

The Assistance of Sukosari Bandongan Elementary School Teachers through STEM Education as a Provision for Learning Innovation

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ABSTRACT

Background. This community service program is encouraged by the need for partners, which is the absence of specific activities related to the development of science and technology. Therefore, through the introduction of STEM (science, technology, engineering, and mathematics) in the learning, it is expected that this program can provide a lighter for the Sukosari Bandongan Elementary School teachers. STEM forms quality human resources to reason, think critically, logically, and systematically so that later they can be useful in facing global challenges and solving problems in everyday life.

Purpose. This program aims to provide teachers with learning innovations through STEM education.

Method. The activity consists of training in making simple products from the surrounding environment which can later be used as learning media. The training is carried out using lecture, discussion, practice, and mentoring methods.

Results. The expected output is an increase in basic knowledge, especially in the field of science and technology which is manifested in simple STEM-based products. There are also some other products like training modules, posters, and publications of service results on social media.

Conclusion. STEM education is a form of assistance to Sukosari elementary school teachers in improving learning innovation. The teachers need assistance to explore learning materials that can be integrated with STEM. They have very good motivation in practicing simple STEM-based tools. This can be seen from those who actively participate in the training sessions, practice properly, and ask some questions about some matters they do not yet clearly understand. The created simple products can be simple demonstration examples in a STEM-nuanced learning.

KEYWORDS

Education, STEM, Learning

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INTRODUCTION

Law Number 6 of 2014 concerning Villages clearly stated that developmental stages should be carried out in a participatory manner, including at the village level (Gordon dkk., 2020; Karras dkk., 2019). The villages need to be developed well, starting from planning, budgeting, implementation, to monitoring and evaluation (Cao dkk., 2020; Shorten & Khoshgoftaar, 2019; Tang dkk., 2020).

The development can also involve cooperation among villages or other elements. This developmental process involves other parties because the village cannot implement the programs alone, either due to limited funds or time. Based on the Village Medium-Term Development Plan (*RPJMDes*) of Sukosari Village, Bandongan Sub-district, Magelang Regency for 2020-2026, several programs aim to improve and empower both natural and human resources (Van Doremalen dkk., 2020). One of these programs is in the basic education and technological aspect. The Sukosari Village community is expected to be able to improve their knowledge and optimize their roles for mutual progress.

One of the most urgent needs concerning basic education and technology is access ease. Therefore, the introduction of the STEM (science, technology, engineering, and mathematics) program, is expected to provide light for the people of Sukosari Village (Wu & McGoogan, 2020). STEM forms human resources who can reason and think critically, logically, and systematically so that later they can be useful in facing global challenges and solving problems in everyday life. STEM has the potential to train anal skills in problem-solving through a project that is integrated with one or several other disciplines. STEM is currently alternative learning that can build a generation that can face 21st-century challenges. In the current modern era, all society elements are required to be responsive to progressive developments (Dong dkk., 2020; Paradis & Schliep, 2019). The introduction of the basics of STEM is one of the innovations in improving local people's insight in Sukosari Village. STEM education is a learning approach that applies between one or more STEM elements or also between other disciplines with one STEM element. This shows that STEM education is a curriculum that integrates some specific subjects (science, technology, engineering/applied, and mathematics) based on certain theme units and skills. There is no doubt that science and technology play a major role in the lifestyle of 21st-century people. The application of STEM in learning is expected to be able to encourage the students to design, develop, and utilize technology, hone their cognitive, manipulative, and affective skills, and apply their knowledge to solve daily life issues. The STEM learning approach can train the students regarding their cognitive, skills, and affective aspects, and they are not only taught about theories but also practices so that they can directly experience the learning process. Therefore, the STEM method is suitable for use in science learning.

The learning model used in the STEM approach is similar to the PBL (project-based learning) model, but there is a slight difference, where the STEM approach contains a test/evaluation stage.⁷ In the STEM learning approach, the students will learn through project-based learning. There is a process of thinking, designing, creating, and testing (Deng dkk., 2019; Harris dkk., 2020). After they create a project, the project will be tested whether it has been following what is expected or not. If it is not, it will be redesigned. This process is carried out because STEM learning emphasizes the engineering stage, but it still intersects with the scientific process (G. Chen dkk., 2020; T. Chen dkk., 2020). The engineering stage in question is designing an object, conducting a process, or creating a system that is tailored to human needs.

The researchers have found an essential problem from the observation field, i.e. there has been a teacher training program at Sukosari elementary school (Finn dkk., 2020; Shi dkk., 2020).

However, there is no specific stage that introduces specific aspects of science and technological development (Wang dkk., 2020). Thus, it is necessary to carry out further activities to assist with STEM education at Sukosari elementary school of Bandongan.

