Students' Perception of Home-STEM Project Kits for Science Learning in Junior High School

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***Abstract*—In general, our research aims to produce Kits for STEM at Home Project for Science subjects in Junior High Schools through several stages of research and development activities. In this paper, we report the results of the field trial of the STEM kit at home, specifically on the perception aspect of the STEM project. The topic we chose was Simple Machines which was taught to eighth grade students of SMP. Therefore, the specific purpose of this study was to obtain feedback from students on the use of the Home STEM Project kit in science learning on the topic of Simple Machines. A total of 33 students in one junior high school in Pekanbaru, Indonesia have participated as respondents in this study. Respondents gave their opinions through questionnaires after the Simple Machines learning was completed. Descriptive data analysis showed that almost all students showed a positive perception of the use of the Simple Machines STEM Project Kit in science learning. These positive perceptions include usefulness, convenience, attractiveness, flexibility, and relevance.**

Keywords—STEM Project Kit, Simple Machines, Junior High School Science Learning, Student Perception.

I. INTRODUCTION

The Covid-19 pandemic that hit almost all countries in the world including Indonesia caused the education process to experience significant disruptions. The Covid-19 pandemic requires schools to be closed for an uncertain period of time. This situation is very detrimental to students and educators [1]. Educators have difficulty in applying hands on activities in their learning. This problem is deeply felt by science learning. Learning science, especially for junior high school education, really needs direct scientific activities. This problem causes experiments or laboratory practices to not be carried out properly.

Science learning really needs hands on activity because science contains ways to find out scientific knowledge. The results of the study of Ergul, et al [2] found that hands-on activity is very necessary for students in inquiry-based teaching because it will improve scientific attitudes and science process skills and make a positive contribution to science academic achievement, scientific literacy, and attitudes towards science. Meanwhile, Trumper [3] said that science learning is not possible without practical work or field work.

In overcoming obstacles in the form of limitations of teachers and students interacting directly in the school learning environment, online learning is an alternative choice. Preparing for effective online learning is not an easy job. Educators must be creative in choosing strategies and make good preparations [1]. Online science learning is only focused on delivering scientific theory or knowledge. There are also creative teachers who use experimental videos or virtual labs to provide indirect practical experiences. However, these two methods do not provide complete scientific skills because students do not interact directly with the equipment and materials used during the experiment.

On the other hand, science learning must try to improve its quality along with the times. The quality of science learning is indicated by scientific literacy, critical thinking skills, and creative thinking skills. PISA measurements in 2018 and previous periods show that the science achievements of students in our country are still not encouraging. This means that the scientific literacy, critical thinking skills, and creative thinking skills of the students are still low and an effort is needed to improve them.

One strategy to build these abilities is to use a multidisciplinary learning approach such as the STEM approach. Many studies show that STEM education has a significant influence in improving critical thinking, creative, and scientific literacy skills. STEM education can improve higher order thinking skills in the problem solving process and in solving problems of daily life [4].

STEM is a multidisciplinary approach that integrates Science, Engineering, Technology, and Mathematics which are generally embedded in science learning. The integration of disciplines in STEM is realized in the form of a STEM project. STEM projects in science learning are a concrete form of the application of science concepts. With STEM, students can see that science cannot stand alone and science requires disciplines in producing technological products and even in marketing products. STEM education is defined as an approach to develop knowledge, skills, and beliefs about STEM subjects with an interdisciplinary approach [5].

In an increasingly advanced era like today, the implementation of science learning applying learning with a STEM approach is one alternative, because it can train students in applying their knowledge to create problem-solving designs related to the environment through the use of technology. The relationship between science and technology as well as other sciences in science learning cannot be separated. STEM is a discipline that is closely related to each other. Science requires mathematics to

process data, while technology and engineering are applications of science [6].

Efforts to improve STEM education have been increasing for more than two decades [7]. Global concern for improvements in STEM education is increasing as a skilled workforce, STEM is critical to meeting economic and sustainability challenges in the 21st Century [8]. Although it is recognized that the STEM approach is indispensable in preparing the younger generation to be able to compete in the 21st century job market, but, for our science educators, STEM still seems new and unfamiliar.

