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Identification of the Need for PhET Simulation-based Interactive Media for Learning in Vocational High Schools

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ABSTRAK

Proses pembelajaran yang efektif tidak bisa dilepaskan dari berbagai faktor pendukungnya, salah satu diantaranya adalah faktor penggunaan dan dukungan teknologi selama proses pembelajaran. Oleh karenanya riset ini bertujuan untuk mengidentifikasi kebutuhan media digital dalam format media interaktif untuk menunjang pembelajaran di sekolah menengah kejuruan. Metode penelitian ini termasuk dalam penelitian kuantitatif dengan jenis deskriptif, menggunakan Teknik pengumpulan data non tes berupa angket sebagai instrument peneltiiannya. Subjek riset ini merupakan siswa sekolah menengah kejuruan dengan jurusan Teknik instalasi tenaga listrik yang berjumlah 36 siswa. Teknik analisis data yang digunakan adalah deskriptif dengan melakukan konversi respons siswa menjadi bentuk persentase. Dari hasil riset, diperoleh informasi bahwa selama ini guru masih nyaman dengan metode ceramah dan diskusi, sementara dalam konteks pemanfaatan media pembelajaran, guru masih cenderung konsiste menggunakan modul cetak dan buku – buku materi yang dicetak. Sangat minim sekali pemanfaatan perangkat TIK oleh guru, padahal hampir 72,2% siswa telah mampu mengoperasikan computer dan cukup familiar dengan teknologi – teknologi digital oleh sebab itu melalui riset ini juga didapatkan informasi bahwa Sebagian besar siswa setuju dengan inovasi media pembelajaran berbasis TIK dalam format media interaktif untuk menunjang pembelajaran. Melalui penelitian diharapkan dapat memberikan wawasan baru terkait pentingnya media interaktif dan pentingnya melakukan identifikasi yang dibutuhkan siswa demi peningkatan kualitas pendidikan.

ABSTRACT

An effective learning process cannot be separated from various supporting factors, one of which is the use and support of technology during the learning process. Therefore, this research aims to identify the need for digital media in interactive media formats to support learning in vocational high schools. This research method is included in quantitative research with the type deskriptive, using non-test data collection techniques in the form of a questionnaire as the research instrument. The subjects of this research are vocational high school students majoring in electrical power installation engineering, totaling 36 students. The data analysis technique used is descriptive by converting student responses into percentages. From the research results, information was obtained that so far teachers are still comfortable with the lecture and discussion method, while in the context of using learning media, teachers still tend to consistently use printed modules and printed material books. The use of ICT tools by teachers is very minimal, even though almost 72.2% of students have been able to operate computers and are quite familiar with digital technologies. Through this research, information was also obtained that most students agree with the innovation of ICT-based learning media in the format interactive media to support learning which so far has very minimal application and integration of ICT. This research is expected to provide new insights regarding the importance of identifying what students need in order to improve the quality of education.

1. INTRODUCTION

Basic Electrical Engineering subjects aim to equip students with attitudes, knowledge, and skills (soft skills and hard skills), including, understanding business processes as a whole in the electricity industry, understanding the development of technology used and global issues in the electricity industry, understanding the profession and entrepreneurship (job-profile and technopreneur) as well as business opportunities in the electricity sector, understanding practical activities related to all work processes and technology applied in the electricity sector, understanding the application of Safety and Occupational Health, and Environment (K3LH) in the work environment, understand the basic theory of electricity and the types of materials used in electricity, understand hand tools and electrical work tools, understand measurement and testing using appropriate tools, understand the use of electrical engineering drawing

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software (Asdar et al., 2020; Saepulloh et al., 2016). Parallel series electrical circuits are one of the materials in electrical engineering competence, namely in the learning achievement of basic electrical circuits. The series circuit has a characteristic that there is a division of voltage at each load in the circuit, while in a series and parallel circuit there is a current distribution for each load in the circuit (Hasanah et al., 2018; Rosman et al., 2019). Parallel series electric circuits are often found in everyday life and are important so that this is a great opportunity for students, so students must be able to recognize and be able to distinguish which is a series circuit which is a parallel circuit (Erfan et al., 2020). By studying this material, students will be able to analyze when to use a series circuit and when to use a parallel circuit by considering costs, aesthetics and ethics in the use of lighting (Hasanah et al., 2018).

