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Workshop Learning Tools for STEAM Classes to Enhance Learning Process

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Abstract: *Online learning tools are in demand these days since the COVID-19 pandemic, which forces everyone, except for some jobs, to work from home. In this community service event, we use three online tools: Nearpod, PhET, and Desmos. Nearpod is a tool learning which combines learning from videos and simulations, the interactivity of a quiz, and a reward-based learning system. PhET is a collection of lots of STEAM simulations, including some topics in Chemistry and Physics. Desmos is an extension of an online graphing calculator, which also has a quiz feature. We introduce these tools to students in East Jakarta's SMP Negeri 174 Jakarta, which is a public junior high school. As a result, the students are now familiar with online tools that can enhance their experience in learning STEAM topics.*

Introduction

The term STEAM stands for Science, Technology, Engineering, Arts and Math (Colucci-Gray et al., 2019; Perignat & Katz-Buonincontro, 2019). The STEAM education approach aims to equip students with an interdisciplinary and well-rounded education, which prepares them for the 21st-century workforce (McGunagle & Zizka, 2020; Utomo et al., 2020; Wang et al., 2020). STEAM education is essential in helping students develop critical thinking, problem-solving and creative skills (Anggraeni & Suratno, 2021; Rahmawati et al., 2019). The effectiveness of STEAM education can be further enhanced by integrating learning tools designed to facilitate the learning process (Dasgupta et al., 2019; Krasny et al., 2018; Ozkan & Umdu Topsakal, 2021).

Previous research shows that the use of technology in education can significantly improve student engagement, motivation and learning outcomes (Dunn & Kennedy, 2019; Yu et al., 2021). The use of Nearpod (https://nearpod.com/) in a chemistry course increases student engagement and improves learning outcomes (Buttrey, 2021; Putra et al., 2021). Similarly, the

use of Desmos (https://www.desmos.com/) in a high school math class increased students' independent exploration on math concepts (Gulli, 2021; Mungan, 2021; TLS & Herman, 2020). Finally, another study found that the use of PhET simulation (https://phet.colorado.edu/) in a physics course improved students' engagement and understanding of scientific concepts. The study also found that students were more likely to explore scientific phenomena when using PhET simulations (Ndihokubwayo et al., 2020; Yunzal, Jr. & Casinillo, 2020).

Despite the positive findings mentioned above, there hasn't been much research on the use of technology in education to improve STEAM classes at SMP Negeri 174 (SMPN 174) Jakarta. Note that it is possible that the effectiveness of this method may vary depending on the subject, the type of students, and other related educational aspects. Therefore, it is essential to conduct more research to ascertain the efficacy of these educational resources in the context of SMPN 174. More specifically, it is imperative to carry out more studies to see the impact from using three learning tools, i.e., Nearpod, Desmos, and PhET, on student learning outcomes in SMPN 174.

In this article, we investigate the effectiveness of three learning tools (Nearpod, Desmos, and PhET) in improving learning outcomes in STEAM classes at SMPN 174. This study aims to explore the impact of some features in these learning tools, e.g., virtual simulations, educational games, and interactive videos, on students' engagement in learning and academic performance.

Methodology

On Tuesday, March 7, 2023 an event was held at SMPN 174 Jakarta. The day began with preparations for equipment, refreshments, and transportation. They departed from Sampoerna Campus to SMPN 174 Jakarta. Upon arrival, preparations for the room and presentation equipment was done. Registration was done by recording attendance through a Google Form, a pre-test was given through Nearpod, and snacks were distributed.

The event was officially opened with remarks from the Principal of SMPN 174 and the Dean of FAS SU. The event was facilitated by an MC who was a student. The first presentation was delivered by Mr. Lukman Baihaqi on Nearpod. After a short break, Mr. Iwan Setiawan presented on PhET, followed by Ms. Tika Lestari on Desmos. The post-test was then given through Nearpod, and the best scores from the post-test and quiz for Desmos, PhET, and Nearpod were announced by Mr. Ilham Prasetyo and Mr. Lukman Baihaqi.

The event ended with closing remarks and the distribution of questionnaires and souvenirs from Sampoerna University to the Principal of SMPN 174. Mr. Ilham Prasetyo and Mr. Lukman Baihaqi helped facilitate this.

