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Development of the edu-game media *Lom's Ethnic Journey* to enhance interest in learning Mathematics and Physics among students

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ABSTRAK

Secara umum pembelajaran Matematika dan Fisika masih dirasakan sulit bagi mahasiswa. Hal ini karena minat belajar mahasiswa pada kedua mata kuliah tersebut masih rendah. Hal ini dikarenakan metode pembelajaran yang monoton, dan penggunaan media yang terbatas. Penelitian ini bertujuan untuk meningkatkan minat belajar mahasiswa pada mata kuliah matematika dan fisika dengan mengembangkan media pembelajaran berbasis game edukasi yang bertemakan kearifan lokal "orang Lom," yaitu "Lom's Ethnic Journey". Metode penelitian yang digunakan adalah design research meliputi expert review, one-to-one, small group, dan field test. Hasil penelitian menunjukkan bahwa game edukasi ini telah terbukti valid, praktis, dan memiliki efek potensial. Dari hasil efek potensial diperoleh user acceptance sebesar 86 persen dapat diterima dengan baik tanpa kendala saat digunakan di banyak jenis smartphone dan applicability organizational acceptance dalam peningkatan minat belajar mahasiswa sebesar 44 persen. Urutan minat belajar yang peningkatannya dari tertinggi ke terendah antara lain, adanya kemauan belajar, adanya pemusatan perhatian dan pikiran terhadap pembelajaran, adanya upaya yang dilakukan untuk merealisasikan keinginan untuk belajar, dan adanya perasaan senang mahasiswa dalam belajar.

ABSTRACT

Learning Mathematics and Physics is generally perceived as difficult for students, primarily due to low interest in these subjects. This is due to monotonous learning methods and limited use of media. This research aims to increase students' interest in mathematics and physics courses by developing educational game-based learning media with the theme of local wisdom "Lom people," namely "Lom's Ethnic Journey." The research method used was design research, which includes expert review, one-to-one, small group, and field tests. The study results show that this educational game has been proven valid and practical and has potential effects. The result of the potential effect is 86 percent of user acceptance, meaning it can be well received without problems when used in many types of smartphones. The implementation of organizational acceptance increased student interest in learning by 44 percent. The order of learning interest that increased from the highest to the lowest included the willingness to learn, the concentration of attention and mind on learning, the efforts made to realize the desire to learn, and the feeling of student happiness in learning.

INTRODUCTION

Learning Mathematics and Physics is generally perceived as difficult for students. This perception is reflected in the learning outcomes observed at the State Manufacturing Polytechnic of Bangka Belitung, where student interest in these subjects remains notably low. Data reveals that only 33% of students in the mathematics group and 48% in the physics group exhibit a strong interest in their respective subjects. Contributing to this issue are monotonous teaching methods, a heavy reliance on lecturer-centred instruction, and limited use of interactive media. These challenges result in a lack of engagement and motivation among students, which further exacerbates the difficulties they experience in grasping mathematical and physical concepts. To address these concerns, exploring innovative approaches that can enhance student engagement and foster a more effective learning environment is essential.

The low interest in studying the subjects is causing students to be less active and motivated, have a low understanding, and achieve poor learning outcomes (Rahma et al., 2023; Junita et al., 2023; Harahap & Hasibuan, 2023; Ramadani et al., 2023). The lack of interest in learning is due to the monotonous nature of the teaching, centered around the lecturer, and the use of learning media that is still limited to books and PowerPoint presentations (Anugerah et al., 2023). From the field study activities that revealed issues or shortcomings in the learning process, a literature review was conducted to find solutions to those problems (Hariyanti & Wutsqa, 2020).

One way to cultivate interest in learning is through the development of learning media (Rahma et al., 2023; Harahap & Hasibuan, 2023). This is because using appropriate learning media can foster a love for learning (Khabib & Auliya, 2023). The Government Regulation No. 19 of 2005 explains that learning devices are expected to be able to educate, motivate, entertain, challenge, and encourage students to participate effectively and provide space for their activities (Peraturan Pemerintah RI Nomor 19 Tahun 2005 Tentang Standar Nasional Pendidikan, 2005; Hasanah & Ain, 2022).