One of the institutions that accommodate these activities is the Vocational High School (SMK). Vocational High School (SMK) is an educational institution which is also called a vocational institution where this institution prioritizes the skills of its graduates so that they can be used to find work in the industrial world (Hammi et al., 2020; Rokhani & Purnami, 2021). One of the expertise programs in SMK is Electrical Engineering. One of the subjects studied is the basics of electrical engineering. Basics of Electrical Engineering are subjects that contain competencies that underlie mastery of basic electricity concepts and basic practical skills (Hammi et al., 2020; Lytvyn et al., 2020). Basic Electrical Engineering subjects serve to provide knowledge, skills, and attitudes that will underlie mastery of knowledge and skills in advanced vocational subjects, including Electric Power Generation, Electric Power Transmission, Electric Power Distribution, and Electricity Utilization Installations in Indonesia. Industry (Saripudin, 2017; Wardani, 2019). In addition, one of the competencies in Vocational Schools is Electrical Engineering, where this competency is needed in all things, both small scale such as households and large scale such as companies. In terms of theory and practice, the competence of electrical expertise provides a lot of lessons about electricity, especially in terms of practice of skills in the world of electricity (Ratnaya, 2019).

However, from the results of observations in classroom activities of Electrical Engineering programs, many students do not understand about direct and parallel current circuits, so students have not achieved the learning objectives. This is based on the scores in the series and parallel circuit practical activities, namely only 25% of students whose scores are more than or equal to the KKM, the other 75% are still below the KKM of 36 students. This is due to the lack of students' skills in practical parallel series and series activities caused by various factors. As we know that the low value of learning is caused by 2 (two) factors, namely internal factors and external factors (Nabillah & Abadi, 2019). Internal factors include the will / interest and encouragement from within oneself. While the internal factors are external factors, namely the methods used by educators, learning strategies, and learning facilities and infrastructure (Alifya & Rahman, 2020; Pangestika et al., 2022). After doing observations with students and educators, it turns out that the biggest cause of low student learning outcomes is the use of learning facilities and facilities, the main being the media in the practice of parallel series electric circuits. The number of media used is limited so that it cannot accommodate all students. In addition, because each practical activity for 1 (one) set consists of many tools and materials, each student must be observant and careful in choosing which materials and tools to use. In practical activities, electrical circuits use electricity and electrical materials such as cables, lights, batteries. Practices like this require precision in assembling tools and materials. If an error occurs in the assembly, a short circuit can occur in the circuit which can cause sparks and even burn the components used. Incidents like this are dangerous for both students and the equipment used.

As it is known that learning activities can be interpreted as a conscious effort from an educator so that students can learn according to their needs and interests (Kustandi & Darmawan, 2020). Learning is an activity that produces behavioural changes in learners who interact with their environment to fulfill their life needs (Setiawan, 2019). What has resulted as a change will always be seen in daily activities. So that learning can be interpreted as an effort that has been made by a student and the learner to be able to change his behavior positively. Learning focuses more on ways to achieve goals and is related to organizing learning content, delivering learning content, and learning management (Nindiati, 2020; Setiawan, 2019). One of the important components in learning is the media that the teacher uses as an intermediary in delivering the subject matter. As already stated, according to the results of observations during learning in the electrical power installation engineering department, the use of learning media is still limited and less varied. Some research shows that the use of learning media for practical materials in vocational schools helps students to make it easier for students to learn the material (H et al., 2021). Parallel series practice learning media that still utilize these materials and tools can be replaced with computer-based interactive media which will be packaged into learning videos containing parallel series practice simulations using PhET simulations (Hasyim et al., 2020; Yuliati et al., 2018). In selecting media, it is necessary to consider several things, namely the media must be attractive, easy to operate and understand by students and educators, utilize technology, and the availability of infrastructure (Aisyah &

Haryudin, 2020; Taubah & Hadi, 2020). Therefore, for the practical learning activities of parallel series electric circuits, the suitable media is computer-based interactive media with simulation methods. The simulation that will be used is PhET (Physics Education Technology) Simulation. PhET is a simulation created by the University of Colorado that contains simulations of learning physics, biology, and chemistry for teaching purposes that can be accessed freely via https://phet.colorado.edu/ (Hasyim et al., 2020; Widyawati et al., 2019). PhET Simulation is an application that can be downloaded for free. PhET simulation has the advantage that it provides features that cannot be provided when using real materials and tools (D. Hadiyanti et al., 2018). In addition, PhET simulations can also give students the opportunity to explore dynamically and quickly respond to investigation results (Susilawati et al., 2021; Yuliati et al., 2018). By using this simulation, it will be easier for students to do practical work on series and parallel circuits and do not require places, tools and materials, all of which have been provided on the menu in the PhET simulation.

