How is STEM learning for children with special needs in Indonesia?

by Muhammad Nur Hudha

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Abstract. This paper is a preliminary study aiming at discovering information on STEM learning for children with special needs in Indonesia. The method used in this study was descriptive qualitative using a questionnaire and interviews with teachers, parents, and students with special needs as the research instruments. It is concluded that the students needed more effective media in STEM learning.

1. Introduction

Science, Technology, Engineering, and Mathematics (STEM) learning is in rapid development nowadays [1]. It is becoming imporant as the era of industrial revolution 4.0 takes place causing the fast development of technology which needs to be inserted in education as well [2]. It has been evident that STEM learning can be integrated with such learning models and problem-based learning (PBL), inquiry, and cooperative learning [3].

The primary focuses of STEM learning are to learn mathematics, science, and technology, to design and implement experiment, to analyze and interpret data, to communicate and cooperate different kinds of science. Thus, STEM does not merely focus on science, but also on curiousity, evidence-based reasoning ability and cognitive skills, understanding and appreciating the process of scientific investigation [4]. Integrated STEM should be able to create students who are (1) problem solvers, (2) innovators, (3) inventors, (4) logical thinkers, and are able to understand and develop their skills in (5) self-reliance and (6) technological literacy [5]. Therefore, integrating STEM involve both content knowledge, problem solving, and inquiry [6].

STEM learning in children with special needs (ABK) / disability has now been widely approved [7-9]. However, there are currently not many who discuss STEM learning in the deaf in Indonesia.

It is commonly known that students with special needs have difficulties in communication when learning STEM, especially when have to learn abstract concepts. The roles of sign language in language

mastery, cognitive development, literacy are necessary in learning STEM for students with special needs [10]. In reality, STEM learning for students with special needs has not been implemented optimally. In general, their difficulties deal with understanding complex matters such as the shift of physic materials to chemical and communicating experimental results.

The purpose of this study is to find out information related to STEM learning for students with special needs in Indonesia. It is expected that this study can offer solutions to STEM learning for students with special needs.

2. Methos

This study used a descriptive qualitative research approach putting more focus on limited research subjects. To collect data, this study used a questionnaire and interviews. The subjects were randomly selected from schools in Malang, Surabaya, and Yogyakarta, Indonesia. The interview indicators used were (1) problem solvers, (2) logical thinkers, dan (3) technological literacy [5]. In addition, to acquire students' basic information such as their IQ, demographical information, and their basic knowledge skills of mathematics, social science, Indonesian language, and basic Islamic studies, we interviewed their teachers. The selection of this informant is done randomly but still considers several aspects. Among them are teachers who have taught STEM to ABK students. The data collected in this study were analyze qualitatively by using data reduction technique. The data were then evaluated and presented in a narrative way.

3. Results and discussion

Integrating STEM involves a combination of two or more sciences [11-12]. The focus of the activity is optimizing students' involvement in defining and formulating solutions. STEM is also able to help students analyze and solve problems so that they are ready for the work field [13-14]. This multidisciplinary integration model demands students to correlated the concent of various lessons [15]. To do so, they are required to think crirically, analytically, creatively, and innovatively [6]. These skills are important indicators Higher Order Thinking Skills (HOTS).

This study shows tha STEM learning for students with special needs should adjust to each student's characteristics. For instance, students with Deaf and Harf of Hearing (DHH) actually has equal intelligence with those without DHH. However, they have difficulties in verbal communication which demands the learning process to involve visualization and sign language. In reality, most teachers usually provide visual learning media so that students with DHH learn well [16].

STEM learning is also considered difficult for students with special needs since it contains analytical skills. Data showed that in all school investigated in this study, most of the teaching and learning materials were below average of public schools in terms of complexity and difficulty due to their lack of analytical skills.

The results of an interview revealed that some students show competences lower than where they should actually belong. For instance, eighth grader students were actually in the level of understanding seventh graders. Unfortunately, when the time comes, they have to graduate as their fellow friends do.

The teaching methods that has been widely used in special schools have been lecture and practice. The practice usually takes place after verbal, or sign language, explanation. In the practice session, teachers usually give tasks to both reguler and special needs students to solve problems in accordance with the topic being taught.

For lessons that were easy and moderate, most students with special needs showed good individual performance in STEM learning. However, when they faced difficult lessons, they seemed to constantly need assistance either from their teachers or their peers. In the schools studied, some of the skills promoted through STEM learning were critical thinking, individual/ independent work, and team work.

As it has been mentioned that students with DHH need visual and sign language aids to help them understand, the use of technology is usually helpful as well. Pictures and videos are commonly used to help them understand the lessons better. For students with DHH, the videos shown are usually a process video since they lack understanding verbal explanation without visual aid. The videos are usually easily

downloaded from YouTube. To cope with this, the development of adaptive e-learning is worth to try. Some other possible media are bilingual/ bicultural, adaptif multi-agent learning, cellular technology, and other adaptive e-learning systems which are easily accessible and used for learning [17].

A meta-analysis has been conducted and collected findings from 28 whose some of the important notes are students' academic achievement has big portion of impacts from integrated STEM learning, their science achivement is medium, and their mathematics achievement is relatively low [18]. STEM is proven to be able to motivate students to implement their mathematical understanding in real life even if their mathematical achivement at school is still low. This approach enables students to enhance their learning achivement as their learning interest increases, which makes it more important rather than scores since STEM helps them shape their future career [19]. Advanced STEM learning has been also evident to be successful to be implemented for students with special needs [7].

4. Conclusions

STEM learning for young students with special needs ought to be implemented since early ages since it is able to enhance their logical thinking. However, integrating STEM learning to students with special needs comes with its challenges and uniqueness. One of which is the selection of proper learning media in accordance with their characteristics. Therefore, the use of technology needs to be implemented to enhance their interest and understanding of STEM learning.

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