Integers Learning Module with Constructivist Approach

Stevi Natalia[1], Kerdid Simbolon[2], Ira Maya Sofiana[3]
{stevi.natalia@uki.ac.id1, kerdid.simbolon@uki.ac.id2, 1513150010@ms.uki.ac.id3}

Universitas Kristen Indonesia[123]

Abstract. The aim of this study is to find out the suitable learning of mathematics based on constructivist approach. This research was conducted because the lack of concept understanding in students and the weak culture of making findings on their own, and this problem can be found out in the basic mathematics subject that is integer. So this research begins by designing a type of module that can help students to build integer concepts on their own. This research was conducted using research and development methods. Respondents of this study are 7th grade junior high school students, at this level they are already have the ability to perform arithmetic operations on integers, but without understanding the subject. The result of this study obtained by seeing the comparison of learning effectiveness test through the post-test and pretest scores, in addition, by looking at the student assessment questionnaire. The results show the comparison of the posttest and pretest is 66,86>43,43 with 83,15% positive respond from the students. It can be concluded that the learning module is effectively used to support the learning process on the integer subject for 7th grade junior high school students.

Keywords: Constructivist; Integer; Research and Development

1 Introduction

Learning mathematics is a learning which was frequently considered hard by students in Indonesia. The low-level achievement of the learning mathematics can be observed from the test results that have been done. International-scaled tests in which this experimental work based are Programmed for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS). Further, let see diagram results of PISA 2012 that compares the achievement of students in mathematics and in reading[1] .

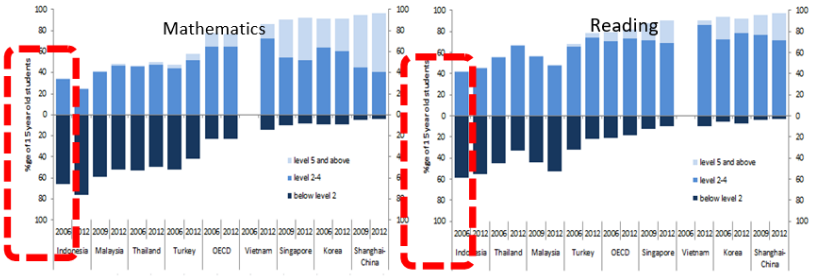

Fig 1. PISA 2012 Results and the comparison between mathematics and reading competencies.

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It appears that in figure 1 the result of learning mathematics within students in Indonesia is in a low value. It is even lower than the reading ability. This is an apprehensive achievement, so it needs further studies of learning mathematics that is able to increase students' capacity to think. In addition, the scores in 2000-2015 are also apprehensive as it seems at the figure below.

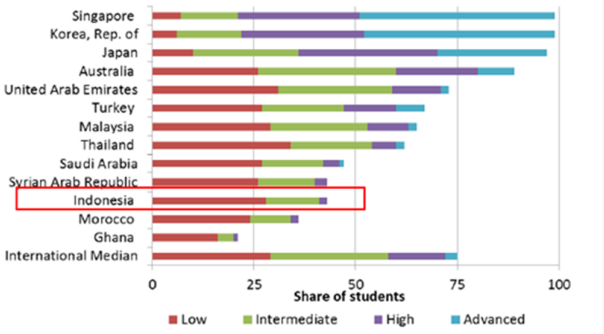


Fig 2. Mathematics Result on TIMSS 2011

Based on figure 2 more than ¾ students are at the low level in mathematics and none are at the advanced level. Andreas Shleicher, OECD Director of Education and Skills said that it is time for Indonesia to ensure the quality of teaching and learning on an article that was published in official site of the Ministry of Education and Culture in Indonesia (Kemendikbud) when released the response of PISA 2018 results. [2]

The best quality of learning mathematics is learning that can take students to have the high-level thinking. In taxonomic Bloom, the level of thinking consisted of six levels starting from C1 Remember, C2 Understand, C3 Apply, C4 Analyze, C5 Evaluate, and C6 Create. These are what were expected to be reached by students in the process of learning. Yet the fact is below the expectation, learning in class often only reached up to level C3 Apply, therefore the students do not have the opportunity to develop their mindset maximally. Not only that, this teaching tradition that only up to level C3-Apply has become a tradition thorough teachers, so it is difficult to change it.