There are so many types of learning media that can be used by teachers to convey to their students. In general, the media consists of print and non-print media, sound and video media as well as electronic and non-electronic media (Dewi et al., 2019; Ponimin & Suryani, 2019). The development of the media today is influenced by many factors such as technological developments, printing science, behavior and communication. One thing that develops from media is the emergence of various types and formats of media such as print modules, films, television, computer programs, etc. On this basis, grouping was finally carried out based on the similarity of characteristics or characteristics of the media (Aghni, 2018; Alobaid, 2020). Utilization of information and communication technology as a medium, in this case including the use of interactive media that supports the learning process and makes it easier for teachers to convey and provide understanding to students on the material being taught (Astriyani & Zahra, 2021; Parmiti et al., 2022), besides that it can provide new experiences for participants students who are too saturated with the simple learning method that the teacher does, in this case the lecture method. Most school institutions have used the media to support learning carried out with the aim of improving the quality of high-quality human resources and skilled in utilizing existing technology (Indartiwi et al., 2020; Roemintoyo & Budiarto, 2021). Teachers should be able to use the media as a supporting facility in learning activities. It's just that the teacher has not fully been able to create or create their own media used for teaching. So that sometimes the media used is not fully in accordance with the material being taught when the learning process occurs, then the media used must be innovative and can attract students' interest in learning at school and at home.

Learning innovation in the digital era as it is today can actually be realized through the development and use of learning media, such as the integration of smartphone use, computer use, and internet use into the learning process as described and proposed in the previous paragraph regarding multimedia learning (Amelia et al., 2021; Dewi et al., 2019; Perdana et al., 2021; Saputri et al., 2020). The integration of ICT into the learning process comes with the consideration that currently students are very familiar with technology, such as smartphones, computers and even internet networks (L. Budiarto & Akhyar, 2022; Lim et al., 2020; Rahiem, 2020). Considering that overall schools must also be able to equip students with cognitive knowledge, but also affective and psychomotor abilities as well as various soft skills needed in the 21st century (Afandi et al., 2019; Pamungkas et al., 2020).

This is what makes this research important to carry out, looking at comparisons with several previous studies, this research will focus on the research subject, namely vocational high school students who besides having to understand the subject matter, but also must be able to practice the theories that are used during the learning activity. In addition, schools that are the object of research during the learning process have never developed PhET-based interactive media for practical learning, even though several studies have shown that using PhET-based interactive media can make it easier for students to learn and understand the material before they do practical activities. Referring to the description of the analysis and field facts, it appears that there is a discrepancy regarding the use of learning media to support activities in the classroom, which theoretically should be learning in the digital era as it is now able to utilize various learning resources and interactive digital learning media. However, the facts on the ground show otherwise, where teachers tend to stick with their habit of only using learning media in a limited way to only textbooks or printed modules. Thus, teachers have a great opportunity to develop learning media through the use of technology in the digital era such as interactive media that can be accessed and operated via smartphones and computers as an effort to maximize the learning process (Roemintoyo et al., 2022; Sari et al., 2020). Therefore, as an educator and practitioner in the field of education, we must be able to see how the opportunities for utilizing and integrating ICT into the learning process are as a tool to support teaching and learning activities. Interactive media can be one of the real manifestations of ICT-based learning media innovations that will facilitate students to learn theoretically and practically. The presence of interactive media has been empirically proven to have a positive impact

on students' academic achievement and practical skills. This study aims to provide answers to questions about how to analyze the needs of interactive media products based on PhET simulations for learning in vocational schools in the electrical power installation engineering department.

