

# The Needs Analysis for an Educational Physics Game with Scientific Literacy and Ethnoscience Content

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**Abstract** – *The advancement of science and technology in the era of the Industrial Revolution 4.0 encourages government regulations in changing all life governance, including education. The independent curriculum is used as a solution to answer the demands of the world of education and to be able to create active and creative learning. In learning Physics in schools, its application is rarely exemplified in everyday life. Physics learning is only taught theoretically and has minimal explanation related to the implementation of Physics, so learning becomes less meaningful. Cultural or ethnoscience approaches are important in implementing learning so that community culture is not lost. It can help improve students' scientific literacy and make science learning more meaningful for students. One of the technology-based learning media that can be developed is Physics educational games. This study aims to analyze the development needs of Physics educational games containing scientific literacy and ethnoscience. This type of research is descriptive quantitative. This research data instrument uses observation sheets and questionnaires. Data collection techniques are carried out through methods: (1) observation and (2) questionnaires. The research technique used is the quantitative descriptive analysis technique. The study subjects were 42 grade X students of SMAN 1 Padang. The students are represented by three classes X at SMAN 1 Padang, grouped into high, medium and low-level classes. The results showed that using learning media increased student participation in learning and made it easier for students to understand the material. Linking Physics learning with the local culture can make Physics learning more meaningful and increase students' scientific literacy. These results illustrate the need to develop physics educational games based on scientific literacy and ethnoscience.*

**Keywords:** Needs Analysis; Educational Game; Scientific Literacy; Ethnoscience

## INTRODUCTION

The advancement of science and technology in the era of the Industrial Revolution 4.0 encourages government regulations in changing all life governance, including education. The curriculum is developed to meet goals based on changing demands and improve the quality of education because the heart of education is the curriculum (Aprima & Sari, 2022). At this time, there is a new curriculum, namely the independent curriculum.

The independent curriculum is used as a solution to answer the demands of the world of education and to be able to create active and creative learning. This program is not a replacement for an existing program

but improves the system that is already running. Law No. 20 of 2003 concerning the national education system states that to achieve a national education goal, education providers need a curriculum as a program containing a set of learning plans related to the objectives, content, teaching materials and means used in the learning process.

The Merdeka Curriculum presents the concept of "Merdeka Belajar" for students designed to help recover from the learning crisis due to the COVID-19 pandemic. This adjustment requires the use of technology, and this competency need is one of the bases for developing the Independent Curriculum (Marisa, 2021). Indonesia needs innovation in the aspect of education. One of them is

using technology and information to support learning success.

One of the technology and information that is growing rapidly today is the smartphone. The level of development of smartphone devices that are getting higher and relatively cheaper is a supporting factor for smartphone users to increase. In 2018, more than half of the population in Indonesia or 56.2%, had used smartphones. In 2019, it increased to 63.3% of people using smartphones. By 2025, it is predicted that 89.2% of the population in Indonesia will have used smartphones (Retalia et al., 2022). It can be an opportunity for teachers to develop learning media.

One of the learning media that teachers can develop is smartphone-based learning media. Because many students use smartphones to play games and social media, this interferes with their learning because their concentration decreases or decreases. Students are more focused on looking at smartphones, even to the point of smartphone addiction. To overcome this, it would be nice for smartphones to be used in learning so that students can learn independently through their smartphones. Learning media that can be accessed easily via smartphones are educational games.

Educational games are designed for education by inserting certain learning materials into the game so that users or players are not pressured by learning too seriously (Ayu et al., 2017). Educational games are designed to teach the user a certain learning, concept development and understanding, guide the user in training abilities, and increase learning motivation.

Physics is one of the fields of study at the high school level that underlies the development of advanced technology and the concept of living in harmony with nature. In addition to studying natural phenomena, Physics teaches humans to live in harmony

based on natural laws. Management of natural resources and the environment and reducing the impact of natural disasters will not be optimal without a good understanding of Physics (Sarah & Maryono, 2014).