STEM development in Indonesia is urgently needed, although it is not easy. It takes at least a decade to develop STEM education [9,10]. The contribution of science teachers is the main key to support the development of STEM in the field of education, especially in the field of science. Science teachers must have a strong enthusiasm to start integrating science learning with other STEM subjects [11].

Project-based science learning with the STEM approach is often misunderstood as learning that requires relatively expensive costs. In fact, students' STEM projects can be started from simple projects using used tools and materials or relatively inexpensive materials. Another assumption is that STEM learning takes a lot of time while the hours of science lessons in class are limited. To overcome this time problem, the researcher proposes that science educators can design STEM projects that students can work on at home. Many studies show that hands on science activities at home have a significant effect on improving science learning outcomes. These studies include: [12,13,14]. Zulirfan, et al [14] found that experimental activities at home can be carried out by students and have a positive impact on scientific achievement and attitudes.

To answer the challenge of improving the quality of science learning during the pandemic and efforts to facilitate the implementation of the STEM approach, the researchers sought to develop STEM Project Kits and Modules that could be used for science learning at the junior high school level through research and development activities. In this paper, we report one stage of R & D, namely a field trial using the STEM at Home Projects' Kits. The chosen science learning topic is Simple Machines which are taught in 8th grade of junior high school. Therefore, this study specifically aims to obtain feedback from students on the use of the STEM at Home Projects' Kits on the topic of Simple Machines. The research questions that will be answered are:

1. Where do students generally work on their project assignments at home?
2. Who help students with their STEM projects at home?
3. What is the student's perception of the use of the STEM at Home Projects' Kits in learning Simple Machines in Junior High School?

II. METHODS

The trial of using our Home STEM Projects' Kit was carried out at SMP Negeri 21 Pekanbaru. A total of 33 students of class VIII became respondents in this study. Science learning online with the STEM approach was carried out for 5 meetings for the topic of Simple Machines. Sub-topics in Simple Machines include: Work and Power, Levers, Inclined Planes, Pulleys, and Axle Wheels. There are 4 simple project assignments that students have to do at home.

To find out feedback from students, we provided a questionnaire on students' perceptions of learning with the STEM Project Kit. The instrument which consists of 12 items identifies students' perceptions of the aspects of usefulness, convenience, attractiveness, flexibility, and relevance. Through the questionnaire, we also wanted to find out which places students prefer to work on their STEM projects, and who helps them in working on these projects. Student perception data were analyzed descriptively to obtain an overview of the various aspects of perception that have been described.

III. RESULT AND DISCUSSION

Through Simple Machines STEM project-based learning, as many as 33 respondents have had hands-on experience using the STEM project kit in making simple projects that are relevant to simple machines. Four simple STEM projects have been done by students during the lesson. The project work was carried out by the respondents in their respective homes. Three projects are in the form of simple models, namely: a wheelbarrow model, a seaport pontoon model, and a container lifter model. Meanwhile, 1 project is in the form of a design for transportation across the river that utilizes pulleys. The design is drawn on paper on the student project worksheet. With this experience, respondents have provided feedback through questionnaires on the use of the Home STEM Project Kit in science learning. Descriptive data analysis provides the following information.

1) Where do students work on their STEM project assignments?

The Simple Machines STEM project kit has been designed for student project projects at home. The survey results show that there are several places at home that students use as places to work on their STEM projects, as shown in Fig. 1. Fig. 1 shows that the respondent's favorite place at home to work on student projects is the living room. In addition to the living room, other places chosen by a small number of respondents to work on their STEM projects are in their yard, bedroom, and on the terrace of their house.

1) Who is helping with their project assignments?

Although the project kit has been designed to be done by students at home, because project-based learning is rarely implemented in science learning, the survey results show that some respondents still need the help of their parents, family, or friends in working on their STEM projects, as shown by Fig. 2.

Interviews were conducted with several respondents who admitted that their STEM projects were assisted by others. From the interview, information was obtained that the involvement of parents, other families, or friends in working on their project was only a small help on how to assemble. However, most of the process of working on their STEM projects is still done independently as shown by Fig. 2.

2) What is the perception of junior high school students on the use of STEM projects in science learning?

Based on the questionnaire, we have identified respondents' perceptions of the STEM at Home Kit developed for Simple Plane learning. Perception is reviewed

on five aspects, namely: ease of use, attractiveness, flexibility, usefulness, and relevance. Respondents' perceptions are shown in Table I.

