STEM Education Through Mini Water Filter Based on SDGS Approach on Water Polution

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Abstract. One of the important components of the fourth sustainable development goal is enhancing human populations' knowledge of Science, Technology, Engineering, and Mathematics (STEM). Many countries are facing challenges to implement STEM education. Start from the problem of water pollution, student learn how to prevent the harmful effect of toxic subtance to water environment. This study aims to exercise STEM model. Descritive method used as the research method, and twenty two students chosen by purposive sampling. Learning activities using STEM were make students enthusiastic to learn about science related to the water polution. First, students learn from the water enviroment around school. Second students do the experiment by using fish and polluted water. Third, students design the innovation to prevent the toxic subtance to water environment. Fourth, students make an innovation. Five, students give reflection, and the last student do the exercise based on the activities. The total average results from the students' cognitive test about the material show a score of 90. Based on encouraging knowledge and life skills regarding the Sustainable Development Goals (SDGs) and making connections in education to primary school students depends heavily on the learning process from early awareness of the SDGs. Students can learn about environmental issue directly.

Keywords: STEM education, SDGs, water filtration, toxic subtances, water pollution.

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INTRODUCTION

In the modern society, water pollution is still a large concern, and reducing it is now one of the top priorities for sustainable development. Based on the data from Water Environment Partnership in Asia (WEPA) the availability of clean water in term of quantity tends to decrease due to environmental degradation and pollution. The WHO estimates that eighty percent of diseases are water-borne(Mekonnen & Hoekstra, 2018). Numerous regions' drinking water does not adhere to WHO criteria 3.1% of deaths are linked to unclean and subpar water. When harmful substances enter water, the water's quality changes and becomes damaging to the environment and human health, causing water pollution. Water is an essential source of infection since it is a substance that dissolves. Natural resource used in our lives for drinking and other needs of growth. Worldwide, access to clean drinking water is essential for maintaining human health. Human health is impacted by plant and animal species that suffer direct nutritional degradation. Water contaminants are causing the death of seaweed, mollusks, marine birds, fish, crustaceans, and other sea animals that are consumed by people. (Koshal, 2017). Along the food chain, the concentration of insecticides like DDT is rising. These insecticides are potentially harmful to humans, because the rate of water resources degradation accounted for 15-35 % per capita annually.

By establishing a particular goal (SDG 6 : Ensure availability and sustainable management of water and sanitation for all), the 2030 Agenda for Sustainable Development puts water quality issues to the fore of global action(Ezbakhe, 2019). Numerous ecological and social obstacles must be overcome in order to achieve sustainable development, including resource scarcity, single-sector resource management, environmental contamination, and the continued use of forced labor(Singh et al., 2018). These issues are connected, thus solving them will call for a concerted international effort that goes beyond individual or specialized initiatives.

Education was seen as a crucial field for spreading the ideas of sustainable development, and Education for Sustainable. The importance of change has been recognized by education

research, which presents a chance to examine and reconsider what characterizes acceptable and effective educational methods(Leal Filho et al., 2018). There are few studies that look at how transformation and learning about sustainable development may be combined, despite the importance of transformation in higher education and in particular in sustainability learning. Numerous studies have been undertaken in the last few decades in response to environmental problems that have caused people's perspectives on how humans and nature interact to adapt(Biasutti & Frate, 2017). Given the complexity that sustainability provides, integrative and multidisciplinary approaches to teaching and learning that might promote sustainability skills, such as problem-solving, critical thinking, action competence, and systems thinking, appear appropriate(Cebrián & Junyent, 2015).

In line with Education for Sustainable Development, in order to prepare students with the necessary abilities for the 21st century, critical and creative thinking instruction is an essential component of the educational process. Additionally, it is crucial to underline clearly the need of paying attention to local culture, particularly that which is closely tied to scientific ideas (Charlesworth & Banaji, 2019). The STEM project-based learning for elementary students has been implemented, and its impact on students' critical and creative thinking skills has been examined, due to those two features, namely, creative and critical thinking as well as attention to local culture. Science subject is critically a good way to enhance students' critical thinking skills. Biology is the subject chosen in this research because biology is mainly based on textbooks; therefore, many students are still passive in learning this material (Aminudin et al., 2018).

Some research about Education for Sustainable Development was conducted. Anastasia Nasibulina (2015) conducted research about Education for Sustainable Development and Environmental Ethics(Nasibulina, 2015). Meanwhile, Jelle Boeve-de Pauw's (2015) research aims to determine the effectiveness of education for sustainable development(Pauw et al., 2015). The research method used was quasi-experimental design with a posttest-only design. The instrument used is about thinking skill. However, there is no research on excercising STEM education through mini water filter based on SDGS approach on water polution. Therefore, a learning activity, was needed to exercise STEM education through mini water filter based on SDGS approach. Therefore, this study aims to exercise STEM education through mini water filter based on SDGS approach on water polution.

METHOD

Descritive method used as the research method, and twenty two students chosen by purposive sampling. The research method used in this research was descriptive because it is dealing with making a description of the current or past status of phenomena (Vigo, 2019). The process of this research includes arrange the test item, attempt the test, implement the test to the students, and gaining the data, and convert it to the Microsoft excel, process the data, and analyze it. Data profiling utilizes methods of the descriptive statistic by proper analyses, interpretation, comparisons, identification of trends, and relationships. This research attempt to test twenty two (22) students in their sixth year study. The participants in the current study are from SD Labschool Bumi Siliwangi UPI Bandung. Bahasa Indonesia and English is used as the main language in this school.