RESEARCH METHODOLOGY

The method applied in this research is the service-learning method. It is a teaching approach that combines academic goals and efforts to provide awareness in solving events or problems in the community directly. The service-learning approach consists of three stages, namely preparation, service, and reflection.

Preparation Stage

The preparation stage consists of the following activities:

- a. Internal coordination in the service team to share tasks and prepare training needs (materials, equipment, accommodation, and administrative matters).
- b. External coordination carried out with the Head of Sukosari Village in Magelang Regency and the headmaster of Sukosari elementary school to cooperate in preparing participants, providing training places, and drafting material concepts

Training Stage

- a. The training is divided into some phases: materials presentation, structured practices, and direct assistance.
- b. The first activity (before presenting the materials) is the opening of the service training.
- c. The materials presentation and assistance are held four times. Structured practice is carried out in conjunction with materials presentation. The activities are adjusted to the participants' needs to strengthen the existing materials. One practical activity carried out by the participants is making simple STEM-based products by utilizing materials taken from the surrounding environment (Grasselli dkk., 2020; Perkovic dkk., 2019). The service team leads and guides the mentoring process.

Reflection and Evaluation

There are some evaluations after the program ends

- a. Process Evaluation is carried out on the presenters and their materials at the end of the training. This is a reflection of the participants on what has been presented and how the presenters present the materials. Likewise, the service team evaluates participants' attendance, activities, and activeness in each training session.
- b. Product Evaluation; it is seen through the quantity and quality of the products prepared by participants in the mentoring process.
- c. Evaluation of Significance; this is done by screening a questionnaire (including partners' satisfaction measurement instrument) to identify the aspects of the meaningfulness of the training. Also, there are brainstorming and sharing sessions at the end of each activity.

RESULT AND DISCUSSION

The community service activities were carried out in four meetings. The consultation was held from July to September. Service activities were conducted from July 6 – August 25, 2021, at Sukosari Elementary School, Bandongan. The details of the activities are as displayed in Table 5.1.

Table 5.1 Community Partnership Program Activities (PKM)

No.	Date	Material
1	July 6, 2021	Equalizing perceptions of empowerment program

		through STEM education
2	July 13, 2021	Introduction to Basic STEM program
3	July 28, 2021	The practice of making simple STEM-based tools
4	August 25, 2021	Follow-up on making simple tools and activity reports

Each meeting ran smoothly and attracted participants’ enthusiasm. The participants were classroom and sports teachers. This training was carried out in the afternoon before school hours so that it does not interfere with teaching and learning activities. A series of community potential empowerment activities through STEM education was charged to three persons from the Student Partnership Program (PKM) team and involves some students in its technical implementation. Each speaker had good competence in their respective field.

Equalizing perceptions of empowerment program

The perceptions equalization was held on July 6, 2021, which was intended to build participants’ initial view of the program implemented by the PKM team from Universitas Tidar. It involved the headmaster, vice headmaster, teachers’ representative, and the PKM team. Besides equalizing perceptions, the PKM team also explored the learning atmosphere related to STEM. Based on this initial meeting review, the school was not used to including or giving innovative touch in STEM-related learning (Siegel dkk., 2019). The school teachers were interested in knowing more deeply about STEM and its simple applications for the students in learning.

Introduction to Basic STEM

The second meeting was held online on July 13, 2021. This was due to the increasing Covid-19 pandemic cases Magelang area. The materials were presented by the PKM Team through Google meet with STEM Basic Introduction material. They were given information about STEM and examples of STEM activities. However, several participants could not participate in full due to a weak internet connection.



Figure 1. Online training on Introduction to Basic STEM

Practice activities for making simple STEM-based tools

This session was attended by the teachers of Sukosari elementary school of Bandongan. It was not only attended by the PKM team but also assisted by college students as the models. After being given examples and instructions by the team, then the teachers were given the opportunities to practice the materials they have just got.

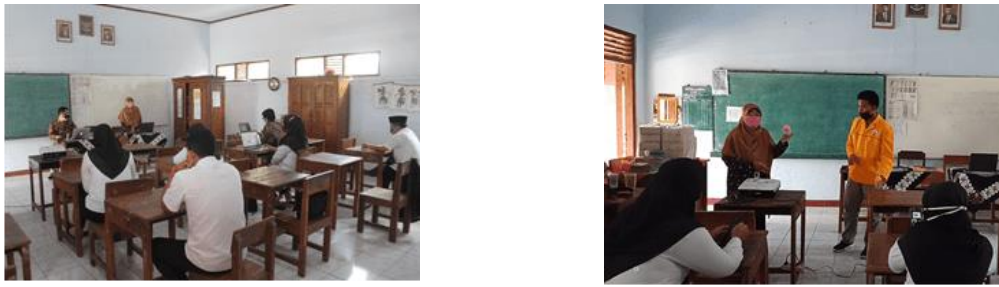


Figure 2. Assistance to Sukosari Elementary School Teachers

Some examples of simple experimental practices that had been carried out by the teachers were making a simple speaker device, an inflatable experiment, and a simple self-tie ice experiment. The references were taken from several STEM activity books and video experiment tutorials at the Indonesian science film festival.

