

Developing a Learning Module About Integers for 7th Grade Students through Writing-to-Learn

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Abstract

Previous research shows that seventh-grade students lack a sense of flexibility about numbers, lack comprehension of the effect of the operation on numbers, and lack estimation skills. On the other hand, writing to learn is one of the learning activities where the students actively write to express themselves in learning specific material/topic. This project aims to develop a learning module for students about the integers by utilizing the basic number sense framework: the six strands of number sense (Mcintosh et al., 1997) and combining it using writing to learn mathematics (Burns, 1995). The module developed using the steps proposed by Purwanto (2007) and then validated by the experts and tested to the subjects' trial. The module was then validated by three experts who are lecturers at Sampoerna University. After validation, the module was then tested on four seventh-grade students, where the data gathered by both observation and group interview. As a result, all participants agree that the learning module is easier than what they taught at school and would recommend the module to their friends.

Keywords: a learning module; number sense; integers; writing to learn.

INTRODUCTION

Numbers is one of the most significant components that appears a lot in mathematics, for it is used to represent the quantity. According to NCTM from Small (2009, p. 16), numbers can be represented in various ways to highlight the different things of the number itself. Moreover, numbers are near in our daily lives. For instance, counting the number of pens that one has, comparing the numbers of girls and boys in a classroom, or buying something using a certain amount of money. However, it should be noted that learning about numbers is not only about learning how to calculate numbers. By understanding numbers, one will be able to make sense of mathematics, such as expressing the right amount of quantity, doing measurement and comparing between two or more abstract or concrete expressions of numbers, doing operations, and using the properties of each type of numbers. The students need to comprehend the topic of numbers and operations, especially integers. Integers as the extended form of natural and whole numbers introduce negative numbers, which values below the zero, which plays essential roles in other concepts of numbers, such as fractions, exponentials, radicals. However, some research found that junior high school students in Indonesia have difficulties facing numbers and lack of number sense. Number sense does play a significant role in understanding the number and operation beyond the calculation. The characteristics of students who have good number sense by NCTM from Howden (1989, p. 6) are "Children with good number sense (1) have well understood number meanings, (2) have developed multiple relationship among numbers, (3) recognize the relative magnitudes of numbers, and (4) know the relative effect of operating on numbers." Thus, number and operations and number sense are a unity that cannot be separated from each other.

Ekawati (2013), in her study, describe the number sense profile of the 7th-grade students in Mojokerto, found that students from different level (high, middle, and low) are: Not flexible in terms of using their comprehension about integers and their relationship to solving the problem, Unaware of the number's operation and the relationship between the operation of integers and their properties, Unable to estimate a calculation using the concept of the numbers and their operation.

According to Utami (2016), the discussion of her analysis of the 7th graders' work on problems including integers, fraction, exponential and radical, and percent explained that the students lack a holistic understanding of the concept, operation, and properties of each type of numbers. In addition, the students also lack representation sense and have weaknesses in a problem-solving type of problem and reasoning type of problem, that also supported by a lack of reinforcement of the previous concept by the teachers.

One of the teaching and learning activities that can enhance students' involvement in their learning is writing. Writing can be integrated not only in the language subjects but also in other fields of study, such as sciences and social sciences. Writing, especially hand-writing, involves the students expressing their thinking, ideas, and feeling about what they learn in the classroom. Implementing writing activities in the mathematics classroom can help teachers and students create a meaningful mathematics learning and communication way.

Other researchers also suggest that writing helps students to have a better understanding of their learning process. Palmer (2018), in her research, found that writing in mathematics classrooms can benefit both students and teachers. Students can learn how and why mathematics and teachers can evaluate the students' process of thinking. She suggests it for the teachers to provide a communication-rich classroom environment, provide scaffolding and explicit mathematics writing instruction, and give their students opportunities to practice. Therefore, applying writing in learning numbers can also benefit students in learning numbers, specifically integers.

To solve the issues in the previous research above, learning media is needed to help the students learning in numbers, specifically increasing the number sense. The module is one of the learning media that teachers and students in the classroom can use. Thus, the developer would like to develop a learning module that utilizes the writing-to-learn concept to support students' numbers and operations. This module has a novelty feature; it is not only merely contains about fraction concept, but it also supports reading and writing or, in other words, literacy of mathematics. Even though writing may be perceived as traditional, the writing activity requires students to be creative and trigger their thinking. Students will also learn how to interpret and express numbers in a different type of representation and describe their learning process in their own words. It is expected that this module will help students, teachers, and schools to pay more attention to the students' fundamental skills in numbers and literacy of mathematics..