One of the solutions of this problem is using constructivist approach. Constructivist was introduced by many figures, some of them are Vygotsky (1962) and Piaget (1980). On constructivist approach, learning mathematics become learning that get students to develop their mindset to reach level of thinking up to C6 Create. Constructivist approach is an approach that emphasize on the establishment of students' knowledge. Constructivism is an approach to teaching and learning ist based on the premise that cognition (learning) is the result of mental construction [3]. Communication, negotiation, cooperation, reflection, discussion and reciprocity are qualities of constructivist approach. [4].

The principles on constructivist approach include (1) knowledge is built by students themselves, whether individually or socially; knowledge cannot be transferred from teachers to students, but only by students' own activeness to reason; (3) students is constructing actively and continuously, so that there is always change in concept towards a more detailed concept; (4) teachers only help providing facilities and situations for the construct process of students run smoothly [5]. So there are differences between traditional classroom and constructivist classroom, there are lists the comparisons the traditional classroom to the constructivist one. [6]

Table 1. Difference between traditional classroom and constructivist classroom

Traditional Classroom	Constructivist Classroom
Curriculum begins with the parts of the whole. Emphasizes basic skills.	Curriculum emphasize big concepts, beginning with the whole and expanding to include the parts
Strict adherence fixed curriculum is highly valued	Pursuit of student question and interest is valued
Materials are primarily text books and work books	Materials include primary source of material and manipulative materials
Learning is based on repetition	Learning is interactive, building on what the student already knows
Teachers disseminate information to students: students are recipients of knowledge	Teacher have a dialogue with student, helping students construct their own knowledge
Teacher's role is directive, rooted in authority	Teacher's role is interactive, rooted in negotiation
Assessment is through testing, correct answer.	Assessment includes student works, observation and point of view, as well as tests. Process is as important as product.
Knowledge is seen as inert	Knowledge is seen as dynamic, ever changing with our experiences
Students work primarily alone	Students work primarily groups

Based on table 1 were analyzed a learning mathematics for integers subject based on constructivist approach. Integer's subject was chosen because it is a basic subject needed by students to develop understanding on more advanced mathematics subjects. [7]. The difficulties experienced by 7th grade junior high school students who were respondents in this study. They can do the operation on integers but have difficulty understanding the concept of the subject. A module of mathematical learning of integers subject based on constructivist approach is developed to help students understanding the concept of the integers and its operations.

Based on the discussion above, this research seeks to complete 2 research questions as follows:

a. Is the integers subject module with constructivist approach feasible and valid for use in 7th grade students of State Junior High-school 117 Jakarta?
b. Is the integer module using the constructivist effective for use in 7th students of State Junior High-school 117 Jakarta?

2 Materials and Methods

The research method of this research is using research and development (R&D) method. Research and development (R&D) method is a method that produces product and tests the effectiveness of the product so that it could be used for wide community. This research has stages, the stage which this research used is research stage level 4, with details of the stages as shown below.

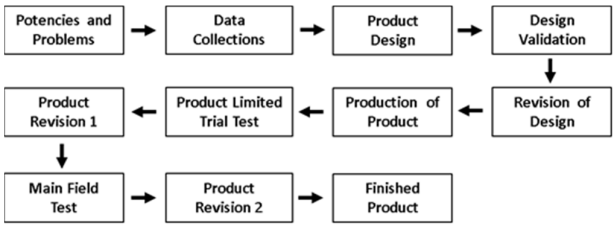


Fig 3. The stages of research and development method

The research stage level 4 is chosen because there is necessity of a new product to help students understanding mathematics learning in the form of learning module. This research will be limited to the stage of product revision 2 so as to produce the final product. So it does not reach the stage of product implementation.