Today's innovative and effective interactive learning media increasingly incorporate game-based elements, as evidenced by recent studies (Hidayati et al., 2023; Nisa & Fryda Mawardah, 2023; Triyani, 2023). This approach leverages the engaging and immersive nature of games to enhance learning experiences, making complex subjects more accessible and enjoyable. According to a survey by the Asosiasi Penyelenggara Jasa Internet (A.P.J.I.I.) in 2023, internet users rated their engagement with online content, including games, at 2.9 on a scale of 1-4 (Asosiasi Penyelenggara Jasa Internet, 2023). This indicates a strong preference for and significant time spent on gaming activities among students and college students. Research by Putri et al. (2023) further supports this, highlighting that students are not only fond of games but also frequently integrate them into their daily routines. Given this trend, incorporating game-based learning into educational strategies can capitalize on students' interests and habits, potentially leading to improved engagement and better educational outcomes. By aligning educational tools with students' preferences for interactive and gamified content, educators can create more effective and compelling learning experiences (Putri et al., 2023).

The solution to increasing learning interest is to develop educational games that can be used as a medium for independent or classroom learning (Iqbal et al., 2020; Libryanti & Sudihartinih, 2023; Muhtarom et al., 2023; Purwanto & Gita, 2023). The results of several previous studies related to game-based learning media include: 1) The conclusion from the study titled "Android-based game design as a learning medium for mathematics on the topic of function presentation using Scratch software" in 2022 stated that the use of games could make learning effective with an outstanding category (Libryanti & Sudihartinih, 2023); 2) The study "Development of the educational game 'Phygo' for the Pythagorean material" in 2022 concluded that students' numeracy skills improved after the game was implemented (Muhtarom et al., 2023); 3) The conclusions from the studies titled "Development of web-based educational games in junior high school mathematics" and "Development of differentiated mathematics games" in 2022 showed that the results of both studies indicated that games can make students feel comfortable and enthusiastic and foster their interest in learning (Iqbal et al., 2020; Purwanto & Gita, 2023).

However, the limitation of previous research is that game-based learning media only contains one material or one course. In a game, it is expected to include many materials or courses so that

students can learn more. In addition, educational games are not limited to answering questions and reading material. It is recommended that the game has several challenges or strategies that are carried out outside the subject matter so that to increase students' interest in learning, an educational game is developed that contains more than one material and has challenges or strategies in the game as an effort to make them feel happy, can focus their attention and thoughts, make them want to learn, and make them realize their desire to learn (Charli et al., 2019; Slameto, 2010).

In this study, the researchers developed an educational game as a medium for learning mathematics and physics at the State Manufacturing Polytechnic of Bangka Belitung that is suitable (valid), practical, and effective for students in fostering their interest in learning. The game presents challenges, such as users needing to avoid enemies and strategies involving assistance items that users can utilize in the game.

The novelty of this research is that the researcher developed an adventure-based educational game for Android using Unity software to advance learning technology for students at the State Manufacturing Polytechnic of Bangka Belitung. The game contains material for mathematics and physics courses infused with local wisdom from the Bangka Belitung Islands Province, such as music and visuals in the game. This is because the current younger generation is less familiar with the culture of their region, making it essential for us as educators to reintroduce it to them so they can develop a love for their own culture or local wisdom (Kiriana & Widiasih, 2023; Sahira et al., 2023; Widyanti & Saingo, 2023; Yusuf et al., 2023). The State Manufacturing Polytechnic of Bangka Belitung, located in Bangka Regency, Bangka Belitung Islands, thus prompts the researcher to feel the need to develop its culture. One of the local wisdom in that district is the Lom people, who are the oldest inhabitants there (Sulaiman, 2014; Yusuf et al., 2023). They spread across two sub-districts, namely Riau Silip and Belinyu. In the Riau Silip sub-district, they are located in the villages of Mapur and Tuing, while in the Belinyu sub-district, they are found in the villages of Air Abik and Pejem (Iskandar, 2014; Wirazilmustaan et al., 2020). They spread out in the forest's interior and settled in small groups in a structure consisting of 4 to 7 memarongs, so their traditional house is called gebong memarong (Yusuf et al., 2023).