1. Simple speaker device

- 1) Punch a hole in the middle of the tissue carton according to the size of the cell phone. For convenience, measure, and mark with a marker, and cut properly.
- 2) Punch a hole on one side of the two plastic cups the size of a paper towel roll.
- 3) Assemble all the materials one by one.
- 4) Put down the cell phone and turn on your favorite song

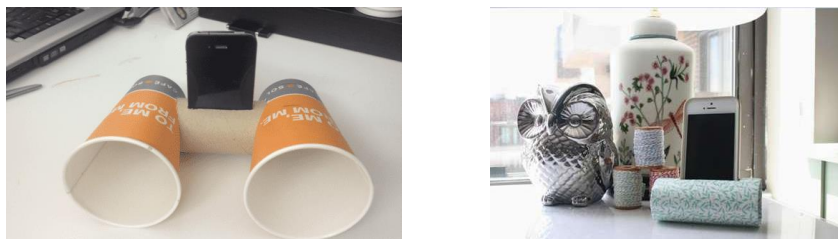


Figure 3. Example of a simple speaker product

2. Inflatable experiment

Steps

1. Put the balloon into the bottle.
2. Blow the balloon until the balloon is inflated.
3. Pierce the bottle with a needle to make a hole. Then blowback the balloon in the bottle. We can see that the balloon can inflate

Concept / Learning

Air moves just like water. Water moves from highlands to lowlands, while air moves from high to low pressure. Try practicing by inhaling and exhaling. When you inhale, air from outside enters the lungs, which means the air pressure outside is higher than the air pressure inside the lungs. Conversely (Siegel dkk., 2020), when the air is exhaled, the air from the lungs will come out to the environment outside the body.

Similar to the experiment of blowing a balloon in a bottle, when the balloon is blown, the air from the lungs moves into the balloon, and it means that the air from the bottle moves out into the environment. Perforating the bottle makes it having a path to move the air outward so that the balloon can inflate as expected.

3. Self-Iced Experiment

Steps

1. Prepare a container/glass, and then fill it with water
2. Put ice cubes in a glass/container until they float above the water surface

3. Cut the thread sufficiently, and then lay it evenly on the surface of the ice. The thread should stick to the surface of the ice cube.
4. Next, put salt on top of the ice cubes that have been attached to the thread.
5. Wait a few moments, and lift the thread.

Concept / Learning

Salt is neutral (pH 7). It makes the ice sheet melt so that a layer of water appears on it. Ice from the inside will rise, and make the layer of water freeze. The thread will be blocked by a layer of frozen water, so it can be lifted without being tied (an interesting fact is that in snowy countries, the salt is used to melt frozen roads). If you want to repeat the experiment, don't forget to replace the water that had been used.

Follow-up activities for making simple tools

This follow-up is in the form of reports from the teachers who have tried to apply simple tools to be conveyed to their colleagues or practiced with the students in learning.

Reflection

The reflection is held after the mentoring program. It aims to get feedback from Sukosari elementary school teachers to the service team. This is an effort to improve and enhance the quality of the next program. The data obtained from the questionnaire cover some aspects such as the delivery of materials during the session, increasing understanding of the introduction of basic STEM, and the usefulness of the program.