In learning Physics in schools, its application is rarely exemplified in everyday life. So that students feel that Physics is a lesson that is not useful after graduation later. In addition, Physics lessons are also considered difficult because of many formulas and calculations as revealed by Suparno (2009: 2) that some high school students do not like Physics and end up choosing majors that do not have Physics lessons because Physics is considered scary, difficult to learn, many calculations and formulas. Some high school students complain of difficulties in learning Physics, so there are often mistakes in doing the questions. They feel it is better to avoid Physics than encounter difficulties if they study Physics. If they are forced to study Physics, they follow to fulfil the obligations of studying at school, not try to understand it (Suroso, 2016).

Physics material is related to everyday life, so teachers must be able to explain the concept in real form. Newton's law of motion is one of the high school physics materials that are difficult for students to learn and is full of formula calculations, and is abstract (Nasir et al., 2014). As a result, many students are lazy to learn Physics because there are too many formulas, and they feel bored (Astuti et al., 2017). So to learn the material, special efforts are needed by the teacher so that students easily understand the material. One of the efforts made is to make the concept of Physics clear, know its implementation and can be visualized (Syafi'i et al., 2017).

Based on observations at SMAN 1 Padang class X, teachers have not optimally utilized the facilities available at school. In

learning, teachers are more likely to explain so that interaction is more dominant in one direction. In physics learning, teachers usually use lecture methods and whiteboard media. After the material is finished, the teacher will give practice questions. So that students here are only required to listen and record explanations from the teacher so that students do not develop their abilities. Of the many students in the class, only a small part is active in the learning process in class. Furthermore, students become more enthusiastic about learning using learning media. The next problem is that Android-based technology learning media has not been developed in schools.

The integration of literacy in schools is still limited and has not been carried out properly, especially in scientific literacy. The literacy applied by schools is only functional literacy, namely reading and writing (Afrizon & Asrizal, 2019). Scientific literacy means the ability to use science skills. Scientific literacy is also defined by how a person makes decisions and their implementation in social life. Scientific literacy is important for students to have. The rapid development of science and technology requires students to have good scientific literacy skills in order to be able to overcome problems. Integrating scientific literacy will become more meaningful because learning is connected to real-world contexts.

In addition, in the current era, globalization is increasing more rapidly. It will lead to the erosion of cultural values. Globalization through the development of digital technology is the main cause of acculturation and cultural assimilation in Indonesia. So that is the need for a solution in the learning process that can instil a sense of love and ownership of the values of the richness of local cultural diversity in each student, especially with the strengthening of

the problem of national identity in Indonesia, which is characterized by the erosion of local cultural values in the social environment of the younger generation (Santoso & Wuryandani, 2020).

Cultural or ethnoscientific approaches are important in implementing education so that community culture is not lost. Ethnoscience is knowledge derived from certain local community norms and beliefs that influence the interpretation and understanding of nature (Sudarmin, 2014). It is relevant to the purpose of science, which is oriented towards mastering knowledge, skills, values and attitudes so that students can participate in the environment. Learning with an ethnoscientific approach is based on recognizing culture as a fundamental part (fundamental and important) for education as an expression and communication of an idea and the development of knowledge (Khoiri et al., 2018). Through an ethnoscience approach, there will be special excavations in empowering students' knowledge embedded in students to develop indigenous knowledge in society.

Based on these problems, this study aims to analyze the need for learning media in educational physics games to support learning in the current era. The results of this study are expected to provide initial information about Physics educational games that need to be developed. Furthermore, the results of this research were used to develop Physics educational games for further research.

## RESEARCH METHODS

This study used a quantitative descriptive method. The study of a descriptive approach is used to describe the reality that occurs in the field. At the same time, quantitative methods are an approach rooted in the natural background of systematic wholeness by developing and

using mathematical models (Fitriani & Khairulyadi, 2019).

The study subjects were 42 grade X students of SMAN 1 Padang. The students are represented by three classes X at SMAN 1 Padang, grouped into high, medium and low-level classes. Data collection techniques are carried out through methods: (1) observation and (2) questionnaires. Observations were made to determine the type and condition of learning media owned by the school. The data instruments used are observation sheets and questionnaires filled out through google forms.

