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The Use of STEM Integrated Crosscutting Concepts Science Module on Science Curiosity of Junior High School

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Abstract: One of the goals of learning science is to help students develop their science curiosity. Students' curiosity is a personality trait motivated by the desire to find a solution or fill a specific knowledge gap. Using science modules in science is expected to be a solution to stimulate student's science curiosity. The purpose of this study was to determine the curiosity level of class VII students at SMP Negeri 1 Yogyakarta, especially on the temperature and heat topic. Type of this research is descriptive qualitative. Data analysis used the N-gain test to determine the increase in student's science curiosity. The subjects in this study were students of class VII G SMP Negeri 1 Yogyakarta, who collected 32 students using purposive sampling technique. Data collection techniques consist of questionnaires and the data collection used in the form of pretest and posttest. Based on the data analysis there is difference in the pretest and posttest results with the average N-gain obtained is 0.69, which is in the medium category. It can be concluded that the use of STEM integrated Crosscutting Concepts can improve students' science curiosity. This is evidenced by the difference in pretest and posttest, also the N-gain score which is in medium category.

Keywords: Crosscutting concepts; Module; Science curiosity; STEM

Introduction

Education is a vital necessity for people's lives. Implementation of education in Indonesia has the goal of developing all the potentials of the Indonesian people with the hope of creating a capable, creative and independent society so that they can manage Indonesia's abundant natural resources. Human resources needed are intelligent and have good character. So good character education is needed in order to form a society that is intelligent in knowledge and has good manners. Character education also needs to be developed in science learning. One of the characters that is needed in science learning is high curiosity. High curiosity (curiosity) will have an impact on the amount of knowledge possessed by students when compared to students who only rely on material from the teacher in class (Artinta & Fauziah, 2021; Constance & Tzipora, 2022; Hunaepi et al., 2021).

Based on latest research results by, it was found that 54% students have low science curiosity, and in fact 4% of students in junior high school have very low science curiosity (Hariyanti & Lestari, 2023). If the average students' science curiosity is still low, it's necessary to examine how to improve that aspect. But, improving the science curiosity of students in school is a challenge because it requires continuous practice and the teachers role (Crough, 2019).

The curiosity that students have cannot be separated from the role of the teacher while at school. Today a teacher is required to have various ideas in using learning models and media (Setyaningsih et al., 2021; Wu et al., 2018). One of the innovations that can be carried out by teachers in order to improve the character of students' curiosity is to use learner-centered learning strategies and hands-on activities (Fuadati & Wilujeng, 2019; Mardhiyana & Sejati, 2016). The character of students' curiosity needs encouragement so that it can develop and improve, one of which is the role of the teacher in the classroom to bring out this curiosity.

The character of curiosity is the need to obtain knowledge or information and has the motivation to

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obtain this through exploration (Grossnickle, 2016). According to Lamnina et al. (2019), curiosity is a term used to differentiate interest. Curiosity has a goal of seeking certainty or filling in the deficiencies of specific material (Grossnickle, 2016; Lamnina & Chase, 2019). The curiosity that arises in individuals who study science functions to build their scientific knowledge by investigating, asking, and manipulating (Weible & Zimmerman, 2016). Various activities in science learning such as asking questions, making observations, and manipulating objects of observation are some of the habits possessed by individuals with high curiosity (Özkan & Umdu Topsakal, 2020; Weible & Zimmerman, 2016).

To overcome this problem about students' low science curiosity level, the important thing to do is to choose the learning materials that can catch attention of students'. One of learning material that can be used to increase students' science curiosity is the module integrated with several learning strategy (Masaguni et al., 2023). Learning strategies that can be used to improve scientific literacy are STEM approach and crosscutting concepts (Lavi et al., 2021; Sumirat, 2019).

STEM referred to Science, Technology, Engineering, and Mathematics (Clarke et al., 2019; Emery et al., 2019; McGee, 2020). Learning with STEM approach gives students studying science, technology, and engineering practical experience (Taqiyyah et al., 2023; Vennix et al., 2018). At least four of these science fields can be brought together in the classroom through the use of STEM in a meaningful way (Bassham et al., 2011; Rasmi et al., 2023; Stohlmann, 2019; Townley, 2020). STEM education can help students to solve problems, conclude and apply their knowledge (Fikriana et al., 2023; Lou et al., 2017). Innovative strategies for teaching students who are literate in science and technology are one distinctive aspect of the STEM approach (Bramastia et al., 2023). National Research Council's make a framework for model in STEM education, namely three-dimensional learning (3DL) (NGSS Lead States, 2022). According to 3DL, there should be three components to scientific discipline teaching and learning: discipline core ideas, crosscutting concepts, and scientific practices. Based on NGSS, combining STEM approach with crosscutting concepts will bring more effect in science learning.