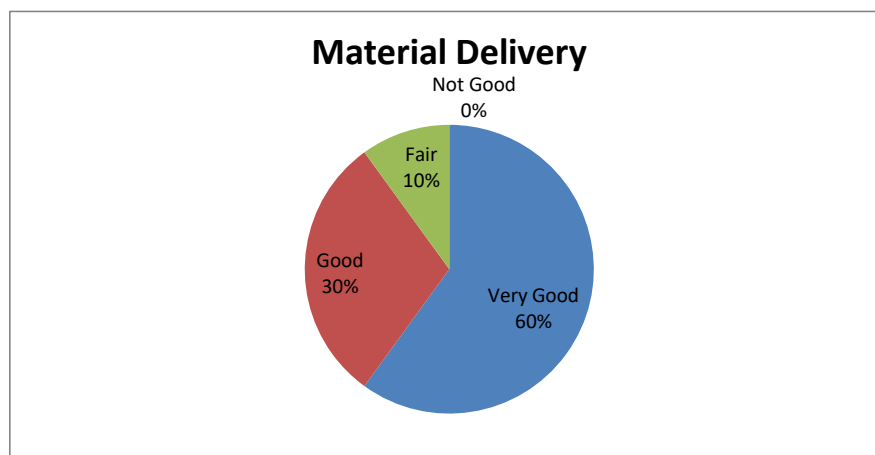


Figure 4 Respondents' responses regarding the delivery of materials in mentoring

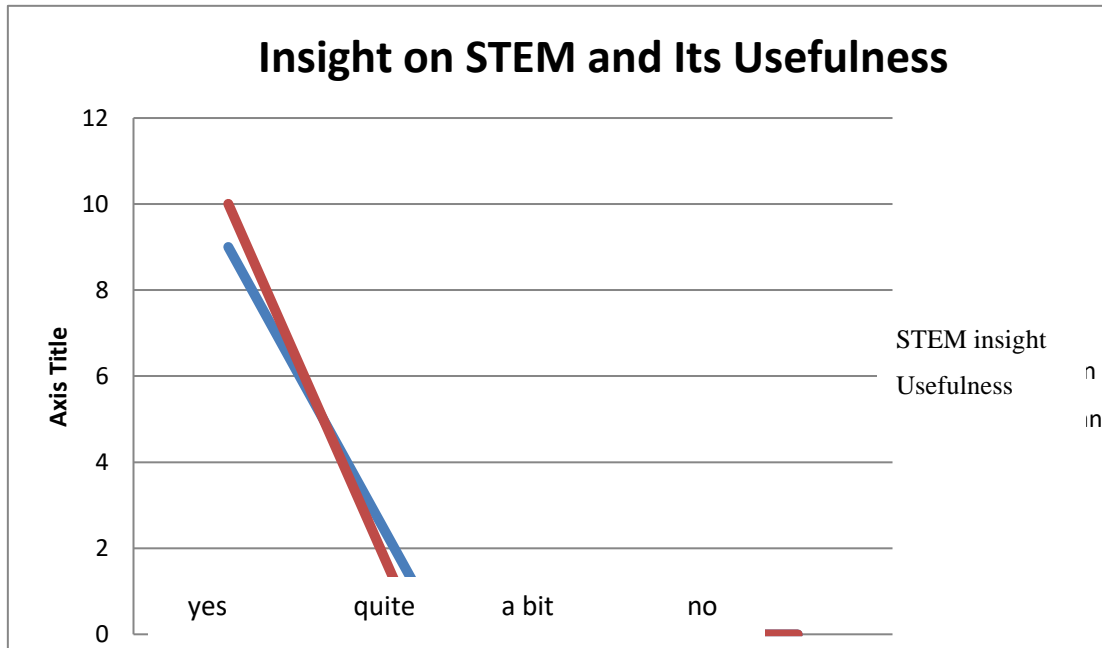


Figure 5 Respondents' responses regarding the addition of insight into STEM

RESULT AND DISCUSSION

The results of the reflection of the Sukosari Elementary School teachers' mentoring process indicate that the teachers get additional insight and information about STEM so that STEM can be the teachers' provision in making innovations for their learning. The implementation of mentoring for the Sukosari elementary school teachers starts with an introduction to STEM (science, technology, engineering, and mathematics) (Siegel dkk., 2021). STEM is an approach that integrates and links several subjects to create problem-based learning in everyday life so that it can train the students to implement the knowledge they obtain in class with real phenomena that occur in the world.⁹ The materials presentation is held and adjusted with the time available and suits the needs and scope. The session is then followed by simple practices. The team assists the teachers to explore STEM as a means of learning innovation (Miller dkk., 2019; Onder dkk., 2020). This method goes hand in hand with the theoretical materials so that the practical results can be directly reflected.

The output of this service program is some simple products created by the Sukosari Elementary School teachers and a training module for holding STEM activities. The outcomes are expected to strengthen the teachers' and service team's spirit to continue to explore STEM creative ideas so that they can become a collection of innovations in learning (Siegel dkk., 2022). Some teachers who have implemented this approach also stated that STEM can improve their students' interest in learning. This is in line with findings from Kelley who stated that STEM is an approach to teaching two or more STEM subjects related to practice authentically so that it can attract students' attention and enthusiasm in learning.

CONCLUSION

STEM education is a form of assistance to Sukosari elementary school teachers in improving learning innovation. The teachers need assistance to explore learning materials that can be integrated with STEM. They have very good motivation in practicing simple STEM-based tools. This can be seen from those who actively participate in the training sessions, practice properly, and

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