

Digital Mathematics Tasks

HOTS Type: A Review

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Digital Mathematics Tasks HOTS Type: A Review

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Abstract. Mathematics instructional activities, regarding to Indonesia curriculum, are emphasized to High Order Thinking Skills and the use of ICT. This article describes the review of digital mathematics tasks HOTS type which was designed. The review itself is a part of a design research purposing to produce a valid and practical digital mathematics task, and having potential effect to train students' high order thinking skills. Data were gathered through expert review documents. The result showed that digital mathematics tasks designed were mostly suitable with content, context, mathematical thinking process, and level of High Order Thinking Skills. For all digital mathematics tasks that have been designed, expert reviews suggested to give explanations of HOTS level category of tasks given.

1. Introduction

High order thinking skills (HOTS) including abilities to analyze, to evaluate, and to create ideas are very important skills to achieve 21st century competencies that consist of critical, creative, collaborative and communicative thinking skills [1, 2]. Those skills are needed by students in solving real-world problems [3]. The importance of HOTS for students affects the orientation and structure of the curriculum in Indonesia so that the Indonesian government applies the 2013 Curriculum by setting graduation standards that expect students having the ability to think critically, productively, independently, collaboratively and communicatively [4]. Improving students' abilities can be done by giving context based mathematical problems since the problems can stimulate students to think in solving the problems [4, 5]. Typically, the problems can be seen in PISA. It is kind of contextual and non-routine problems [6]. PISA results showing low rank of Indonesian students indicated that Indonesian students' thinking skills are still dominant at low levels [7, 8]. This becomes issues in Indonesia where there is a gap between the demands of 21st century skills for students and PISA results of Indonesian students.

Previous researches in Indonesia have been carried out the study related to PISA. Some of them are about developing mathematical tasks like PISA problems [9-12]. Furthermore, studies describing students' abilities such as problem-solving skills, reasoning, argumentation, creativity, and high order thinking skills were also conducted [13-17]. However, the study on PISA integrated with the use of technology in Bahasa Indonesia are still very rare. Whereas, the use of technology has a good role in learning mathematics [18-25].

This study was conducted taking into account the limitations of previous studies in Indonesia related to PISA. It aimed to develop digital mathematics tasks like PISA problems. Specifications and descriptions of the digital mathematics tasks meant are further explained. Specifically, this article tells about review results of the digital mathematics tasks developed.



2. Methods

The research method used is design research type development study that purposed to develop PISA-like digital mathematical tasks which are valid, practice, and having potential effect to 21 century competences of students in secondary school. There are 3 stages in this study namely preliminary stage, prototype stage, and evaluation stage. The preliminary stage includes analysis of PISA framework and curriculum. The prototype stage is a stage where digital mathematics tasks designed. Then, they are evaluated by formative evaluation in the last stage. The formative evaluation itself consists of self-evaluation, expert validation, one to one, small group, and field test. However, the discussion in this article is focused to the expert review results of digital mathematical tasks developed.

Data were gathered through expert review documents and were analyzed qualitatively. The expert review document provided contains the assessment rubric for the digital mathematics tasks developed. The assessment rubric was compiled based on the PISA framework which contained mathematical content, context, mathematical processes, and HOTS level criteria.

3. Result and Discussion

Digital mathematics tasks designed are in the form of digital videos that contain HOTS mathematics problems. At the preliminary stage, researchers analysed the PISA framework, PISA questions, and PISA results of Indonesian students. Based on the analysis results, the researcher decided that the digital mathematical task was designed based on the PISA framework and HOTS category. Selection of the HOTS question level was taken into consideration that Indonesian students were only dominant in solving problems at the lower level, namely the level of thinking for the categories of knowledge, understanding, and application.

At the prototype design stage, the researcher compiled PISA-like HOTS question grids and question cards. There are as many as 20 questions developed based on the PISA framework including mathematical contents namely quantity, change and relationship, space and shape, and uncertainty and data; mathematical contexts such as personal, social, occupation, and science; and mathematical processes including formulation, application, and interpretation [26]. Besides that, question grids developed contain the prediction HOTS problem levels such as analysing level, evaluating level, and creating level. After the grid has been set, all questions are packaged in the form of digital video. HOTS digital video is a video that contains a mathematical problem categorized as HOTS. It is intended to stimulate students to learn mathematics in class.

Digital videos designed were then evaluated. To get better design results, digital video designed were validated by experts. There were 2 experts involved in this study, each of whom was known for his expertise related to HOTS. One is a doctorate in mathematics education at Sanata Dharma University and the other is a doctorate in mathematics education at Semarang State University. The following is the description of the review results of the digital mathematical tasks developed.



Figure 1. Digital Video of a mathematical problem about uncertainty and data

Figure 1 is a capture of a digital video about an uncertainty and data problem, number 15. More or less experts argued that this digital video has been designed quite well. The video has short duration approximately about 1 minute 6 second and contains about 1 mathematical problem. The problem raised is about purchasing a laptop that matches the criteria. It is begun with a little introduction of the problem in combination description between narrative and depictive way. It also has human sound in Bahasa Indonesia and animation on it.