A questionnaire was developed regarding the learning experience and the needs of Physics learning media with five aspects. Five aspects used in the questionnaire include physics learning, learning styles, use of learning media, support facilities, completeness, and use of games. These aspects are then described into several indicators to make analyzing the learning experience and the needs of Physics learning media easier. Experts have validated the questionnaire used and can be used. The data analysis technique used is a quantitative descriptive analysis technique. Descriptive statistics are statistics that function to describe or describe the object under study through sample and population data. The percentage formula (Aguss & Fahrizqi, 2020) is used in the calculation technique for each questionnaire indicator. The score for each indicator is calculated using the following equation.

$$P = \frac{f}{n} \times 100\% \quad (1)$$

Information:

P: Percentage

f: Frequency

n: Number of Respondents

The processing of research results is then converted based on the category of assessment criteria. In (Retnawati, 2016),

the data is then interpreted in four levels, namely:

**Table 1.** Needs analysis categories

| Percentage (%) | Criteria  |
|----------------|-----------|
| 76-100         | Very High |
| 51-75          | High      |
| 26-50          | Low       |
| 0-25           | Very Low  |

## RESULTS AND DISCUSSION

Observations conducted at SMAN 1 Padang aim to determine students' interest in learning Physics. In addition, observation aims to determine students' interest in technological developments. The results of observations at SMAN 1 Padang can be seen in Table 2.

**Table 2.** Observation Results of SMAN 1 Padang

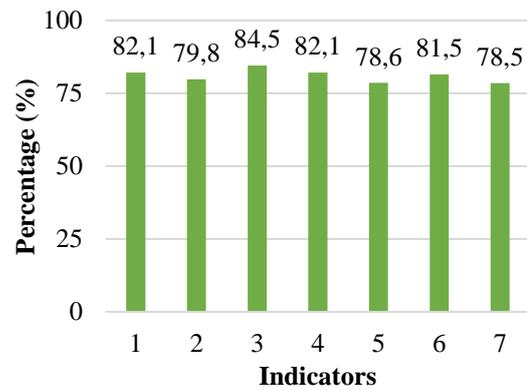
| No | Answer  | Question  |
|----|---|---|
| 1  | Facilities at SMAN 1 Padang that can be used to support the learning process of Physics at school | Facilities used in learning Physics, include: classrooms, Physics laboratories, computer rooms, and libraries. The Physics Laboratory is usually used as a place for practice. However, currently practicum is hampered because the Physics labor is converted into a class.                            |
| 2  | The enthusiasm of students participating in learning that uses Learning Media                     | When the learning process takes place using media brought by the teacher to class or media in the Physics laboratory, students are more enthusiastic in learning. However, some students are also confused because the media is limited in number, which is not proportional to the number of students. |

| No | Answer  | Question   |
|----|---|--|
| 3  | The use of Android-based learning media in classroom learning         | Classroom learning has not used Android-based media.               |
| 4  | The technology-based learning media used contains scientific literacy | Learning has not used scientific literacy media.                   |
| 5  | Technology-based learning media used integrated with local culture    | Learning has not used media that is integrated with local culture. |

Results of the needs analysis questionnaire distributed to grade X students at SMAN 1 Padang. The results of the questionnaire analysis reviewed aspects of physics learning, learning styles, the use of learning media, the use of supporting facilities and completeness, and the use of games. The results of the analysis of student needs are as follows.

### Physics Learning

Analysis of aspects of Physics learning is reviewed from seven indicators, namely: (1) for me, Physics material is quite difficult, (2) I need a long time to understand Physics material, (3) I better understand Physics material if I use learning media, (4) practicum is carried out in Physics learning at my school, (5) simulations/demonstrations are carried out in Physics learning at my school, (6) I like to study Physics when it is associated with local culture in the community, (7) I like to learn Physics when it is related to global issues in society. The analysis results of students' Physics learning are presented in graphs in Figure 1.