The following subsections describes the presentation material given on D-Day. These are divided into 3 parts, i.e. Nearpod, PhET, and Desmos.

Nearpod

Nearpod is an online teaching platform that allows teachers to create interactive and engaging lessons. The platform has gained popularity in recent years due to its innovative features and benefits that enhance the learning experience. Nearpod offers a range of features that make it a valuable tool for teachers. One of the most significant features is the ability to create interactive presentations. The platform allows teachers to add various multimedia elements to their lessons, including images, videos, and audio recordings. Teachers can also include interactive quizzes, polls, and open-ended questions to assess student understanding in real-time.

Another feature of Nearpod is the ability to provide students with a personalized learning experience. Teachers can assign lessons to individual students or groups of students, depending on their needs and abilities. The platform also offers real-time feedback and analytics, allowing teachers to monitor student progress and adjust their teaching strategies accordingly. Nearpod offers several functions that support the teaching and learning process. One of the most significant functions is the ability to create and deliver live lessons. Teachers can deliver lessons in real-time, allowing interactive discussions and feedback from students. This function is particularly useful for distance or hybrid learning environments, as it allows teachers to replicate the classroom experience.

To prepare for an earthquake, it is important to have a plan. This includes creating an emergency kit with enough food, water and supplies to last at least 72 hours. It is also important to secure heavy furniture and equipment so that they do not fall during an earthquake. During an earthquake, stay calm and take shelter under sturdy furniture or in interior walls. After the earthquake, check yourself and others for injuries and avoid entering damaged buildings. Check for damage to gas, water and electricity lines before turning them back on. Be prepared for potential aftershocks by staying alert and following instructions from local authorities.

PhET Colorado

PhET is a series of interactive simulations designed for use in science and math education. They were developed by a team of educators and researchers at the University of Colorado Boulder, and are freely available to educators and students around the world. PhET simulations have many benefits for science and math education. First, they help make abstract concepts more concrete and easy to understand. For example, simulations that allow students

to explore the behavior of gases can help them understand the relationship between temperature, pressure, and volume more engagingly and interactively than traditional lectures or reading a textbook. There are 5 main subjects that one can explore in PhET, i.e., Physics, Chemistry, Math, Earth Science, and Biology.

PhET simulations allow students to explore scientific phenomena in a safe and controlled environment. For example, students can simulate chemical reactions without the risk of dangerous chemicals or explosions. This allows students to explore scientific concepts engagingly and safely. Finally, PhET simulations allow for individualized and self-paced learning. Students can work through the simulations at their own pace, and they can repeat the simulations as many times as necessary to fully understand the concepts. This allows for a more personalized and effective learning experience.

Desmos

Desmos is a free graphing and teaching tool for math. This tool can be used to learn geometry in a fun and interactive way. Not only that, but it also can help students with matrix operations. Before the event, we gave students a pre-test that include a set of 4 equations whose plots are unknown. Students are requested to draw these plots. In the presentation about Desmos, we include a quiz that utilize many features of Desmos, e.g., graphing calculator, matrix operations, and geometry tool. The last one is very interesting because it introduces mathematical concepts such as what an arc is. It also provides some hard-to-imagine jargons such as perpendicular bisector, which cannot be explained except by drawing. Another interesting feature is called Transform, which consists of math concepts, e.g. reflection and rotation, that are also deeply related to theoretical physics. The students' response to the introduction of Desmos in STEAM learning includes they got an enthusiasm and the realization that the tool is very helpful and plays an important role in learning process. The next steps is that the results of the material presented are tested in a post-test, which is intended to assess students' understanding of the given materila.

Result

To observe the impact of this community service, we provide a questionnarie that we gave to students. In the following passage, we show the results of the questionnaire. The questionnaire consists of 4 instruments:

1. Overall, how would you rate the activities organized today?
2. In your opinion, how useful is the material presented in today's activity?
3. What do you think of the speakers who presented today?

4. How likely are you to attend an event like this in the future?

These are answered by circling a number from a list of whole numbers 1, 2, 3, 4, and 5. The smallest number 1 denotes ordinary impression and the largest 5 denotes very good impression. The results from each question are shown in Figures 1-4 below.