The followings are the stages of the research process being carried out: finding potentials and problems by interviewing teachers in State Junior High-school 117 Jakarta; collection of data in the form of curriculum analysis, namely curriculum 2013 revised 2016 edition; product design is done using Microsoft Word for the book content and Adobe Photoshop for the book cover; design validation is carried out by the experts. The instrument that will be used to validate is a questionnaire which conducted by the supervisor.

The results of the questionnaires validation will be analyzed quantitatively. According to Syarifudin to change the rough data obtained from the score criteria into values is adjusted to the categories as follows [8].

Table 2. Criteria scores become values with normal distribution theory

Score Interval	Category
$x \geq M + 1.5SD$	Very Valid
$M \leq x < M + 1.5SD$	Valid
$M - 1.5SD \leq x < M$	Less valid
$M - 1.5SD \geq x$	Very Invalid

Annotations:

M : ideal average

$M = \frac{1}{2}$ (maximal ideal score + minimal ideal score)

SD : ideal standard deviation

$SD : \frac{1}{6}$ (maximal ideal score - minimal ideal score)

x : trials results score

Thus obtained:

$$M = \frac{1}{2}(4 + 1)$$
$$M = 2{,}5$$
$$SD = \frac{1}{6}(4 - 3)$$
$$SD = 0{,}5 \quad (1)$$

Furthermore, the results of the acquisition are substituted in the table as follows:

Table 3. Results obtained of criteria scores

Score Interval	Category
$x \geq 3{,}25$	Very Valid
$2{,}5 \leq x < 3{,}25$	Valid
$1{,}75 \leq x < 2{,}5$	Less valid
$0{,}5 \geq x$	Very Invalid

Design improvements carried out in accordance with the advice of the validator in order to obtain the best product before being tested, product trials conducted on limited trials and on the main field. The analysis was performed using SPSS and manual methods to find statistics (mean, mode, median) and data distribution calculations (standard error of mean, standard deviation, variance). Then the normality test is done using the Shapiro Wilk test in a limited trial. At this stage a pretest is conducted to see the students' abilities before using the module and then given a posttest after the module has been taught.

Product revision 1 is carried out if there are obstacles from students in using the module then a trial run is used on the main field, further tests will be done if there are still obstacles that make the product ineffective. The final product is an integers subject module based on the constructivist approach for 7th grade students which has gone through the process of expert validation and effectiveness tests. this research was conducted within 4 months, that is from March till June 2019 at State Junior High-school 117 Jakarta.

3 Result

Learning module was made in Indonesian language and in accordance with the achievement of curriculum material in Indonesia that was Curriculum 2013 Revised 2016 Edition. The results and analysis of this research will explain the answer of the research questions asked at the introduction. So that this part there were two sub-topics to be analyzed, as follows:

3.1 Product Feasibility Test

Product feasibility analysis is obtained from validation results of experts to the integers subject module based on constructivist approach for 7th grade, with assessment results detail of each aspect as follows:

Score of Material Aspect Assessment

Table 4. Score of Material Aspect Assessment

No	Validator	Aspect Average Score	Category
1	Validator 1	3,54	Very Valid
2	Validator 2	3,47	Very Valid

Total Average	3,51	Very Valid

Score of Presentation Aspect Assessment

Table 5. Score of Presentation Aspect Assessment

No	Validator	Aspect Average Score	Category
1	Validator 1	3,7	Very Valid
2	Validator 2	3,7	Very Valid
	Total Average	3,7	Very Valid

Score of Language Aspect Assessment

Table 6. Score of Language Aspect Assessment

No	Validator	Aspect Average Score	Category
1	Validator 1	3,5	Very Valid
2	Validator 2	3,5	Very Valid
	Total Average	3,5	Very Valid