**Figure 1.** Student Physics Learning Analysis Graph

Based on the graph of Figure 1, the third indicator obtained the highest percentage. It states that students are more proficient in Physics material if they use learning media. Students consider Physics material difficult, so it requires a long time to understand it. It follows the analysis results on the first and second indicators in the high category.

According to Guido (2013) that physics is a subject that students like less. Students find physics a difficult subject in school and increasingly difficult in college. It is because physics not only masters mathematics but is also reliable in logic.

Student attitudes towards Physics lessons become one of the important factors in learning activities. Students' views on Physics learning can affect students' attitudes and learning outcomes. Students with a positive outlook tend to be enthusiastic and motivated in the learning process. It will have an impact on improving student learning outcomes. Conversely, students with a negative view of Physics tend to have a less enthusiastic attitude and low motivation, which can reduce student learning outcomes (Veloo et al., 2015).

Physics is a scientific discipline that studies real and abstract natural phenomena. Physics uses experimental methods and mathematical approaches to prove and understand these phenomena. It can make students find Physics difficult to understand

and study. Therefore, teachers must explain the Physics material clearly and give relevant examples so students can understand it more easily (Wahyuni et al., 2017). In addition, teachers need to use diverse teaching methods, not just lectures, so that students do not feel bored and bored. With various teaching methods, teachers can change the mindset of students and create a more interesting and interactive learning atmosphere (Dwi et al., 2017).

To overcome this, taking advantage of innovative and fun learning media is important. Learning media must be well prepared so that it makes it easier for students to learn and become an effective intermediary tool in delivering material (Affandi et al., 2020). The more interesting the media is applied, the more the student's learning stimulus increases (Tafonao, 2018).

One way to increase students' interest and stimulus in learning Physics is to associate it with local culture in the community. Research by Astuti et al. (2021) shows that the application of local culture in learning makes it easier for students to observe and practice independence from various concepts in a meaningful, authentic, and active manner.

Physics learning can be related to various aspects of local culture and is very close to community life (Sarini et al., 2019). Local culture significantly influences the initial formation of students' knowledge (Suardana, 2014). As stated by Dwipayana et al. (2020), if science learning is not associated with cultural aspects, it will cause students to be less accepting or only accept some of the science concepts taught.

Students' skills in explaining symptoms in life based on science are part of scientific literacy competence. So applying local cultural aspects as national identity in science learning is important. One way to make this happen is a learning approach that

focuses on ethnoscience. Ethnoscience is an approach to science learning that reconstructs scientific understanding from a current understanding of science in society. Ethnoscience-based learning is important because Indonesia is rich in ethnic diversity, but this diversity has not been applied as a source of learning. The role of teachers is very influential on students' scientific literacy (Irmita & Atun, 2018). Indonesia is a diverse country with various cultural diversity that needs to be integrated into science learning. Culture is an order of life that develops, becomes common property by the community, and is maintained from generation to generation (Setiawan et al., 2017).

Scientific literacy is an important indicator in the implementation of science learning. Student involvement in direct observation can help students understand the subject matter and develop scientific literacy. The quality of science education in Indonesia is still low. One of the reasons is the lack of concern for the social and cultural environment as a source of learning (Hadi et al., 2019). Physics learning is only taught theoretically and has minimal explanation related to the implementation of Physics in social life, making learning less meaningful. However, most teachers express a desire to develop ethnoscience-based learning. However, few teachers have enough insight to develop it (Hadi et al., 2019).

Scientific literacy has four dimensions: process, content, context, and attitude (OECD, 2017). PISA (Programme for International Student Assessment) is one of the efforts to measure students' scientific literacy internationally. The results of PISA in 2012-2018 illustrate Indonesia's stagnant ranking in a low position, even almost in the last two ranks (OECD, 2018). It shows that students' scientific literacy in Indonesia is still low, and students have difficulty

connecting science concepts with symptoms in life (Hadi et al., 2020).

