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Developing Critical Thinking of Students with Hearing Impairment for Computational Thinking in Mathematics with E-Module Design

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ABSTRACT

The purpose of this research is to analyse and design computational thinking-based e-module learning to increase critical thinking skill of students with hearing impairment. This qualitative descriptive research involved VII grade students from Special Junior High School of Djojonegoro Temanggung as the subject of research, while the data collection instruments were guidelines to validate the e-module design, guidelines to observe class learning implementation, and interview guidelines for teacher. Furthermore, the Data was analyzed with reducing, serving, and concluding techniques. The findings are the necessity analysis of the e-module and designing it based on analysis needs, in which the e-module was designed based on computational thinking in order for the students with hearing impairment to increase their critical thinking skill based by their character, curriculum, and student's tasks. This study offers its findings as a guide for mathematics teachers to develop e-module to simultaneously help students understand mathematics and have critical thinking skills. The research advantage is the integration of critical thinking skills into e-module.

Keywords

Computational Thinking; Critical Thinking; Students with hearing impairment; E-Module.

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Introduction

Education is an important thing for the young generation to get both science and skill. Both skill and knowledge are imparted to the students inside the class with teachers' fascinating and affective model of learning (Yuanita et al., 2018). Critical thinking skills are one of the most important to be developed (Han & Appelbaum, 2018). These skills could be developed by creating a method where the students not only received the concept but also be active participants (Rasiman, 2015; Kusaeri & Aditomo, 2019). Critical thinking is the ability to think logically and systematically in valuing, solving problems, and researching (Runisah et al., 2017).

Critical thinking is the ability to solve problems (Rasiman, 2015). This skill is important in mathematics for it could be developed the quality of mathematics to be better and meaningful learning (Firdaus et al., 2015; Cahyani & Putri, 2019). Mathematics is an important ability that should be had by the students (Arnidha & Hidayatulloh, 2019). It is a universal science-based on the development of modern technology. In mathematics, the students should be given realistic skills, analytical, critical, and creative thinking (Wahyudi, 2016; Anwar, 2018). With the development of science and technology, the innovation in the pedagogy in basic, media, and technology.

tertiary and the children with special needs also should be developed (Arnidha & Hidayatulloh, 2019).

According to Keilin (Arnidha & Hidayatulloh, 2019), special education aims to focus on creating the standard curriculum for children with special needs. The deaf children are they who had a deficiency in their hearing sensory caused by missed of some or all of the instruments of hearing sensory. They were difficult to understand language or communication. In learning, students with hearing impairment hard to develop themselves which affected their ability to receive when the teacher delivered the lesson.

Students with hearing impairment have the intelligence that are potentially as good as ordinary students, but with development affected functionally by their language ability or communication, the limitation in information, and the language abstraction.

The upgrading of achievement the students with limited hearing sensory relates to the approach of the lesson in challenging problems of mathematics. The lesson focuses on the skill to think advanced and problem solving (Shelton & Parlin, 2016). In (Sondakh, 2018), Polyawrites about the methods of solving the mathematics problem. This approach is called computational thinking (Sondakh, 2018). Computational Thinking (CT) is the process of thinking involved in problem formulation and problem solving (Khasyyatillah & Osman, 2019). CT changes the problem to be the computational solution, it is an algorithm which avowed as the critical skills, especially for middle school (Sondakh, 2018).

Lesson material is one of many ways to develop the skill of the students. It is part of many sources in the learning activity. It contains the information both of printing or electronic that is used by the students for learning (Cahyadi, 2019). In addition, learning by using modules helps students in identifying and interpreting the information. In the module, the mathematics content not only explains

the steps or using formulation in solving

the problem but also to giving an understanding of the concept of integration and critical thinking skill (Firdaus et al., 2015).

From the interview and the observation, the researchers get the data about the mathematics lesson in Special Junior High School of Djojonegoro Temanggung. Generally, the teachers had been used instruments of learning, they are books and student's tasks but have not developed the critical thinking skill of the students yet. According to Kluwin dan Moores (Govindan & Ramaa, 2014), difficulties in mathematics are due to the lack of emphasis on mathematics education for students with hearing impairment and reduced opportunities for incidental learning. Another factor according to Pagliaro (Kelly & Pagliaro, 2014) the teacher who teaches students with hearing impairment is not quite enough to preparing the mathematics materials and limited in knowledge or using the language. Based on the explanation above, the researchers analyzing, designing, and developing the e-module design that is combined with Computational Thinking learning in developing the skill of critical thinking in students with hearing impairment.