Crosscutting concepts is *"some important themes pervade science, mathematics, and technology and appear over and over again, whether we are looking at an ancient civilization, the human body, or a comet. They are ideas that transcend disciplinary boundaries and prove fruitful in explanation, in theory, in observation, and in design"* (NGSS, 2022). Crosscutting concepts have 7 dimension namely patterns, cause and effect, scale proportion and quantity, sytems and system models, energy and matter, structure and function, and stability and change. In learning process, crosscutting concepts play several roles as a lens, tool, bridge, or rules of the game (Rivet et al., 2016). Crosscutting concepts can be used in learning as an instruction to guide the students' understand the science.

Based on the description of the need of improve students' science curiosity as well as learning materials using new curriculum, this study discusses the use of STEM integrated Crosscutting Concepts Science Module in class. The aim of this research is to describe the effectiveness of the module developed after being used by students.

Method

This type of research is a qualitative descriptive research. The research data was analyzed quantitatively and qualitatively. The subjects in this study were students in class VII G of SMP Negeri 1 Yogyakarta with a total of 32 students. The sampling technique used was a purposive sampling technique, with the consideration that the level of curiosity of students had never been measured in this class, and had never carried out practicum activities in the laboratory. In this study, data collection technique used was using a questionnaire of students' natural science curiosity. From the data obtained from questionnaire was analyzed by n-gain which is expressed by equation 1. The interpretation of N-gain score criteria shown in Table 1.

$$g = \frac{Spost - Spre}{Smax - Spre} \quad (1)$$

The description:
Spost : average posttest score
Spre : average pretest score
Smax : maximum score

Table 1. Category Level N-gain

Range of Value	Category
g > 0.70	High
0.30 ≤ g ≤ 0.70	Medium
g < 0.30	Low

Result and Discussion

The character of curiosity is a character that can be trained and developed. Every individual can develop the character of curiosity through activities carried out in the family, community and educational institutions such as schools. Currently curiosity is an important character in learning activities, because it can determine. One effort that can be done in developing the character of curiosity is through science learning activities. Science learning is a learning that is a means to improve human resources, especially in character building. According to Schizas et al. (2016), natural science material is knowledge that includes facts, concepts, laws, and theories as objects of observation that can trigger an individual's curiosity. The focus of this research is to find out the level of curiosity of students in the matter and its changes.

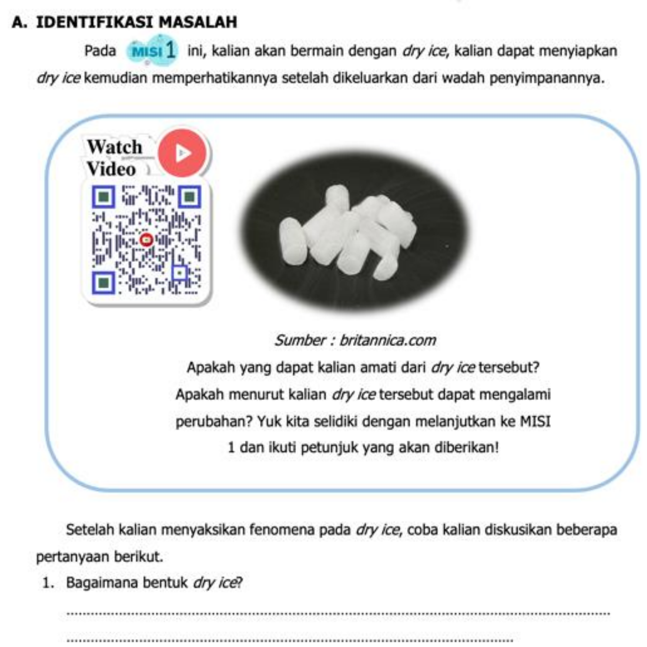
There are three aspects of curiosity that are measured in this study, namely focus during learning activities, seeking information from learning sources, and asking questions. The curiosity questionnaire consisted of 20 statements with the answer choices always, often, rarely, and never. Each item is adjusted to the aspect of curiosity being measured. There are 7 statement items to measure focus aspects during learning activities, 6 statement items to measure aspects of seeking information from learning sources, and 7 statement items to measure questioning aspects. Data collection using a curiosity questionnaire was carried out directly at SMPN 1 Yogyakarta. Participants were given 25 minutes to work on the questionnaire. From the results of filling out the questionnaire, data was obtained in the form of student questionnaire answers which were then analyzed by the researcher. The results of the curiosity questionnaire analysis are presented in Table 2.