During the development of the design guidelines, the activities included selecting teaching materials, designing the educational game concept, and designing the media software, which was evaluated from the perspective of content and structure (Al-mira & Hidayah, 2020). The developed educational game, which contains material on mathematics and physics, is expected to increase interest in learning, thereby achieving the learning objectives.

The synopsis of the edu-game "Lom's Ethnic Journey" is an educational adventure game where the user plays the role of a traveler presented with a choice between two villages (Mapur containing Mathematics material and Air Abik containing Physics material) located on Bangka Island. After entering the village, the user meets a "La" person who provides information about the local culture, and after that, they will look for three objects and answer questions. After that, the user will enter the settlement of Gebong Memarong, where the "lom" people are already guarding the area to prevent the user from entering it. The user must avoid them as any contact will result in a deduction of their life. After entering the learning module, the user will watch a learning video and three associated questions. The game will end once the user passes through four meanings in each village and, therefore, can proceed to the next scene. In solving problems, users can choose assistance items such as "fifty-fifty" or "smart clue" to exchange for life supplies. After the user completes one village, they deal with a post-test questionnaire to assess the students' interest in learning about specific topics after using the game. Based on the explanation, the researcher developed educational media as a game themed around "lom people" in mathematics and physics to enhance the interest in learning among students at the State Manufacturing Polytechnic of Bangka Belitung. The educational game is called "Lom's Ethnic Journey."

METHOD

This research aims to develop a game that can enhance students' interest in learning, using the design research model of Rowntree development studies as shown in the Figure 1 (Bakker,

2018; Gustiningsi & Somakim, 2021; Habibi & Prahmana, 2022). The stages of this model are planning, development, and evaluation. This method aims to develop a product that is deemed valid, practical, and has potential effects, thereby helping to address issues according to the product's criteria (Akker et al., 2006; Gravemeijer, 1998; Nurhayati & Darmawijoyo, 2023).

The research subjects are students at the State Manufacturing Polytechnic of Bangka Belitung. The sample was taken using purposive sampling based on specific considerations, namely that the students understand the material presented in the game and have diverse abilities, including high, medium, and low levels (Sari et al., 2023). The sample for Mathematics and Physics each consisted of three students for the one-to-one test, five students for the small group test, and the field test consisted of 29 students. The students come from various study programs, including Electronics Engineering, Electrical Engineering, and Mechanical Design Engineering (Sania et al., 2021).

The instruments for data collection consist of a validation sheet, a learning interest questionnaire, interview guides, and documentation. Experts use the validation sheet to conduct an expert review with four validators to assess the game's suitability, the history of the Bangka Belitung, Mathematics, and Physics. The interview instrument is used during one-to-one testing to determine the validity of the game's use from the student's perspective. In contrast, the small group assesses the practicality of the game's usage. The potential effect of interest in learning before and after using a game was tested using a learning interest questionnaire in the field test stage (Gustiningsi & Somakim, 2021). In addition, documentation is carried out at each stage.

The data collection procedure is through responses on the validation sheet and questionnaire. The expert review validation sheet contains a checklist assessment and comments. The learning interest questionnaire included in the game also contains a checklist assessment taken during the field test phase. The interview needed to be more structured to identify the challenges, advantages, and suggestions during gameplay.

The data analysis used involves questionnaire management and data reduction. The study's validity was determined through triangulation and peer-checking (Sari et al., 2023). In this article, the stage discussed is the evaluation of the prototype for developing the Edu-game media "Lom's Ethnic Journey" to enhance the interest in learning mathematics and physics among students. The main stages in the evaluation of this prototype are formative evaluation, which begins with self-evaluation, expert reviews, one-to-one assessments, small group evaluations, and a field test (Amalia et al., 2021; Nurhayati & Darmawijoyo, 2023).