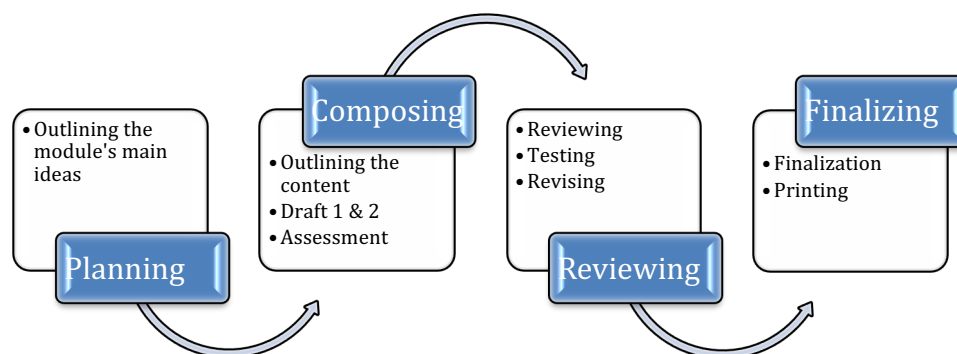
METHOD

The main source of the content will be the integer material from the seventh-grade mathematics textbook that is issued by the Kementerian Pendidikan dan Kebudayaan (Matematika Kelas VII Semester 1 by Abdur Rahman As'ari, Mohammad Tohir, Erik Valentino, Zainul Imron, dan Ibnu Taufiq). Then, the concept of integers will be combined and delivered with the elements of six strands of number sense from McIntosh et al. (1997) and writing prompts in the activity inspired by Burns (1995).

Steps in Developing the Learning Module

In developing the learning module, the steps of module development from Purwanto (2007) include four steps: planning, composing, reviewing, and finalizing, as shown below. In addition, his book provides clear and detailed instructions about how to develop, specifically, the module with examples and exercises to help the readers practice themselves.

Figure 1. Steps of Module Development (Purwanto, 2007)



Planning: the module development usually involves some experts such as material experts who are knowledgeable in a field or subject material, curriculum and pedagogical experts who are knowledgeable in pedagogy and curriculum, and media experts who are knowledgeable in media characteristics, strengths, and weaknesses of the media (especially printed media) and writing experts which is the writers. Several guide questions are used as part of the learning module's planning process and then consult to the advisor after determining the topics and /or activities and the learning objectives, and the rough draft about the coverage of each activity.

Composing: After creating the main ideas of the module in the planning step, composing the module was divided into two processes, outline preparation, and module composition. Next, the last important step in composing the module is designing the assessment to measure the students' achievement. In general, each activity is divided into three parts: material explanation, exercise, and reflection. Material explanation consisted of reviewing the previous topic they have learned in the previous class and connecting with the current material. There are examples with figures/illustrations and some tasks for the students. After that, the students are required to do the exercise. All the activities except for Activity 1 have the exercise divided into several parts. Lastly, the reflection asks the students to go back to what they have done in the exercise and write down their thinking and how they do it. To make the reflection better, the developer gives the students more space to explain their reflection better using words, numbers, and figures.

Reviewing, testing, and revising: The finished module will be reviewed by the experts, mathematics education lecturers who are knowledgeable in both content and pedagogy. Two questionnaires are provided, complete with this project title, standard competencies, basic competencies, project summary, validating instructions, questions with the checklist, and comment box for written feedback. The revision will be based on the feedback from the questionnaire.

Finalizing and printing: In the finalization and printing, paying attention to the completeness of the text, typography, heading illustration, layout, colors, footnotes, and bibliography, and the right order of the page numbers is essential.

Testing and Validating Media

The validation process of the module will be carried out by using validation instruments developed by the developer and validated by the experts. Two questionnaires were developed as the validation instruments using the interval scales, or more specifically, the Likert charts as the responses. According to Creswell (2012), interval scales have more than two "continuous" response options with equal distances/intervals between the options. The Likert charts were then divided into 1-4 scores that indicate the quality of each aspect from very bad, bad, good, and very good, respectively, to help the experts assess the learning module better and avoid the neutral answers. Moreover, the validation

criteria from the total score are categorized into four categories based on the developer's advisor, as shown in Table 1.