What can be done to overcome these problems is to introduce local culture to the younger generation through education as a source of learning. Integrating local culture into science learning allows students to feel more connected to the subject matter and see the relevance between science and real life. It can help improve students' scientific literacy and make science learning more meaningful.

### Learning Style

Analysis of aspects of learning styles is reviewed from seven indicators, namely: (1) I know what audio media is, (2) I find it easier to understand the material when presented with audio (listening), (3) I know what visual media is, (4) I am easier to understand the material when presented with image and diagram media, (5) I know what audiovisual media is, (6) I am easier to understand the material when presented with learning videos, (7) I need an interesting learning medium to increase my desire to study Physics. The results of the analysis of student learning styles are presented in the graph in Figure 2.

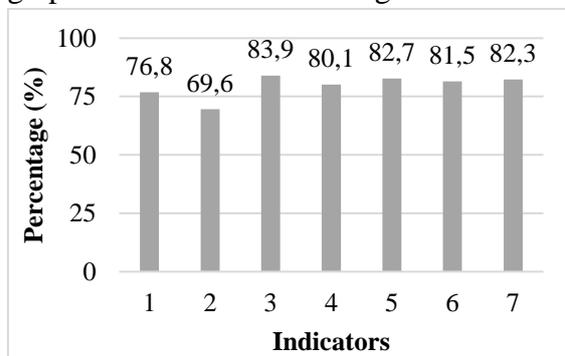


Figure 2. Analysis of Student Learning Style

Based on the graph of Figure 2, the third indicator obtained the highest percentage. It shows that students are more familiar with visual media than audio media. The results of indicator six show that students understand the material using

audiovisual media, such as learning videos, rather than audio or visual media alone.

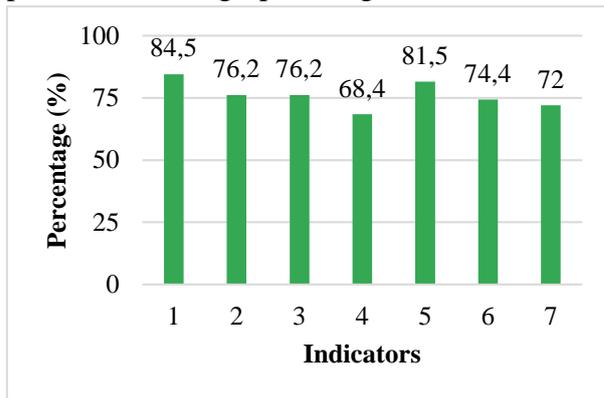
According to Arsyad (2009), audiovisual media positively impacts learning outcomes because it involves students' imagination and motivation. Relevant to Hernawati's (2018) research which states the improvement of learning outcomes with audiovisual media, supports the importance of using media in learning. In physics learning, audiovisual media, such as videos, has been developed in various materials and has proven valid to be used as a learning medium. The format and type of video can be adjusted to physics learning needs, such as experimental media (Hafizah, 2020).

Audiovisual media has advantages in students' cognitive, affective, and psychomotor aspects (Anderson in Ariyani et al., 2017). In the cognitive aspect, audiovisual media can show examples and ways of behaving in an activity, such as student interaction. In the affective aspect, audiovisual media can affect students' attitudes and emotions. While from the psychomotor aspect, audiovisual media can show examples of skills that involve movement, both by slowing down and accelerating the movements displayed. However, audiovisual media also has limitations. One of the limitations is that it requires a relatively expensive cost. In addition, the use of audiovisual media also requires special knowledge and skills about audiovisual in its use (Ariyani et al., 2017).

### Use of Learning Media

Analysis of aspects of the use of learning media is reviewed from seven indicators, namely: (1) the use of learning media helps me in learning Physics, (2) learning media used following learning objectives, (3) learning media used is easily accessible via android / PC, (4) so far the

learning media in schools is only in the form of power points, (5) I prefer to learn using learning media in electronic form accompanied by animation, (6) I prefer learning using learning media made by the teacher himself, (7) I prefer learning using learning media obtained from the internet, (8) Physics learning in my class using print learning media (LKS/ Module/ Handout), (9) Physics learning in my class using non-print learning media (animation/ video/PowerPoint/ simulation). The analysis results of using learning media in schools are presented in the graph in Figure 3.