Methodology

This research is categorized into kind of qualitative descriptive. This research did in the special junior high school of Djojonegoro, Temanggung. The subjects score VII-grade students of special junior high school of Djojonegoro, Temanggung. The instrument for collecting the data is the validation of the guidelines of the mathematics module. The instrument to validate appropriate to the curriculum. The questionnaire was answered with qualitative suggestions and rating from experts in the field. This suggestion is used to revise the product (Suhendri & Suparman, 2019). The validation level of the learning products are indicated by scores from validators through the design validation sheet of the e-module. The validators

included media experts and material experts. The scores shown in Table 1. provided for validating the product are

Table 1. Validating the Product

Criteria	Score
Excellent	5
Very Good	4
Good	3
Fair	2
Poor	1

The analysis of data obtained employed reducing, serving, and concluding techniques.

Results and Discussions

Based on the observation of the curriculum, researchers find that the school has used the curriculum that appropriate the fundamental competence, basic competence, and indicators in the curriculum of 2013 (K-13). Every lesson that has been taught is proper to the indicator of accomplishment of competence. The implementation of learning, a teacher gives materials or lesson which is under the grade. For example, the teacher gives the IV-grade material to students of Junior High School.

Teachers were actively asked by students with hearing impairment when they were provided with tasks as found in the observation. The teacher gives good to respond to the passive students when teaching. Based on the interview with Ibu Dwi Febri Wahyu as the teacher the research site,

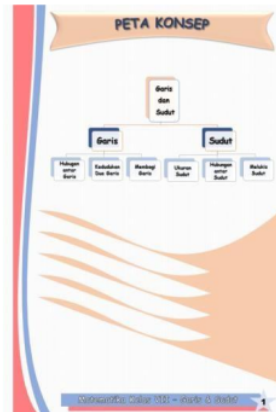
It was found that the students with hearing impairment were difficult to understand the mathematics lesson but they actively asked when they faced a difficult problem. In addition, she said that the obstacles in learning mathematics are giving understanding to the students about the materials and limited media.

In this section, the researcher is designing the e-module based on computational thinking to develop their critical thinking skills of the VII-grade students of Special Junior High School (SMPLB). The cover of this e-module consists of a Logo of UAD, the Title of the module, title of the lesson, target of the user, the author, and the institution. The cover is important for it shows the contents. The cover is shown in figure 1.

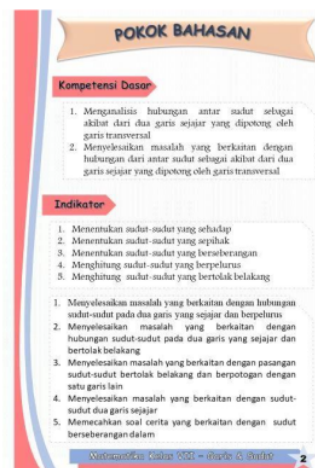


Figure1.MathematicsModulebased ontheComputationalThinkingLearning

The conceptual mapping of this e-module learning in the class. The conceptual mapping is shown in figure 2. The conceptual mapping helps the teacher to improve effective

**Figure2.**Conceptual Mapping

The main lesson of this e-module contains basic competence and indicators of achievement of competence. The main lesson is shown in figure 3.

**Figure3.**Main Lesson

This page contains the summarizing of the line and angle. The summary of the lesson hopefully could help the students to imagine the lesson that will be taught. The page of the lesson is shown in figure 4.

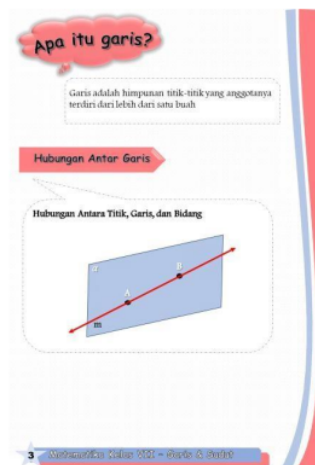


Figure 4. Summarizing the Lesson

The Exercises in this computational thinking e-module contain some problems that should be sorted out by the students. This exercise aims to

trigger critical thinking skills in mathematics about the line and angle. An example of the exercise is shown in figure 5.