Score of Graphical Aspect Assessment

Table 7. Score of Graphical Aspect Assessment

No	Validator	Aspect Average Score	Category
1	Validator 1	4	Very Valid
2	Validator 2	3,4	Very Valid
	Total Average	3,7	Very Valid

Score of Constructivist Approach Aspect Assessment

Table 8. Score of Constructivist Approach Aspect Assessment

No	Validator	Aspect Average Score	Category
1	Validator 1	3,57	Very Valid
2	Validator 2	3,43	Very Valid
	Total Average	3,5	Very Valid

3.2 Results Analysis of Product Feasibility.

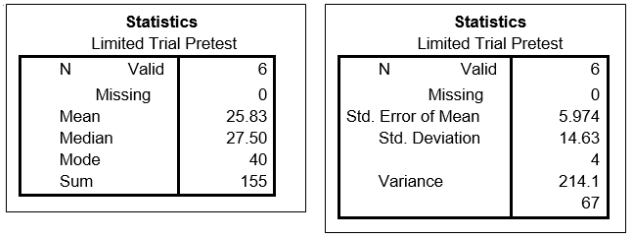
The results of data analysis obtained from the experts' validation questionnaires regarding the development of integers module based on the constructivist approach for 7th grade found that the module received a very valid category in the material aspect getting an average of 3.58. The module presentation aspect is categorized as very valid getting an average of 3.7. The linguistic aspect is categorized as very valid, which is getting an average of 3.46. The graphical aspect is categorized as very valid, which is getting an average of 3.4. The constructivism approach aspect is categorized as very valid, which is getting an average of 3.52.

Based on the expert validation data above, the conclusion is that the Making of Mathematical Module Development Products based on the Constructivism Approach for 7th grade is declared valid and feasible to be submitted to field trials to check product effectiveness.

3.3 Product Effectiveness Tests

The effectiveness of the product is tested trough limited trial test and main field test with analysis as follows:

a. Limited Trials Test: Limited trials is conducted to 6 students with the pretest statistics is as follows.



Statistics
Limited Trial Pretest

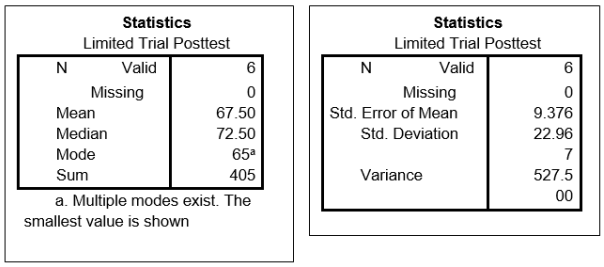
N	Valid	6
	Missing	0
Mean		25.83
Median		27.50
Mode		40
Sum		155

Statistics
Limited Trial Pretest

N	Valid	6
	Missing	0
Std. Error of Mean		5.974
Std. Deviation		14.63
		4
Variance		214.1
		67

Fig 4. Limited Trial Pretest Statistics

According to the Fig. 4 it is seen that the mean of students' score is so low, means that students truly have troubles in understanding the subject, and then product trials is conducted and the results obtained are as follows.



Statistics
Limited Trial Posttest

N	Valid	6
	Missing	0
Mean		67.50
Median		72.50
Mode		65[a]
Sum		405

a. Multiple modes exist. The smallest value is shown

Statistics
Limited Trial Posttest

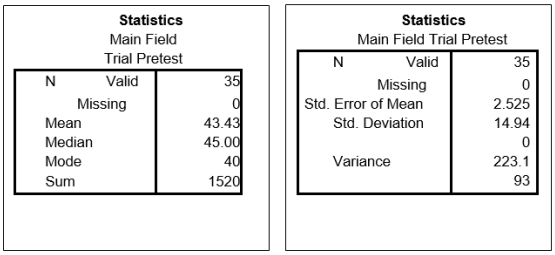
N	Valid	6
	Missing	0
Std. Error of Mean		9.376
Std. Deviation		22.96
		7
Variance		527.5
		00