Table 2. N-gain Score Results

Class	Pretest	Posttest	Average of n-gain	Category
X	47.625	70.28	0.69	Medium

Based on Table 2, it can be seen the N-gain score obtained is 0.69, which means it is included in medium category. It's mean that STEM integrated Crosscutting Concepts science module can be used to increase students science curiosity. The results are in line with the study result of fostering curiosity in elementary school students as an impact of STEM intervention (Adhelacahya et al., 2023; Leas et al., 2017), and curiosity is focused on figuring out phenomena by applying CCC which is one of three dimensional learning (Johnson, 2017). STEM as a learning approach and component for delivering the topic have a contribution to improving students' science curiosity because it can pique students' curiosity, capture their interest, and motivate their continued study (Akhsan et al., 2023; Chen & Tippett, 2022).

The integration of STEM as topic material component and CCC as an instruction and bridge disciplinary boundaries can improve science curiosity because its topic and instruction give interesting activities (Chesnutt et al., 2019; Nazifah & Asrizal, 2022). Students know that the activities they learned was many objects that they found in their daily life, and it piques their curiosity. In addition, at the beginning of module chapter, there is a phenomenon that makes students interested to learn, such as learning about dry ice.


A. IDENTIFIKASI MASALAH

Pada MISI 1 ini, kalian akan bermain dengan *dry ice*, kalian dapat menyiapkan *dry ice* kemudian memperhatikannya setelah dikeluarkan dari wadah penyimpanannya.

Watch Video

Sumber : britannica.com

Apakah yang dapat kalian amati dari *dry ice* tersebut? Apakah menurut kalian *dry ice* tersebut dapat mengalami perubahan? Yuk kita selidiki dengan melanjutkan ke MISI 1 dan ikuti petunjuk yang akan diberikan!

Setelah kalian menyaksikan fenomena pada *dry ice*, coba kalian diskusikan beberapa pertanyaan berikut.

1. Bagaimana bentuk *dry ice*?

Figure 1. The contents of science module

An example of improvement of students' science curiosity is several students asking "why a very big boat like a cruise ship doesn't sink even if it's made from metal?" That question appears after students learn about the density of matter and the effect of density. Another example in class that shows improvement ins students science curiosity is they try to find the answer of things they don't understand. When students can't find the answer, they directly ask the teacher in the class and when the class is over. This science curiosity improvement helps students to learn science in more depth to have complete knowledge.


Figure 2. Students' activities in class

The activities contained in the science module were used to guide students to have a curiosity towards science concepts because the module presented several phenomena that occurred in daily life. Students can observe the phenomena and pick up their curiosity so it can effect the general achievement of their study results in science. This is in line with research by Kibga et al (2021) which says that the activities in the science module help students increase their science curiosity because it's more interesting for them.

The goal of STEM education is to establish a creative and stimulating learning environment that promotes investigation, experimentation, and critical thinking (Suhirman & Prayogi, 2023). Pupils can become active learners who take ownership of their education when teachers support their curiosity, give them chances to explore and experiment, and provide them ideas to help them understand STEM concepts more deeply. With the help of this instructional strategy, students can develop into independent, active learners. This is in line with the purpose of using STEM approach to improve students' science curiosity.

Conclusion

Based on the results and discussion of this study, it can be concluded that the use of STEM integrated Crosscutting Concepts can improve students' science curiosity. This is evidenced by the difference in pretest and posttest, also the N-gain score which is in medium category.

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Conceptualization, F. Z and A. W; methodology, F. Z; validation, A. W; formal analysis F. Z and A. W; investigation, F. Z; resources, F. Z and A. W; data curation, F. Z and A. W; writing–original draft preparation, F. Z; writing–review and editing, A. W; visualization, F. Z and A. W. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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