Table I shows that the five aspects of perception are represented by each of the 2 statement items. Students' perceptions are indicated by opinions stating strongly agree, agree, disagree, and disagree with the statements given. The data in Table I shows that the opinions of respondents vary.

In the aspect of convenience, most respondents (87.88%) agreed and strongly agreed that the Simple Machines STEM Project Kit was easy to assemble in their homes. Only 12, 12% of respondents stated that they did not agree or disagree. This means that most respondents feel that the Simple Machines STEM Project Kit is easy to use at home, while only a small number of respondents find it difficult. In addition, almost all respondents agree that with STEM project-based learning, science concepts are easier to understand. Only a small number of respondents disagree with that.

In general, on the aspect of convenience, respondents have concluded that the Home STEM Project Kit for the Simple Plane topic is easy to use and makes it easier for businesses to understand science concepts. This is in accordance with the results of a study by E. Baran, et al [15] obtained that STEM activities carried out by students could be carried out easily and the simulations provided could be run safely, students work in collaborative groups with simple and easy-to-find tools and materials. In addition, according to Wijayanti [16], it is stated that learning science with a STEM approach has the potential to provide more meaningful learning.

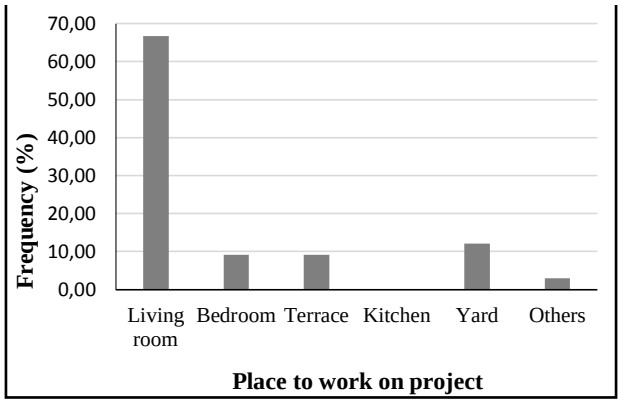

Fig. 1. Where to work on respondents' STEM projects at home.

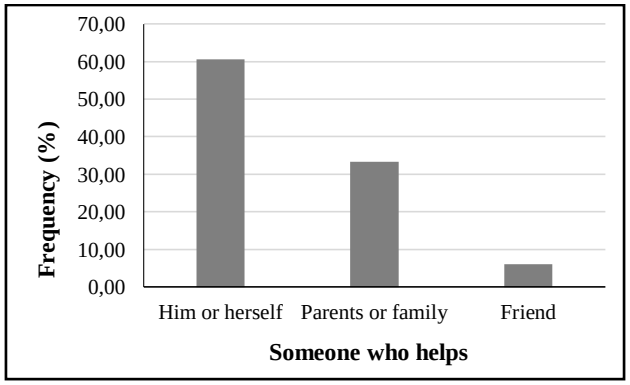

Fig. 2. Someone who helps students STEM projects at home.

TABLE I. RESPONDENTS' PERCEPTIONS OF THE USE OF THE HOME STEM PROJECT KIT

Aspects	Items	Respondent's perception & percentage			
		Strongly Agree	*Agree*	*Not so agree*	*Not agree*
Easy in use	Easy in assembling at home	27.27	60.61	9.09	3.03
	Science made easier	45.45	48.48	6.06	0.00
Interest	STEM project, interesting	30.30	63.64	6.06	0.00
	Desire to make another project	24.24	54.55	18.18	3.03
Flexibility	Can use other materials	3.03	57.58	36.36	3.03
	Can create projects in other ways	9.09	15.15	57.58	18.18
Benefits	Science lessons become useful	57.58	39.39	3.03	0.00
	Give enthusiasm to learn science better	51.52	39.39	6.06	3.03
Relevance	Relevant to the concept being studied	60.61	24.24	12.12	3.03
	Science concepts are better understood	33.33	54.55	12.12	0.00

On the aspect of interest, only a small percentage (6.06%) of respondents were less interested in learning this STEM project, while most of the others expressed interest in learning using STEM projects. In this aspect, we also identified that 90.91% of respondents had a desire to make other STEM projects and the rest, felt less and did not want to make other STEM projects in science learning.