2. METHODS

The research approach used is a quantitative approach with the type of research that is descriptive (Abdullah, 2015). This study took a population of vocational high school students majoring in electrical power installation engineering, with a total sample of 36 students selected randomly. Data collection techniques are included in the non-test type which consists of a needs analysis questionnaire (Sugiyono, 2016). Meanwhile, the instrument used is a questionnaire with a total of 10 questions adapted from research (M. K. Budiarto et al., 2021). This indicator is in line with the research objectives, namely analyzing the needs from the students' point of view regarding the needs of learning media, and an overview of the use of learning media that has been used, Table 1 is a visualization of the lattice of research instruments used.

Table 1. Instrument Grid

No.	Indicator	Question / Statement
1	Use of Learning Methods	Teacher's use of the lecture method
2	Types of Learning Media	Use of computer-based learning media
		Quality of media used by Teacher
		Use of printed modules/books as learning resources
		The use of multimedia by teachers in the learning process
3	Student competence	Understanding of the material presented by the teacher
		Ability to operate computer
4	Supporting facilities	Availability of LCD projectors and computer laboratories in schools
5	Student Opinion	Multimedia is used by teachers when learning at school
		Perception of multimedia development innovation for the learning process

Before being distributed to 36 students, The questionnaire consisting of 10 (ten) questions and statements was first validated by experts who have a doctoral education background in the field of education in general, this consultation process in other terms is called expert judgment (Hanif et al., 2018; Patel & Patel, 2019). Data from the distribution of the instrument to students was analyzed. As for analysis of the data was displayed in the form of descriptive in the form of percentage (Qodr et al., 2021; Salim, 2019), so that a conclusion could be drawn in order to provide answers regarding students' needs for innovation of interactive multimedia for support the learning activities. In general, the implementation of this research begins with researchers who formulate indicators and make research instruments, after the instruments are made then validation is carried out by expert judgment. After obtaining input and discussing with experts about the instrument, the researcher distributed questionnaires to students. The results of student responses are collected and tabulated in a file and then analyzed to determine the percentage of each item. The percentage result data is then categorized according to the aspects attached to the instrument, in order to make it easier when presenting the data in the results section.

3. RESULT AND DISCUSSION

Results

After the questionnaire has been successfully distributed to students, in this section the results of the student responses will be presented which have then been analyzed in percentage terms. There is little information that this questionnaire has been distributed to a research sample of 36 vocational high school students. The following are the results of the tabulation of student responses to several questionnaire items. The first identification of the learning methods that have been used by teachers when teaching in the electrical power installation engineering department. Information was obtained that so far the lecture and discussion methods still dominate learning activities by teachers, this can be seen from the response of 61.1% of 36 students who stated that it was 'true' if the teacher used the lecture method in learning activities. This is of course not very relevant to the development of the learning paradigm that

currently leads to student center learning, where students become the subject of learning itself and are able to construct knowledge based on the information they get.

Furthermore, from student responses, information was also obtained that teachers still have not used computer-based learning media, this is evidenced by the response of 69.4% of 36 students who stated that so far teachers do not use computer-based learning media, but only use printed media such as material books. as well as a short module rather than a description of the material they are studying. According to 61.1% of 36 students stated that learning media such as material books, modules and the internet which are used as a tool to support learning activities are included in the sufficient category, this means that teachers as educators should be able to make better learning media in accordance with developments. era and relevant to ICT integration. Such as the use of interactive multimedia or interactive media to support learning, however, field facts also show that so far teachers have never used interactive multimedia for learning, a number of 52.8% of 36 students stated that as long as they were taught by teachers in electricity concentration subjects, most teachers do not use interactive media even though interactive media will be able to help students master learning materials, both theory and practice. Visualization of student responses to these three questions is presented in Table 2.

Table 2. Use of Learning Media by Teachers

Question items	Student response' in Percentage (%)					Total (%)
	Very Inappropriate	Not True	Uncertain	True	Very True	
When the subject of parallel and series electrical circuits do you use computer-based learning media?	0	69.4	8.3	11.1	11.1	100
Is the media currently used by the teacher said to be in good category?	0	22.2	61.1	16.7	0	100
The teacher has never used interactive multimedia for teaching parallel and series electric circuits in class	0	0	8.3	52.8	38.9	100

It is unfortunate if this situation will continue, where teachers are still comfortable with the use of print modules as one of the learning media they use in class. Given, the identification results show that students have good competence in operating computer equipment. Figure 1 is an overview of student responses related to their ability to operate computer equipment.