**Figure 3.** Analysis Graph of the Use of Learning Media in Schools

Based on Figure 3, the first indicator obtained the highest percentage, followed by the fifth indicator, and the fourth indicator obtained the lowest percentage. It shows that using learning media is very helpful for students learning Physics. Indicator five shows that students prefer to learn using learning media in electronic form accompanied by animation.

Using animation media in learning can make it easier for students to digest conceptual material so that students do not just imagine. The role of teachers is to condition learning situations that reduce boredom through animation-based learning media (Effendi et al., 2020). Animation media is multimedia that contains sound, writing and moving images. Animation media is often computer-based simulation

media (Gunawan, 2015). According to Sari et al. (2017), animation can be designed to convey various subjects according to their learning objectives, and the use of animation can minimize costs compared to the actual use of objects. The use of learning media helps the effectiveness of learning and material delivery. Making media designs must be done properly for the convenience of students when learning as an intermediary for knowledge delivery (Yusnidah, 2022).

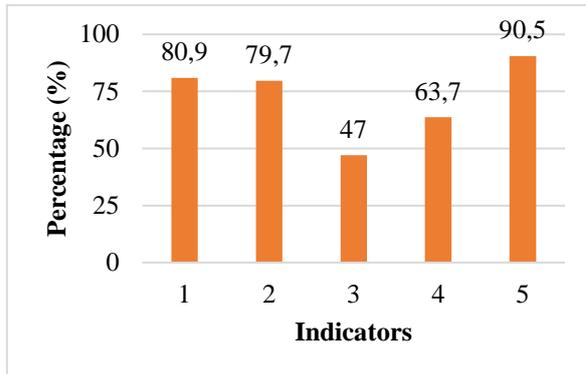
Another relevant research by Satria & Basir (2020) states that there are significant differences in learning outcomes in learning that uses animation media and greatly affects students' interest in learning. Through the use of animation media, students are more focused on learning; this needs to be supported by direct direction delivered during PBM. Instructions or questions can be submitted during PBM as an effort to improve students' mindsets when studying the material.

### Use of Supporting Facilities and Completeness

Analysis of aspects of the use of supporting facilities and completeness is reviewed from five indicators, namely: (1) the Physics laboratory at my school has adequate equipment, (2) my school has an adequate computer for use by students, (3) I have studied Physics using a school computer, (4) my school has a smooth internet/WiFi connection, (5) I always bring a smartphone to school. The analysis results of the use of supporting facilities and completeness in learning Physics are presented in the graph Figure 4.

Based on the chart above, the fifth indicator obtained the highest percentage, students always bring smartphones to school. This shows that smartphones have become a primary need for students and the legalization of smartphone use in schools.

This can be a potential for teachers to make smartphones as learning media or called mobile learning.



**Figure 4.** Analysis Graph of the Use of Facilities and Supporting Completeness in Physics Learning

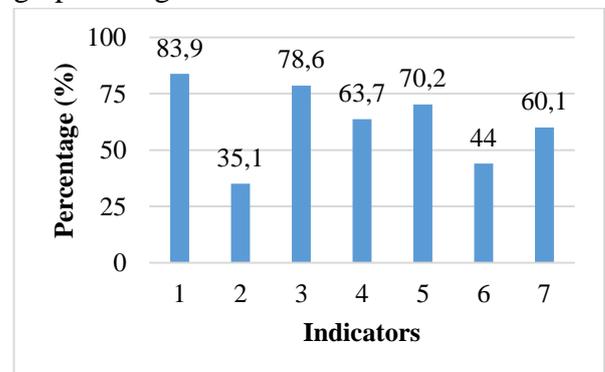
Mobile learning or mobile-based learning has benefits that can be reviewed in terms of students and teachers. In terms of students, mobile learning provides high learning flexibility. Students can access study materials at any time and can repeat material that is difficult to understand. They can also interact with teachers directly, so as to deepen their understanding of learning materials. In terms of teachers, mobile learning is useful in updating learning materials in accordance with the scientific developments that occur. Teachers can develop their potential through their free time to conduct research and improve their scientific insight. Mobile learning also allows teachers to control student learning activities, knowing when they are studying, what topics are being studied, how long the topics are studied, as well as how many times the material is relearned. With mobile learning, teachers can check student performance in doing exercises and provide direct feedback (Samsinar, 2020).