Table 1. List of expert review results of problem 15 related to conformity with the PISA framework

Indicator	Mark
Questions made in accordance with the theme	✓
Questions made in accordance with the description of the problem	✓
Questions are made according to HOTS content selected	✓
Questions are made according to HOTS context selected	✓
Questions made in accordance with process ability addressed	✓
Questions are made according to HOTS level selected	✓
Writing sentences on questions in accordance with the standard spelling rules	✓
The sentence used in the question is not ambiguous	✓

Table 1 shows the conformity of problem designed with PISA framework according to expert review results especially for uncertainty and data problem, number 15. The theme of problem is about laptop. The HOTS content is uncertainty and data. The HOTS context is personal, the context that approaches the life of the student itself. The mathematical process ability is about interpretation, individual's ability to describe mathematical solutions, results or conclusions and interpret them in the context of real-life problems. The HOTS level selected is level 5 namely analyzing level where students can work strategically using broad thinking and reasoning and appropriately relate their mathematical knowledge and skills to the situation. Because all marks were appeared for all indicators, thus problem 15 designed was suitable with PISA framework and HOTS category. However, not all tasks designed look perfect. There are some notes from reviewers relating to deficiencies on them.

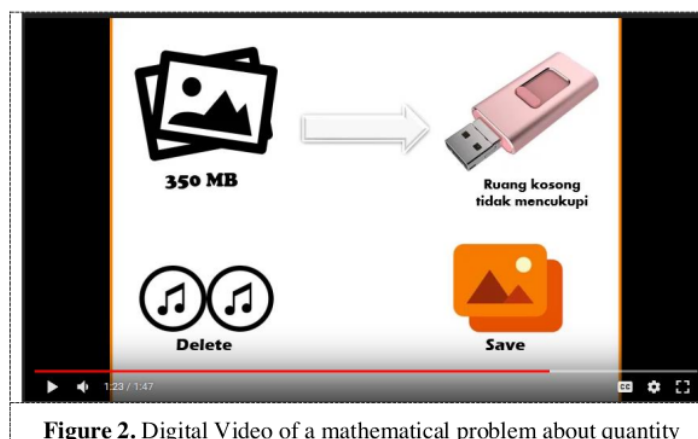


Figure 2. Digital Video of a mathematical problem about quantity

Figure 2 describes one fault in a digital video of quantity problem where there are some foreign language terms used on it. Since this digital video is intended for Indonesian students, it should be in Bahasa. Furthermore, the video should use simple terms that can be understood by students.



Figure 3. Digital Video of a mathematical problem about space and shape

The capture of space and shape problem in figure 3 shows that the picture used in the video is not too clear. This can be an obstacle for students to understand the problem given. In addition, the use of sound and music is not proportional so that students become uncomfortable.



Figure 4. Digital Video of a mathematical problem about quantity

The other deficiency of the digital video designed is showed in figure 4 where the video contains unfamiliar currency. The context used should be adapted to the Indonesian context so that students can explore the problems given.

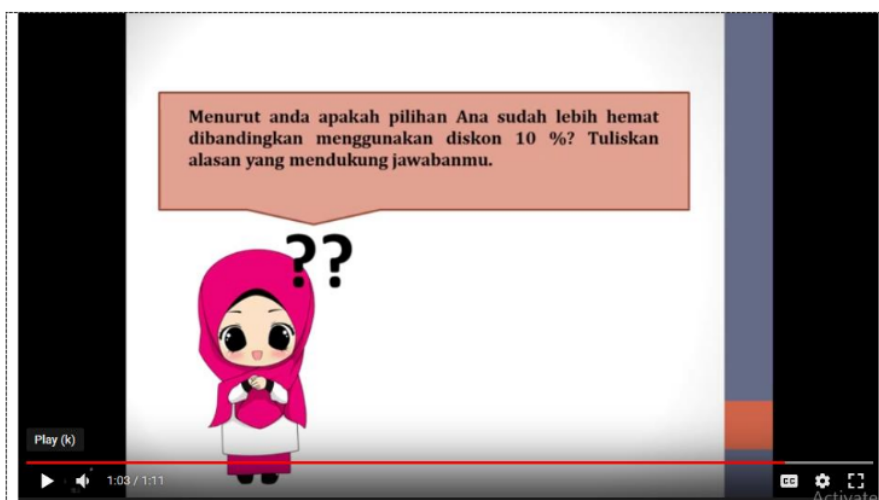


Figure 5. Digital Video of a mathematical problem about change and relationship

The expert also provides notes and questions related to the selection of the level aimed at the question. Figure 5 shows change and relationship problem in the digital video. The level category of the problem according to HOTS level is level 5, evaluating level. Since the problem given is asking about the right decision from the case given, it is categorized into evaluating level. This level means a level where students can choose, **compare, and evaluate appropriate problem solving strategies** when **dealing with** complicated situations **related to** the model.

The development of the PISA-like mathematics problem in digital form should be oriented to the PISA framework as well as what has been done by previous studies relating to the development of PISA questions [9-12]. This is an effort to train Indonesian students to get used to solving problems such as PISA questions. These digital mathematics tasks can be later used in learning that emphasizes the use of mathematical problems in learning such as realistic learning or problem-based learning. This is because mathematical problems have a good role in training and developing the mathematical thinking process of students [4, 6]. In addition, the use of technology also has a good influence on mathematics learning where the learning process becomes more effective [18-25]. Furthermore, depictive presentation of problems in digital video is also very helpful for students in understanding the problems given [27]

4. Conclusion

Digital mathematics tasks in the form of digital videos designed have been reviewed by experts based on the PISA framework and the HOTS category. The good things that can be seen from the digital video designed include the depictive presentation of problems, the use of technology that is able to streamline the delivery of mathematical problems, and conformity with the PISA framework and HOTS category. Some of the disadvantages that appear include the use of terms and foreign contexts and the selection of the size of the image and the sound that is inserted.

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