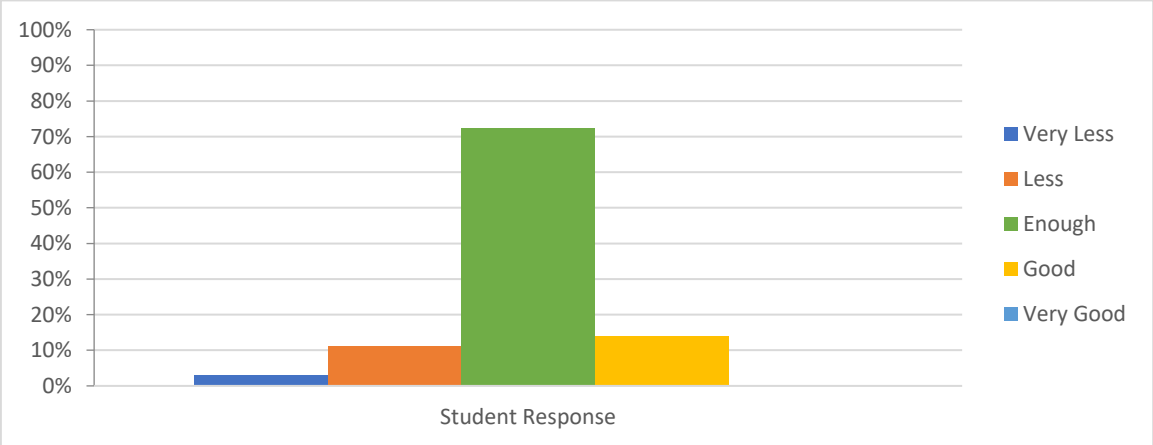

Figure 1. Students' Ability to Operate Computers

From the student responses it was identified that 72.2% of students have sufficient ability to operate computers, another 13.9% are in the good category in operating computers, of course this is a very big opportunity for teachers to start facilitating students by integrating ICT tools incorrectly. the other is a computer, whose empirical use is used to support learning activities in the classroom. This is

also reinforced than the student's response if a learning media product will be developed in an interactive media format or interactive multimedia. Where students stated that they were enthusiastic and agreed with the presence of interactive media in parallel series electric circuit learning, a total of 72.2% of students agreed. This response indicates that so far students are very happy with the presence of innovative ICT-based learning media.

Discussion

As a result of the COVID-19 pandemic, which has implications for various policies related to the implementation of education, the learning system has undergone very significant changes at all levels. Most visible is the learning system that was originally face-to-face in the classroom turned into a virtual face-to-face using a teleconference application as an intermediary. During this learning change, both teachers and students are naturally in a new learning environment, where they are obliged to adapt to the situation. Based on the findings in this study, it was stated that majority of students stated that teachers still use the lecture and discussion method in carrying out learning activities. Although the use of lecture and discussion methods is not always bad, it would be better if in the current digital era, students are facilitated by more dynamic and interactive learning. So that the learning process that takes place is not only one-way, let alone centered on the teacher as a source of learning. Efforts to create an interactive learning process can be circumvented through the development of digital learning media, where during the learning process the media will be used by the teacher so that it is not always teacher-centered. It is known that the incorporation of learning media with learning methods or approaches is also important for educators to pay attention to, as shown by various research results that have successfully integrated and integrated digital learning media with various learning approaches. Such as problem based learning learning methods that are integrated with learning media in the format of e-books, e-modules and even interactive media (Amin et al., 2021; Budiastuti et al., 2018; Nurhidayati et al., 2018; Pujawan, 2019). Not only that, the integration of innovative learning methods with various learning media has also succeeded in showing a positive contribution to various student achievements, such as increasing critical thinking skills, improving language skills, communication, character building and increasing student literacy (N. F. D. Hadiyanti et al., 2021; Sá et al., 2021; Widodo et al., 2020).