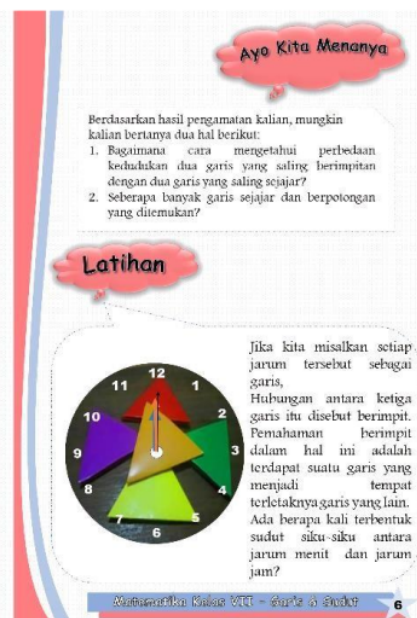


Figure 5. Exercises

The quiz page in this e-module contains the exercises that develop and sharpen the critical thinking skill of the students and

increasing the insight about the line and angle. The page of the quiz is shown in figure 6.

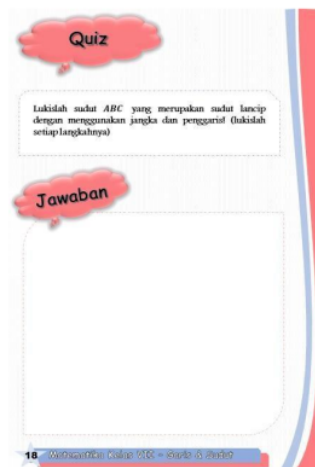


Figure 6. Page of Quiz

The e-module design was intended for computation thinking level by Malik (Malik & Wara, 2018). The levels are 1) Formulating Problem, 2) Ordering and analyzing the data in a logical way, 3) Presentation of the data with abstraction, 4) Optimalization of solution with an algorithm in several steps .5) Identifying, analyzing, and implementing an effective possible solution. 6) Generalizing and transferring problem solving. Computation thinking techniques in (Gare- Penalvo, 2016; Wing, 2017) are 1) Simplification 2) introduction of the system 3) Generalization 4) Designing the algorithm.

The design of the e-module was inspected in the process of validating media and materials. To validate materials, assessment is used for determining the validity of the e-module design. Approved e-module from the assessor will undergo validation process by the validator, lecturer, and media expert. The validation of the e-module uses assessment instruments. It formed in questions and questionnaires. After that, if the instrument is valid, the instrument can be used by experts of materials and media to assess products to be developed. Some suggestions from the experts are summarizing in table 2.

Table 2. The Suggestions from the Expert

Suggestions and Comments	Following
The conceptual map in less detail	The conceptual map has been fixed with more details
Adding the logogram of K-13	Has been added the logogram of K-13
Adding the lesson	Has been added

The suggestions from the expert become references for the research to revise the product. Further, the lesson propriety is passed by two of the experts. The result of the score from the

questionnaire about the properness of the instructional design media by the expert is shown in table 3

Table 3. The Result of the Questionnaire of the Properness Lesson

Assessor	Position	Criteria for the Qualitative Data
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VeniAnggreani	Math.Teacher	Excellent
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Based on table 3, the researcher concluded that the module design is categorized to be an excellent module design. As in (Isnaepi & Suparman, 2019; Suprotun & Suparman, 2019), the next research would be extended on the development, implementation and evaluation. In this phase, the product was developed to fulfill the practice criteria and effective when used.

Conclusion

This research designed mathematics module based on the computational thinking method. In the analyzing, the researcher explained the curriculum, learning instrument, and analyzing the traits of the students with hearing impairment. From the observation, the school has used the curriculum of 2013 or called K-13. Researchers find that the students with hearing impairment were given the materials under their own supposed grade because they cannot understand immediately. The characteristic of the students with hearing impairment, they were actively provided with questions when the teacher give them tasks. On the other side, if the students are not active, the teacher will help to guide them with a good response. In the designing, the researchers designed the cover, the conceptual mapping, the materials of the lesson, exercise, and quiz. The activity of students that triggering the critical thinking skill of the students was found in the exercise part.

Limitations and Future Studies

In this research, the researchers described on the analysis and design of the module for the students with hearing impairment. The future research can be extended on the development, implementation and evaluation.

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