In the context of using smartphones in learning, teachers can use this technology as a learning medium that can increase student interest and motivation. Learning media that

contain multimedia is considered more fun and interesting for students compared to media that is only in the form of text. The development of mobile learning applications is one of the innovations that can be done by teachers by utilizing *smartphone*, PC, or tablets as learning devices (Astuti et al, 2017). The use of mobile learning media can increase student learning motivation, which ultimately has an impact on their learning outcomes in learning materials (Arlen et al., 2020).

### Game Usage

Analysis of aspects of game use is reviewed from seven indicators, namely: (1) I like to learn Physics when using an online learning platform equipped with interesting features, (2) my teacher has used Physics educational game-based learning media in supporting the learning process in class, (3) I have a game application on my smartphone, (4) I play games for more than 60 minutes every day, (5) I like to play games outside of Physics learning hours, (6) I like to play games when learning Physics takes place, (7) I feel something is missing if I don't play games in a day. The results of the game usage analysis are presented in the graph in Figure 5.



**Figure 5.** Game Use Analysis Graph in Learning

Based on the graph of the first 5 indicators, students enjoy learning Physics when using an online learning platform equipped with interesting features. The

indicator with the second highest score is indicator three, most students have a game application on a smartphone. This is an opportunity for teachers to develop technology-based Physics learning media.

Technology-based learning media has the potential to be developed as a learning resource. Its use can increase effectiveness and efficiency in learning activities. There are several types of technology-based learning media that can be used to help the learning process, namely: audio media, visual media, and audiovisual media. One form of technology-based learning media that teachers can develop is physics educational games. Based on research by Hidayati et al. (2023) shows that games have the potential to arouse interest in learning in students. Game-based learning makes Students more active and motivated (Afrizon et al., 2023).

Educational games are media designed to teach users to learn a particular concept and train user abilities through interaction with the game. Learning media, including games, can increase interest in learning and facilitate student distraction in learning activities. Through proper design, educational games can be an effective and engaging tool to make it easier for students to understand physics concepts and develop students abilities. Using educational games can help teachers improve the quality of learning and strengthen student involvement in the learning process (Borman & Purwanto, 2019).

Educational games take various forms based on age, genre, and level of knowledge or intended school. The questions in educational games vary, such as quizzes, picture questions, application questions, and more. Questions in educational games usually contain elements of challenge, accuracy, and reasoning, so they can train

users to answer test preparation questions, tests, and the like (Parlika et al., 2018).

Educational games have advantages over conventional learning methods. One of the advantages is the use of animation, which can improve student memory, so that the subject matter can be more easily remembered in a longer time compared to conventional teaching methods. An educational game usually consists of several levels. The level designer designs information about what the player will experience in each level, including the challenges given, what characters or things are involved in The experience, applicable rules, level design, and environmental conditions at that level. The information is used to develop game control elements and rules. Students can engage in fun and engaging learning with various question forms and levels presented in educational games. Educational games provide interactive learning experiences and challenges to students, increasing learning motivation and student involvement in understanding the subject matter (Agustin, 2017).

## CONCLUSION

Based on the results of the research and discussion above, it can be concluded that students have difficulties in learning Physics. Learning media increases student participation and makes it easier for students to understand the material. Linking Physics learning with the local culture can make Physics learning more meaningful and can increase students' scientific literacy. The results showed that students need learning media through educational physics games containing scientific literacy and ethnoscience. These results illustrate the need to develop physics educational games based on scientific literacy and ethnoscience.

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