Therefore, teachers must be good at choosing learning media for learning activities. However, the facts obtained from the research results are inversely proportional to the teacher's need to adapt to technology. Where the result of student's response showed that teachers do not use computer-based learning media. Even though we know that during the covid-19 pandemic, the presence of digital learning media such as e-modules (Hadianto & Festiyed, 2020; Sofyan et al., 2019), e-books (Harjono et al., 2020; Susantini et al., 2021), multimedia (M. K. Budiarto et al., 2021; Komalasari & Rahmat, 2019) has been very massive to be implemented into the learning process. The presence of various digital learning media is also accompanied by a fairly contributive impact on increasing students' academic and non-academic achievements (Dudung et al., 2022; Okocha, 2020; Sarac, 2017). One of the teacher's efforts to be able to assist students in achieving their competence is by delivering material and being a good facilitator for students, so that through the use of appropriate learning media it will be easier for students to understand abstract material (Kasim et al., 2021; Suyitno, 2016). In addition, another advantage inherent in learning media is that it can clarify the delivery of subject matter in the form of delivering interesting, innovative, and integrative information (Bustanil S et al., 2019; Susilawati et al., 2021). Meanwhile, the learning media that dominates learning in SMK as the research population shows that printed material books and printed modules are still the main learning resources and learning media used by teachers, this indicates that the variation in the use of learning media is still minimal, even though an effective learning process can supported by strengthening the components of the use of learning media so that it has an impact on increasing student learning outcomes (Sanaky, 2013).

In fact, most students agreed with the presence of interactive media innovations for learning parallel series electrical circuits. This result is proven by the students' responses from the results of the questionnaires sent where almost all of students as the research sample agreed with the presence of interactive media. This is become a basis founding for teachers not to hesitate in creating innovative learning media. Given that empirically according to several relevant studies, the use of interactive media has been proven to strengthen students' literacy skills (Opidianto et al., 2021; Shamir et al., 2019; Widodo et al., 2020), increase students' motivation and desire to learn (Anwar et al., 2019; Junaidi, 2019; Zulfarina et al., 2021), can increase students' learning independence considering the characteristics of interactive media which include audio, visual, audio-visual, graphic, text components so that students can be facilitated to learn without the presence of a teacher (Albana & Sujarwo, 2021; Nurjanah & Dahlan, 2018), through the use of interactive media can also improve student learning outcomes both cognitively and psychomotor (Hadiyanto, 2019; Harjono et al., 2020; Yulianci et al., 2021). Findings from various relevant

research results have proven to readers that it is time for educators to be able to innovate the application of digital learning media with interactive media formats, because there are many benefits that will contribute to student success in the learning process. Therefore, teachers must have the intention and need to learn how to use instructional media to achieve learning objectives effectively in the teaching and learning process (Bhattacharjee & Deb, 2016; Zaineldeen et al., 2020).

Referring to the results of this study and analysis of several relevant studies, it is time for educators or in this case teachers to be able to create a dynamic learning atmosphere. One of the efforts he can do is by innovating the components of learning media and integrating ICT into the learning process, such as smartphones and computers (Har et al., 2019; Miskiah et al., 2019; Nisa et al., 2020). Given that these technological devices have now become part of their lives, it appears that currently students already have the competence to operate various technological devices, such as computers. The main purpose of learning is to facilitate students to achieve a certain competence, so as educators must be good at identifying student characteristics, using methods and selecting learning media. Interactive media is considered to have a very large opportunity to be applied in learning in vocational high schools. However, it should be realized that this research is only limited to extracting information on needs from the point of view of students as learning subjects, so that the resulting data, although quite representative, still requires follow-up in the form of designing and developing a product innovation for learning activities.

4. CONCLUSION

The findings of this research and the synthesis of several relevant studies that are mixed in the discussion show that technology has entered into various fields, without exception the field of education. Therefore, educators as implementers of learning activities must be able to adapt to these developments. The presence of various kinds of technological innovations to facilitate learning should be addressed quickly, so that the learning process that millennial generation students actually want can be realized. The current generation looks quite familiar with the presence of technology, this can be seen from their average ability to operate digital devices such as computers which are included in the fairly good category. In addition, many previous studies also prove that the use of interactive media has positive benefits for improving student academic achievement, so this can certainly be a form of innovation and a real form of teacher adaptation in carrying out the learning process. Through these findings, it is hoped that they can become the basis for the development of interactive multimedia products to facilitate learning in vocational high schools. Further research can raise the theme of developing interactive media on other materials and subjects that require a larger portion of practice.

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