mathematics module used by the students during studying the concept of algebra operation. The result showed that the use of constructivism based mathematics module was very effective in improving students' mathematical understanding on algebra operation material. This result was obtained by performing the initial test (*pre-test*) before the use of modules and final test (*post-test*) after the use of module. In addition, the result of observation conducted during the learning activities showed that in the use of modules in learning mathematics, students with high academic ability tended to be more active in the discussion process.

KEYWORDS

module, constructivism approach, algebra operation

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Introduction

The implementation result of IMSTEP-JICA activities in Indonesia shows that most teachers in Indonesia still apply conventional methods. The questions asked by the teacher to the students are still simple questions, and the textbook material used is more suitable for the middle level of the students. Therefore students who are able to pick knowledge are only those in the middle group (Sato, 2007) while students who have the ability in high and low groups receive less attention in the process of learning mathematics. The conventional method that follows the behaviorism that has been followed by educators in Indonesia should be changed to constructivism.

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Constructivism is a learning theory that describes the process of knowledge construction. Knowledge construction is an active process, not a passive one (Major *et al.* (2012). This is because a math learning which is based on constructivist theory provides the knowledge that is not only stored in the minds of students, but it should be constructed by the students through active involvement in learning process. Ann-Sofi Røj-Lindberg (2001) and Bhowmik (2014) state that active learning process requires students to actively construct their understanding of mathematical concepts while Berger (2005) and Bhowmik (2014) state that students are expected to construct a concept which will be possessed by interpreting its use in a suitable mathematical environment. This is in accordance with the principle of mathematics learning in schools in NCTM (2000: 11) that emphasizes students must learn mathematics by understanding, actively building new knowledge from experience and knowledge. The effective mathematics learning requires students' understanding from what they know and what they need to learn, and then challenge and support them to learn more.

Math learning, in order to gain a good understanding, can be added by making a connection, one with a mathematical text. Mathematical text can influence students' perceptions of what math is and whether it applies mathematically (Pepin, B. & Haggarty, L., 2005). One of the efforts in the process of learning mathematics is by using modules. Learning module is a smallest unit of teaching and learning program that is studied by the students themselves individually or taught by the students themselves (Winkel (2009: 472). This is expected to help students make the connection by connecting what is taught with knowledge and experience Formerly (Bhowmik :2014).

Algebra operation is one of the materials that must be mastered by students (Watson, 2007). Understanding algebra material is the key to success in learning the next mathematical material, including geometry and calculus (Star, et al., 2015). However, to gain a meaningful understanding for students toward algebra operations, a learning process that involves students in building the understanding is needed. This research tried to see the use of constructivism based mathematics module in mathematics learning process. With the use of constructivism based mathematics module, it is expected that students will be more active in digging information, actively discussing with fellow students or teachers.

Method

This research was an experimental research using a mathematical module based on constructivism in mathematics learning on algebra material. The study involved 91 students of Junior High School level in Metro City, Lampung, Indonesia. Data collection was done by giving pre test and post test. The improvement of student learning outcomes was calculated through the average normalized gain based on criteria according to Hake R.R. with the formula:

$$\langle g \rangle = \frac{\text{score of post test} - \text{score of pre test}}{\text{maximum score} - \text{score of pre test}}$$

Table 1. Interpretation of Gain Value

| Value (g) | Classification |
|------------------------------------|----------------|
| $\langle g \rangle \geq 0.7$ | High |
| $0.7 > \langle g \rangle \geq 0.3$ | Medium |
| $\langle g \rangle < 0.3$ | Low |

Result and Discussion

The implementation of this research involved 3 Junior High Schools in Metro City, Lampung. The level of students' understanding on the material of algebra operation after using the mathematics module based on constructivism in mathematics learning is presented in the following table:

Table 2. Level of Student Understanding Through the Use of Constructivism Based Math Module.

| State Junior High School 2 Metro | | |
|----------------------------------|--------|------------|
| Criteria | Number | Percentage |
| High | 2 | 6.25 |
| Medium | 29 | 90.6 |
| Low | 1 | 3.13 |
| State Junior High School 4 Metro | | |
| Criteria | Number | Percentage |
| High | 17 | 58.62 |
| Medium | 11 | 37.93 |
| Low | 0 | 0 |
| State Junior High School 6 Metro | | |
| Criteria | Number | Percentage |
| High | 1 | 3.23 |
| Medium | 26 | 83.9 |
| Low | 4 | 12.9 |