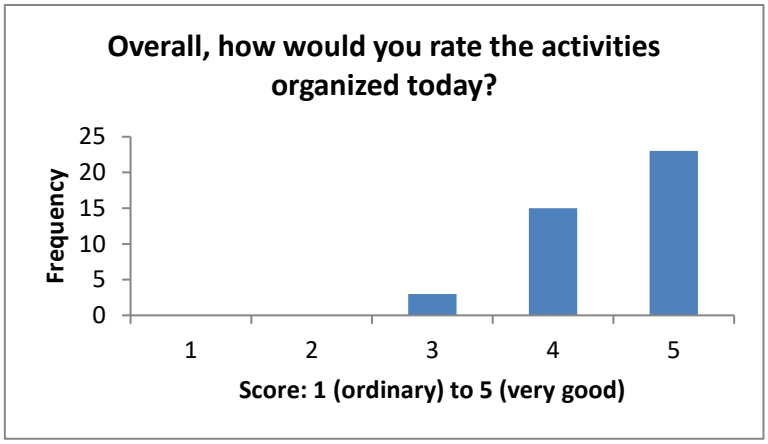

Figure 1. Result from question number 1.

Based on the result of the quisionaire as showed in Figure 1, they rate the activities organized in the score 5 and they also put a very good or 5 score about how useful is the material presented as shown in Figure 2.

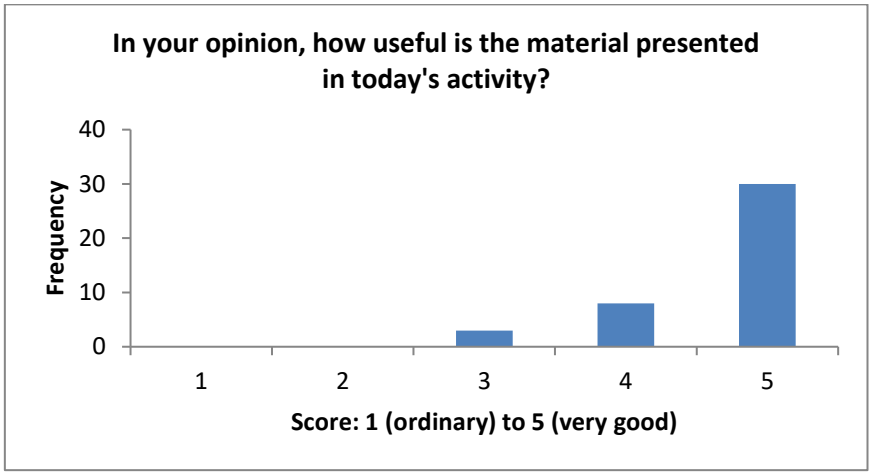

Figure 2. Result from question number 2.

The result for equation 3 shown in Figure 3, the audience's perception of the speakers' presentation is mainly very good. Lastly, the result from question 4 shown in Figure 4 show that most of the audience will attend similar events like this. However, the result for question 4 show a larger range of impression compared to the other questions 1-3, i.e., there are some respondents that score 1 or 2 to question 4.

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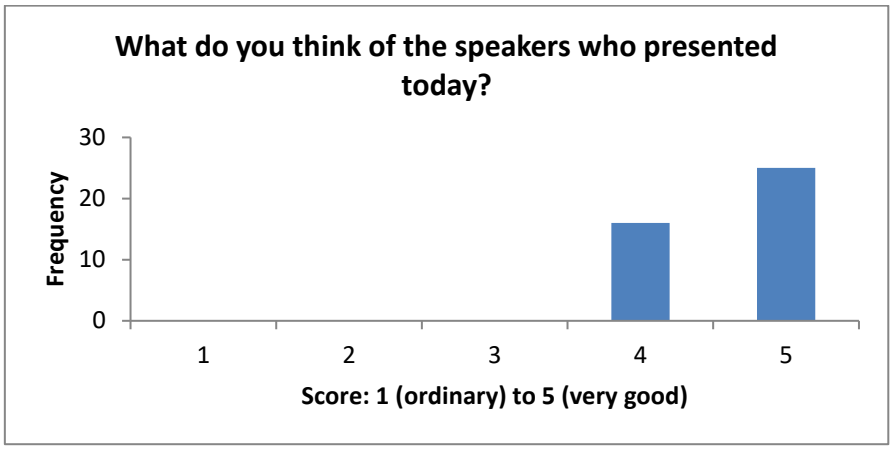

Figure 3. Result from question number 3.