In general, it can be concluded that respondents enjoy learning with STEM projects and are willing to make other STEM projects. The desire of students to make other projects shows that the attitude of creative thinking has grown in most of the respondents. This is in accordance with the results of the study that higher-order thinking skills such as problem solving, critical thinking, and creative thinking are the main targets in STEM learning [17,18]. In addition, based on the results of a study by Ariani, et al [19], it was found that the students' creative thinking ability on the Solubility material increased with good criteria by applying the Problem Based Learning learning model with the STEM approach.

We have also identified respondents' perceptions of the flexibility of the Simple Machines Home STEM Project Kit that has been developed. Most of the respondents agreed that the STEM project kit that had been used could be replaced with other materials. Some other respondents stated that the kit cannot be replaced with other materials. Meanwhile, most

of the respondents stated that the kit could not produce other forms of product. They assume that the kit can only be used to make projects according to the directions in the student activity sheet. Only some respondents (24.24%) think that kits can produce other forms of projects. These results indicate that respondents believe that the kit is only useful for predetermined STEM projects and how to make projects according to the instructions in the student activity sheet. In fact, the STEM project kit can be used for other relevant projects and project work can be done freely, not necessarily according to the instructions given. This shows that respondents are not familiar with STEM project-based learning so that some of their creative thinking skills have not emerged. This is in accordance with the opinion of experts [20], which states that students who are accustomed to solving problems to a certain level rely on their thinking, then students' thinking skills will increase, and vice versa. STEM education is something that is still foreign to science teachers in some schools, teachers do not yet know the concept and implementation [10]. So that some schools are not familiar with the implementation of STEM.

In the aspect of usefulness, almost all respondents feel that through STEM project activities science learning becomes more useful. They also felt that learning with this STEM project gave them the enthusiasm to learn science better. However, there is a small percentage (9.09%) who do not agree with such an opinion. In general, it can be concluded that most respondents have a positive perception of the usefulness of the STEM projects they have worked on in science learning. This is in accordance with one of the goals of STEM learning, namely to make learning useful for students. Teachers who can teach STEM well will be very useful for students in facing a "multidisciplinary" world so that students will be better trained in solving the problems they will face [21]. In addition, teaching through an integrated approach can increase interest in STEM content, especially if it is taught to students from an early age [22].

One aspect that is also quite important to identify is the opinion of respondents about the relevance of STEM projects to science learning materials. As many as 84.85% of respondents strongly agree and agree that learning science with the STEM project is relevant to the science concept being studied. The rest, they expressed less agree and disagree on it. In addition, most of the respondents stated that with this STEM project learning, science concepts were easier to master. This fact leads to the conclusion that respondents have a positive perception of the use of STEM projects in science learning in terms of the relevance of learning activities to the concept of science to be achieved. This means that STEM project-based learning does not merely produce a product in the form of a model or prototype, but science concepts can also be mastered well, because of good mastery of science concepts, supported by adequate mathematical abilities, skilled in using information technology, and skills. engineering will produce better STEM products. This is in accordance with the four disciplines that are integrated in the STEM approach, namely science, technology, engineering, and mathematics [23].

IV. Conclusion

Project-based learning using the STEM at Home Project Kit on the topic of Simple Machines has been implemented by respondents in online junior high school science learning. Most respondents like the living room as a place to work on their STEM projects. Most of the respondents work on their projects independently, while a small number need a little help from other people such as parents, family, and friends. Respondents gave a positive perception of almost all aspects of perception identified. Respondents felt that the Simple Machines STEM Kit was easy to use and provided the attraction of learning science. With this STEM project, they feel that learning science is beneficial for them and is relevant to their efforts to master science concepts. However, some respondents still have the perception that the Simple Machines STEM Kit is less flexible. This is understandable, considering that STEM project-based science learning has never been experienced by respondents in this study, which causes the ability to think creatively has not been developed properly.

In accordance with the results of this study, we recommend that STEM at Home be one of the solutions in overcoming the problem of limitations or lack of direct interaction between teachers and students in the classroom caused by pandemics, natural disasters, and other obstacles. In implementing this strategy, science educators need to consider several things including: the project must be simple, the materials used are cheap and easy to obtain. In addition, this strategy requires parental support.

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