Fig 5. Limited Trial Posttest Statistics

According to the Fig. 5. it is seen that the mean students' score is increased, so that posttest average is greater than the pretest average which is 67,50>25.83. Based on this data the module has been showing effectiveness that it is feasible to continue on the main field tests.

b. Main Field Tests

The tests are conducted in the main field to 35 students of State Junior High-school 117 Jakarta. As well as limited test trials, the main field tests are also conducted by comparing the results of students' pretest and posttest. According to test results of the pretest obtained is as follows.



Statistics
Main Field
Trial Pretest

N	Valid	35
	Missing	0
Mean		43.43
Median		45.00
Mode		40
Sum		1520

Statistics
Main Field Trial Pretest

N	Valid	35
	Missing	0
Std. Error of Mean		2.525
Std. Deviation		14.94
		0
Variance		223.1
		93

Fig 6. Main Field Trial Pretest Statistics

The results on the Fig. 6. shows that the students' average score prior to using the module is 43,43, the product trial is conducted and the following results are obtained.

Statistics
Main Field Trial Posttest

N	Valid	35
	Missing	0
Mean		66.86
Median		65.00
Mode		65
Sum		2340

Statistics
Main Field Trial Postest

N	Valid	35
	Missing	0
Std. Error of Mean		1.880
Std. Deviation		11.12
		0
Variance		123.6
		55

Fig 7. Main Field Trial Post Test Statistics

Based on the Fig. 7. is seen that average score of the students is increased with the post test score is greater than the pretest score which is 66,86>43.43 so that based on the data it could be concluded that the module is proven effective in increasing students' score.

3.4 Analyze the module

Analysis of the module according to the implication theory in constructivist learning approach, the eighth implication analyzed to be loaded in the module that validated by the experts.

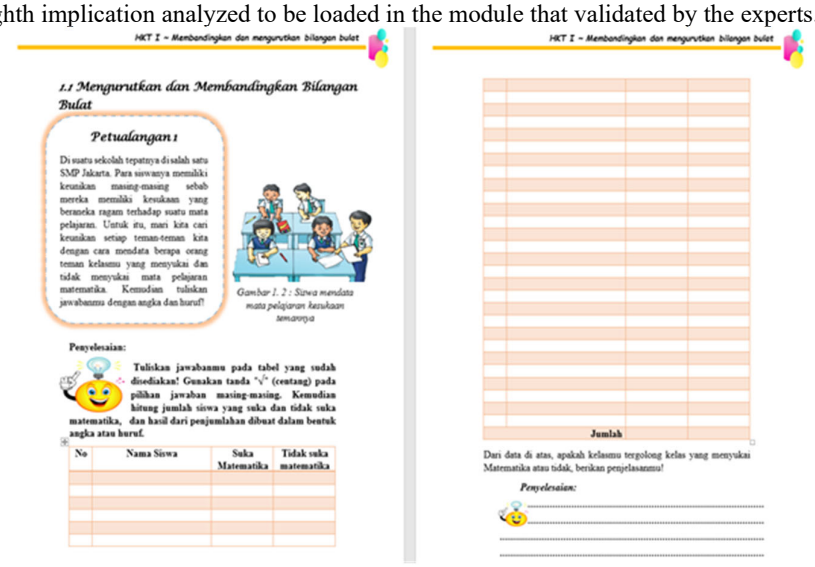


Fig 8. Example of the Implication of Constructivist Approach

In figure 4 module is arranged using a wide variety of materials, including raw data, primary sources, and interactive materials and encourage students to use them. In additions students are also asked to draw conclusions of the activity. Module analysis is carried out by the eighth implications which are found on the theory of Brooks and Brooks [9]. In one example of activity on the module, students were asked to record the fondness of their classmates toward mathematics. The survey then expressed in integers.