Self-evaluation is the researcher's assessment of optimising the prototype before further testing. The scope covered in the self-evaluation stage includes obvious errors (Hamdunah et al., 2016; Tessmer, 1993). This stage aims to analyze the game's development from the perspective of gameplay and content and then revise it. The results of the self-evaluation are referred to as prototype 1.

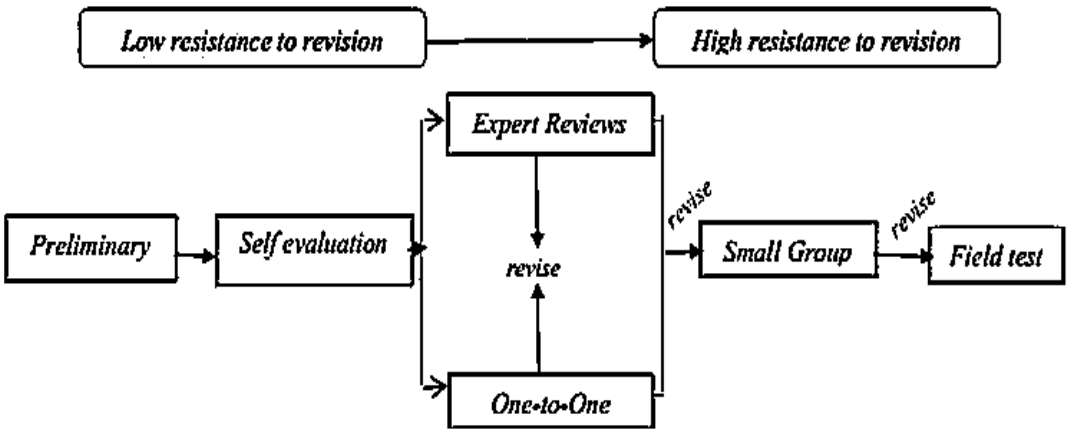


Figure 1. Flowchart of the design research model of Rowntree development studies
(Source: Ridwan et al., 2016; Tessmer, 1993)

Expert review is an expert test that provides assessments and recommendations from specialists regarding the accuracy of the game, content, and history. The scope addressed at this stage included content, design, and technical quality (Hamdunah et al., 2016; Tessmer, 1993). The game that serves as Prototype 1 was given to experts to evaluate its validity and was declared Prototype 2. One-to-one evaluations were conducted with three students to gather feedback on the game from the student's perspective as users (Pratiwi et al., 2022). The scope of this stage includes clarity, appeal, and apparent errors (Hamdunah et al., 2016; Tessmer, 1993). The students were given the Prototype 2 game to test its validity, which can be declared Prototype 3.

A small group is an evaluation of a group aimed at assessing the practicality of using games as a learning medium (Nurhayati & Darmawijoyo, 2023). The coverage performed at this stage is practical and appeals to applicability (Hamdunah et al., 2016; Tessmer, 1993). The game that became Prototype 3 was given to students to be tested for its practicality and could be described as Prototype 4. A field test is an evaluation conducted in one class to observe the potential effects of students' interest in learning through games. At this stage, the scope includes user acceptance and organizational feasibility acceptance (Hamdunah et al., 2016; Tessmer, 1993).

RESULT

The results of this research include the evaluation stages of the prototype used to develop the edu-game media "Lom's Ethnic Journey," which was conducted from July to August 2024 to enhance students' interest in learning mathematics and physics.

Expert reviews

This phase took place from 30 July to 2 August 2024. The reviewers' names and areas of expertise are as follows: Ms. Yuyun Khairunnisa, M.Kom, a game expert; Mr. Derry Nodyanti, a history and culture expert; Ms. Indah Riezky Pratiwi, M.Pd, a mathematics expert; and Mr. Dr. Agus Budiyono, M.Pd, a physics expert. The results of the expert reviews on Prototype 2 are presented in Table 1. At this stage, the material for further research will be mathematics learning videos presented in a more engaging animated format and virtual experiments that students can conduct to experience hands-on experimentation.