Table 1. Validation Score Criteria

100%	The module can be used without any revision.
80%-99%	The module can be used with minor revisions.
60%-79%	The module can be used with major revisions.
< 60%	The module cannot be used.

In developing the validation instruments to assess the module, the guide questions for module review by experts provided by Purwanto (2007) are being used. There are two questionnaires for the validation: content validation questionnaire and media and language validation questionnaire. Content validation consisted of three aspects of validation: a). Content accuracy and alignment with standard competence content accuracy, including the validity of concept/theory/definition being used, the alignment of the content to the existing standard competencies and/or learning objectives, the order and interconnection between the contents, and the existence of examples, analogies, and illustration, b) Number sense aspects: the six strands of the number sense framework from McIntosh et al. (1997) and the definition of each strand, c) Writing aspects based on the core of writing to learn mathematics from Burns (1995) to assess whether the activities and problems encourage students to express their thinking into words, numbers, and figures/representation.

As for media and language validation, the questions assess whether the module contains clear instruction and suitable for the students' condition. It also assesses whether the language is already communicative and can be understood easily by the students.

After the data gathered from the validators, the module will then be revised based on the feedback given by the assessors. They are mathematics education lecturers at Sampoerna University. They suggested that the module content includes more room for writing activity and exploration, and decreasing the number of regular exercises limits the chance for students to write more. Once the revision was done, the developer requested approval from the advisor so that the module can be tested for the subject trial.

The module subject trial involved four seventh-grade students who live in South Tangerang City. Three of the participants are boy students, and another one is a girl. They attended a different kind of schools: student A comes from a private junior high school near Tangerang City (near Student D's), student B comes from a Catholic junior high school in Karang Tengah, student C comes from a Catholic junior high school in Serpong, and student D comes from an Islamic junior high school in Tangerang city. The participants agree to consent to the developer to collect their responses and record data collection documentation.

The module subject trial takes place in the developer's house on Friday, April 23th 2021. The developer gives instructions to the participants to read all of the pages in the module and they also allowed to fill the module, although not compulsory. Then, they began to experience the content of the module and finish around 70 minutes. While they were trying the module, the developer observes and takes note of their behavior. Creswell (2012) suggested that observation is suitable to collect information occurring where it takes place and the participants' actual behavior, which corresponds with the developer's needs. After observation, the next activity is the group interview, where the developer asks the participants using prepared questions regarding the experience and impressions of the module they just read.

RESULT AND DISCUSSION

Content Validation Result

All of the validators have reviewed the module's content and assess it together with the feedback using the rubric provided by the developer. The first validator suggested adding activities that encourage problem-posing skills for students. Moreover, at the final part of each activity, she suggested adding word problems to encourage students to conclude their findings. The second validator suggested the module refer to the newest curriculum available. Then, for the operation of properties is better to make into a discovery activity. She also commented to include more open-ended activities to encourage students in writing their thinking. Lastly, the third validator suggested that the module activity should give more instructions or activities that promote the scaffolding process. Another highlight is the multiple representations, for there is too little room for students to explore more how the integers can be represented in more than one way.

Media and Language Validation Result

First Validator scored 40 for the module media and language aspect; thus, the module can be used without revision. There are several feedbacks given, such as adding a box for reflection for students to answer, adding questions that require the students to pose problems, creating their problem, and adding part where students can give their example. The reflection is also better arranged with space so that they are not confused about to answer. The second validator scored 34 so that the module can be used with minor revision. She suggested using more imagination and changing the wording of the reflection for 7th-grade students' skills in writing are pretty much alike with elementary students, and asking why and asking the students to tell using writing can help. She suggested for some tables to be given more explicit instruction as well as an example. Another highlight is changing the wording about division with zero, which seems to be misworded in the module. Last, from the third validator, scored 32, or in other words, the module can be used with minor revision. The feedback given is that the module is lacking references related to integers. The writing activity also needed to be stressed over the calculation aspects and emphasize integers' essential ideas. She also suggested using graphic organizers as part of the module to organize and connect integers.