Furthermore, the students were asked to measure the length of objects around them using a ruler and the results are expressed in integers and fractions. After classifying the numbers with their teacher students were asked to write down the definition of integer according to their own thinking. Those activities help students to achieve the level of thinking C4 Analyze up to level C6 Create putting elements together to form a coherent or functional whole [10].

Finding the Results

In addition to making analysis process of module, was also carried comparison tests before and after the use of the module. There are different results. The analysis results are showing the comparison of the pretest and posttest that is 43,43<66,86. There has been increasing of 23.43 that is 53.95 % of the student learning test results.

4 Discussions

Constructivist approach in learning can be applied through various forms, Constructivist approach on mathematics learning using this module has been declared feasible to use to improve student learning outcomes. In addition, students also have an increased enthusiasm for learning seen from their interest in learning.

The application of learning is also improving the achievement of teaching until the level of think C6 Create based on Bloom Taxonomy's, because in the teaching, students directed to analyze information and forming new combinations whole over the material that is being taught. This module properly used to familiarize students to train their capacity to think in learning or in other words make student more active both in physical motoric activity and liveliness think.

5 Conclusions

The conclusions obtained based on this study are as follows:

a. Integers subject module based on constructivist approaches for 7th grade is feasible to be used in the learning process activities carried out at State Junior High-school 117 Jakarta because the module has been declared valid by the experts when testing the validation of the product.
b. Integers subject module based on constructivist approaches for 7th grade is effective to be used in learning activities because it has been tested to find out its effectiveness which is carried out in limited trials and on main field tests. Based on the results obtained from the average marks of posttest students significantly higher when compared with the average marks of the pretest. The average marks of students at the post test and pretest in a limited trial is 67,5>27,83. As for the main field test the posttest and pretest is 66,83>43,43.

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References

[1] Purba, S.C., 2019, High Order Thinking Skill. Forum Grup Discussion at Jakarta.

[2] Kemdikbud. Tanggapi hasil PISA 2018 mendikbud: Ini Jadi Masukan Berharga. Date of access: 03/01/2019. https://www.kemdikbud.go.id/main/blog/2019/12/tanggapi-hasil-pisa-2018-mendikbud-ini-jadi-masukan-berharga.
[3] (Bada, 2015), L. S., 1962, Thought and Language, Cambridge, MA: MIT Press
[4] Hasan Karal, Tugba Bahçekapılı, Ilknur Reisoglu, 2009, Usability of Testing Apparatuses About Renewable Energy Resources in Constructivist Class Environment. Procedia Social and Behavioral Sciences, Vol. 1, pp.1264–1271.
[5] Argarini, D. F., Yazidah, N. I., & Kurniawati, A. (2019). Pengembangan Smart Book Materi Geometri untuk Siswa SMP Berbasis Konstruktivisme. Aksioma, 8(2), 344–353.
[6] Bada, S. O. (2015). Constructivism Learning Theory : A Paradigm for Teaching and Learning. IOSR Journal of Research & Method in Education, 5(6), 66–70. https://doi.org/10.9790/7388-05616670
[7] National Council of Teachers of Mathematics, 2000, Principles and Standards for School Mathematics. NCTM: Reston V.A
[8] Syarifudin, B. (2010). Panduan TA Keperawatan Dan Kebidanan Dengan SPSS. Yogyakarta: Grafindo Litera Media.
[9] Brooks. J. G. and Brooks, M. G., 1993, In Search Understanding: The Case for Constructivist Classroom Researcher. Alexandria, VA: American Society for Curriculum Development.
[10] Anderson, L. W. (Ed), Krathwohl, D. R. (Ed), Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, J., and Wittrock, M. C., 2001. A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives (Completed Edition), New York: Longman.