The result of this study indicated that the use of constructivism based mathematics module was very effective in improving students' mathematical understanding on the material of algebra operation. This result was obtained by conducting initial test (pre test) before the use of module and final test (post test) after module use. In addition, the result of observation conducted during the learning activities gave information that the use of module in learning mathematics made students with high academic ability tended to be more active in the discussion process. This situation could be utilized by teachers to help students who were less active in understanding the material. This was suitable with the foundation of constructivism theory saying that knowledge cannot be transmitted and teachers cannot only give knowledge to students. Instead, students' knowledge should be built into their own minds (Bhowmik, 2014).



Figure 1. Students' Activities in Learning Process

Mathematics learning by using constructivism based mathematics module emphasized student's activeness in building their understanding. This is in line with Mousley's (2004) opinion that mathematical understanding can be shaped by the students through the activity of connecting ideas of a concept to solve a problem. To help students understand the learning of mathematics, teachers are equipped with curriculum materials (textbooks of student and teacher editions) and they are provided with guidance (Stylianides, et al., 2007). This is in accordance with NCTM (2000) generalized mathematics learning outlines that students should learn math through understanding and actively build new understanding of previous experiences and knowledge. Based on the statement above, the students are required to be active in building their understanding.

Conclusion

The use of constructivism-based mathematics modules is very effective in helping to build students' understanding of algebra materials. The result shows an increase of students' understanding on the material of algebra operation in the medium category. Besides, the observation result during mathematics learning process by using constructivism based mathematics module on algebra material shows that students are very active in the discussion process to build their understanding while the role of teachers in the learning process is limited to the facilitator. It shows that the use of constructivism-based mathematics modules can be a means to implant and reinforce learning based on constructivism theory.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

- Ann-Sofi Røj-Lindberg. (2001). Active Learning of Mathematics. *Experiential Learning for the Third Millennium*. Vol. 2, 159-168.
- Berger, M. (2005). Vygotsky's Theory of Concept Formation and Mathematics Education. *Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education*, Vol. 2, pp. 153-160.
- Bhowmik, M. (2014). Constructivism approach in mathematics teaching and assessment of mathematical understanding. *Basic Research Journal of Education Research and Review* ISSN 2315-6872 Vol. 4(1) pp. 08-12 January 2015.
- Major, T. E., Mangope, B. (2012). The Constructivist Theory in Mathematics: The Case of Botswana Primary Schools. *International Review of Social Sciences and Humanities* Vol. 3, No. 2 (2012), pp. 139-147.
- Mousley, J. (2005). What Does Mathematics Understanding Look Like? The Annual Conference held at RMIT.
- NCTM. (2000). *Principles and Standards for School Mathematics*. United States of America: The National Council of Teachers of Mathematics, Inc.
- Pepin, B. & Haggarty, L. (2005). *Making Connections and Seeking Understanding*.
- Sato, Manabu. (2007). Tantangan yang Harus Dihadapi Guru. Dalam *Bacaan Rujukan untuk Lesson Study: Sistem (Strengthening In-service Training of Mathematics and Science Education at Junior Secondary Level)*. Dirjen PMPTK-Depdiknas dan JICA.
- Star, J. R., Caronongan, P., Foegen, A., Furgeson, J., Keating, B., Larson, M. R., Lyskawa, J., McCallum, W. G., Porath, J., & Zbiek, R. M. (2015). *Teaching strategies for improving algebra knowledge in middle and high school students* (NCEE 2014-4333). Washington, DC: National Center for Education Evaluation and Regional Assistance (NCEE), Institute of Education Sciences, U.S. Department of Education. Retrieved from the NCEE website: <http://whatworks.ed.gov>.
- Stylianides, A.J. & Stylianides, G.J. (2007). Learning Mathematics with Understanding: A Critical Consideration of the Learning Principle in the Principles and Standards for School Mathematics. *The Montana Mathematics Enthusiast*, (Online), 103-114.
- Winkel. (2009). *Psikologi Pengajaran*. Yogyakarta : Media Abadi.
- Watson, A. (2007). *Key Understandings in Mathematics Learning*. Paper 6: Algebraic reasoning. University of Oxford.