Subject Trial Interview Result

When asked about mathematics, Student A stated that mathematics is confusing because of the calculating, while Student B said he liked it. Further, Student B also said that mathematics is only tricky when he just learned it and exercises while still does not understand the material. On the other hand, Student D seems to have difficulty with division, although she does not have multiplication problems. All of the participants have no experience with writing for themselves aside from the school assignments. When asked about the most interesting part of the module, Student B chose regular multiplication and division because it was easy and unable to specify other reasons other than easy when asked further, and he felt that the most interesting one is the easiest one. Student C chose the targeted number calculation because it is more challenging as it has specific number targets instead of the regular calculations. Student A chose the true false option exercise of subtraction and addition as he felt that choosing between the two options is interesting because he can guess the right answer between them, and Student D chose the table about addition and subtraction of both positive and negative numbers and decided whether its values increase or decrease, and the students have to provide an example of reasoning.

All of the participants agreed that the least interesting part of the module is the Diary Matematika. Their reasons are pretty similar to each other too. Student B said that he was lazy to tell a story/narrate. Student C said that he was lazy to tell a story and prefer to do calculations or exercise. "I don't have topic to tell," Student A stated. When the developer asked back that the Diary Matematika already has its questions, he then answered, "Yes, but still (I am) confused about what to tell." Student D, not different from the boys, said that "(even though) I write, I don't know what to write." Moreover, Student B claimed that "maybe, it is just us who doesn't like it (Diary Matematika), because in my

school they ever ask (the students) to make diary and the other seem to like it while there are some who don't."

By the end of the study, the learning module is developed based on writing to learn and number sense to present the integers topic for 7th-grade students. The data gathered from this study, such as from the expert validation of the content and media and language of the learning module and the data from subject trial participants, is the group interview. The validation results implied that the module could be used with some area of improvement, which includes the scaffolding, writing activity, and number sense. Guidance from teachers is needed to support students in using the module independently, especially when students are not familiar with writing activities. The ideas to help the students become comfortable with writing in mathematics class, Burns (1995) gives the writing prompts and shows constant emphasis and reinforcement to her students to use any words or drawings that express their thinking to solve the problem or answer the prompts. She also suggests that letting the students know why they have to write in the mathematics classroom is also essential as it allows her to talk about her value and do reinforcement to help them understand and encourage them. Regarding number developing the students' number sense, REYS (1994) suggested that teachers can do several things to promote number sense in the classroom: use process questions, use writing assignments, encourage invented methods, use appropriate calculation tools, help students establish benchmarks. Giving freedom to use understandable strategies by the students helps them become comfortable with the problem-solving process and internalize the mathematics in a makes sense way (p.117).

By implementing the module in the classroom, the teacher's role is one of the significant factors in the students' learning. Teachers should give the students' opportunity as widely as possible to learn their learning packages. The role of the teacher as the facilitator and organizer of the learning process includes: preparing and planning for the learning environment based on what activity the students will do, supervising students on their activity, explaining and helping the students who are in need, explaining the planned learning process characteristics in the learning packages before they begin to learn, evaluating the finished activity, and guiding the students in studying the learning packages (Mularsih, 2007).

In the online classroom, the module can be utilized as a learning material and assessment for the students. Teachers can assign the activity in the module outside of the online meeting and provide constant reminders and assessments to make sure the students make progress in the module. The online meeting will only be carried on for discussion regarding the activity they had done by themselves to share what they did and what part they still have difficulty. The teacher can also give additional activity/questions in the online meeting to support the module usage. Similar to the conventional classroom, there will also be an evaluation process at the end of the module. In other words, the module in the online learning setting can be implemented for asynchronous activity.

The result of the subject trial cannot be generalized as the data collected on a small number of subject trials and can be depending on the students' preferences. During the data collection, there were also unavoidable distraction that also may affect the students' responses and behavior. The module also has not been reviewed by the related expert currently teaching the target level of students. Further research is needed to explore the module quality for classroom setting implementation.

CONCLUSIONS AND SUGGESTIONS

The experts' feedback suggested that the module can be made better by giving more space for students to write and explore more. By adding open-ended questions, problem-posing prompts, exploration and multiple representation activity, the students who use the module are able to enhance their number sense about integers independently. In addition, the participants who had trial experience on the module agreed that the difficulty level of this module is much easier than what they experience at school. From the interview, they positively response that the module can be used on their own or with their friends and they would recommend this module for their friends or juniors. As for their dislike of Diary Matematika, it can be compensated by using prompts in a frequent amount within the module. The Diary Matematika's position can also be shifted so that the first thing the students see is not it for

it doesn't decrease students' enthusiasm.

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