RESULTS

The calls for replacing traditional lecture-based teaching methods with more inquiry- and project-based ones, as well as for better preparing college and high school graduates to compete worldwide. STEM is being one of the solution, additionally, STEM more closely resembles the job of an actual scientist or engineer, and it is being promoted as a way to encourage more student to pursue careers in science, technology, engineering, and mathematics. STEM activity on water contamination may include instruction on sustainable development objectives. STEM refers to the deliberate fusion of the various academic fields to address contemporary issues (Mcclure et al., 2017).

(a)

(b)

Figure 1. Students' activities

By implementing STEM on teaching learning process, there are seven learning sequences. First activity is the food chain arrangement. First, student analyze the energy flow through food chains and food webs.teacher given some of the animal card, then ask the students to arrange based on the food chain and food webs (Figure 1.a). The second activity is the exploration about the mechanism of energy flow through food chain and food webs (Figure 1.a), the objective of this experiment is student will analyze the energy flow through food chains and food webs. Studens work in pairs. They will use a model to show how energy flows through a food chain, they place three plastics cups in a row, then label the cups water plant, small fish and big fish. Then they add some beads in the cup labeled 'water plant'. The beads represent the energy in food. They transfer some beads from the 'water plant' to the 'small fish'. Then they transfer to the 'small fish' to the 'big fish' (Figure 1.b).

The third, there is experiment about fish and polluted water. The objective of the experiment is students will be able to analyze the impact of water pollution to the fish. First, student watch the video about water pollution, then they answer some questions. Then, students prepare tools and materials, they put the clean water, dishes soap water, detergent water into a beaker glass and put one fish on each beaker glass. Last, they will identify what happen to the fish on each beaker glass, the data observation is noted in table 1. From this experiment, student can learn about the impact of water pollution affect the environment.

Table 1. Data Observation from students' worksheet

Treatment	3 minutes	7 minutes
Fish in the clean water	Normal and active	Normal and active
Fish in the dishes water	Normal and pale	weak
Fish in the detergent soap water	Active and tying to breath	The fish's gills look bloody

The fifth, there is brainstorming about innovation on how is the prevention the harmful effect of toxic subtance to water environment. They skecth the design and in the sixth meeting, student make their innovation on making water filter. The final activitiy is evaluation, given an exam about food chain, the flow of energy, water pollution and prevention. The total average results from the students' cognitive test about the material show a score of 90.

DISCUSSION

A unifying framework for peace and prosperity for people and the planet, both now and in the future, is provided by the 2030 Agenda for Sustainable Development, which was accepted by all United Nations Member States in 2015 (Giller et al., 2018). They understand that combating poverty and other forms of deprivation requires policies that enhance health and education, lessen inequality, promote economic growth, combat climate change, and fight to protect our

oceans and forests. The 17 Sustainable Development Goals (SDGs), an urgent call to action for all nations—developed and developing—in a global partnership, are at the center of it (Nash et al., 2020). There are six components to effective sustainable development education, according to Sustainable Development (UNESCO, 2009). Establishing partnerships to support sustainable development, developing capacity both inside and outside the classroom, and enhancing the teaching and learning process are some of them (Hamidov et al., 2018). Others include identifying common denominators for education for sustainable development, taking responsibility for contributing to sustainability, making education more relevant and meaningful to strengthen the link between school and society, and making education more relevant and meaningful.

For the purpose of transferring the necessary knowledge and abilities, the education sector is crucial (Nasibulina, 2015). The following skills were listed by teachers as being intended to be developed in elementary school students by ESD activities: thinking power, expressiveness, discerning power, multi-aspect thinking, thoughtfulness, cooperativeness, and respect for nature. The inclusion of sustainable development activities in elementary schools was said to have benefited the schools by strengthening ties with the neighborhood, increasing hands-on activities, raising teacher awareness, enhancing the quality of instruction, and enhancing student academic motivation and aptitude. The lack of instructor excitement, lack of financing for events, lack of time, continuity of activities, and evaluation-related worries were obstacles to success. From activities, the students can exercise the thinking power, expressiveness, discerning power, multi-aspect thinking, thoughtfulness, cooperativeness, and respect for nature.

CONCLUSION

Based on encouraging knowledge and life skills regarding the Sustainable Development Goals (SDGs) and making connections in education to primary school students depends heavily on the learning process from early awareness of the SDGs. Students can learn about environmental issue directly. Twenty-two students did the exercise, and the average score is 85,00. This shows that the learning process may teach students about the water pollution while also challenging their critical thinking abilities. although it still needs to be developed.Students were motivated to study science by participating in STEM activities on the water pollution. These activities used inexpensive materials and STEM studies to teach these concepts. In addition to learning the two subjects that are covered in the curriculum, students can also indirectly learn about technology, and engineering, where they can discover how polluted water can be filtered using a water filter. Activities and educational procedures were enjoyable and consistently inspire students to study and exercise independent thought. Students are familiar with the materials used to arrange the media. They can utilize used things and look for them in their daily life. Students' confidence to evaluate and arrange the water filter. Independent problem-solving skills relating to energy safety, energy resiliency, and efficiency are taught to students.

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