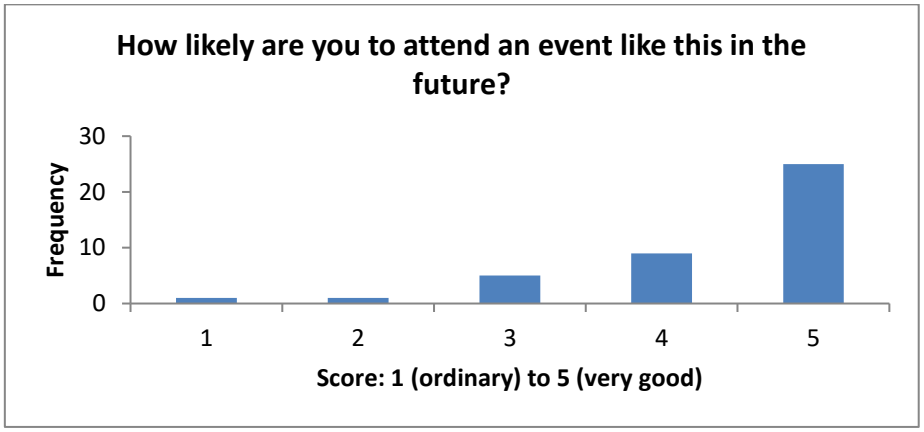

Figure 4. Result from question number 4.

The average and variance result from question 1 to 4 is, respectively, 4.49 ± 0.41, 4.66 ± 0.38, 4.61 ± 0.24, and 4.37 ± 0.94. Question number 3 then gives the least width of impression while question number 4 gives the largest width of impression. However, all questions are implying a good impression. Therefore, most students rate the event as good, the material presented was useful, the speakers were informative, and most of them will attend a similar event in the future.

Discussion

The event was largely successful. At the beginning of the event, we start with a speech from the school representative and the SU representative, shown in Figure 5 below.

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Figure 5. Seminar Opening

The first presentation was given by Mr. Lukman Baihaqi, shown in Figure 6. The topic is Nearpod, with an example about the earthquake as an example of a STEAM topic.

Figure 6. Nearpod presentation

The next presentation was given by Mr. Iwan Setiawan and Mr. Ilham Prasetyo about PhET, shown in Figures 7 and 8 below. Mr. Iwan Setiawan and Mr. Ilham Prasetyo each

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explained some simulators for chemistry and physics, respectively.

Figure 7. PhET presentation for chemistry

Figure 8. PhET presentation for physics

The last presentation was given by Ms. Tika Lestari about Desmos, shown in Figure 9.

Ms. Tika Lestari also held some quizzes which were responded to enthusiastically by SMPN 174's students, as shown in Figure 10. Some of them win the quizzes (Figure 11).

Figure 9. Desmos presentation

Figure 10. Students of SMPN 174 Jakarta

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Figure 11. Winners of the quizzes

After the last presentation, it is closed with lunch, merchandise giving from SU to SMPN 174, and taking a commemoration photo (Figure 12).

Figure 12. Commemoration photo

Conclusion

Online learning tools are in demand these days since the COVID-19 pandemic, which forces everyone, except for some jobs, work from home. In this community service event, we

use three online tools: (1) Nearpod, which is a tool of learning which combines learning from videos and simulations, the interactivity of a quiz, and a reward-based learning system; (2) PhET, which is a collection of lots of STEAM simulations, including some topics in Chemistry and Physics; (3) Desmos, which is an extension of online graphing calculator which has graphing tools and quiz feature. We introduce these tools through a series of presentations and quizzes to students in a public junior high school SMP Negeri 174 East Jakarta. As a result, the students are now familiar with online tools that can enhance their experience in learning STEAM topics. We hope that these online learning tools can enhance the active learning activities inside STEAM classes in SMPN 174 Jakarta.

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