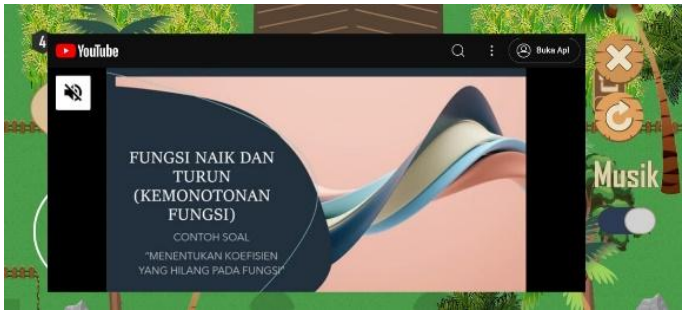
One to one

This stage took place on 5 August 2024. Three students in the Mechanical Design Engineering program conducted trials in mathematics, and three students in the Electronics Engineering program conducted trials in physics. The results of the one-to-one correspondence are presented in Table 2.

Table 1. Results of the assessment and suggestions from the expert review

No.	Area of expertise	Results of the reviewer
1	*Games and the History of Bangka* Belitung	1. The game has been conducted very well and is effective for use as a learning medium. 2. The presentation of the gebong memarong's images and the clothing of the lom people is appropriate, and the illustrations described are also accurate.
2	Mathematics and Physics	1. The materials, illustrations, examples, and practice questions are based on the syllabus, lesson plan, objectives, and learning indicators. 1. The material presented is contextual. 2. The learning video's appearance is quite engaging because the content in each scene is manageable, and the audio is clear. In addition, an interactive element emerges between the user and the material. 3. The illustrations are presented clearly, and the language is effective and efficient. 4. The order of presentation is logical. Before the material is studied, motivation is provided.

Table 2. Results of the one-to-one test

One-to-one results	Research follow-up
1. The materials are obvious and accompanied by detailed videos in the explanations, which makes students more interested and focused. 2. The game concept is engaging, and using lives (points) which helps maintain the focus when answering questions. 3. The videos should be made flexible, like those on YouTube.	 **Figure 2. The appearance of the video before the revision**  **Figure 3. The appearance of the video after revision** The researchers converted the previous learning video format (Figure 2) into a video format linked to YouTube (Figure 3).

At this stage, the materials for further research include creating a more extensive set of questions, implementing a video replay feature for each question, adding a checkpoint display, and fixing bugs or issues in this game on certain types of smartphones, which various factors may influence.

Small group

This stage took place on 12 August 2024. Students conducting trials in mathematics and physics each had five participants. The results from the small group regarding effectiveness showed that presenting material using game concepts was very effective. This is because it can help students focus more on contextually presented material. Additionally, there is a game over that requires users to be more meticulous in answering the questions. There has been an increase in interest from the five students who participated in the trial. In terms of appeal and feasibility, the students were engaged when searching for three objects at the beginning of the game because it allowed them to learn about the history, culture, and customs of Bangka Belitung. In addition, students feel challenged when answering questions where a correct answer can add lives, a wrong answer can reduce lives, and if they run out of lives, they will have to restart from the lowest level. The evil characters in the game that can reduce your life when you encounter them also make it enjoyable.

Field test

This stage was conducted on 19 August 2024. Students conducting trials in the fields of mathematics and physics totaled 58 individuals. The field test results regarding user acceptance showed that 50 out of 58 students were well-received without any issues by the users or students. Regarding organizational acceptance of applicability, students filled out a learning interest questionnaire before playing the game (pretest) and after playing the game (posttest). The increase in students' learning interest after playing the game "Lom's Ethnic Journey," compared based on learning interest indicators (pretest and posttest questionnaires), is detailed in Table 3.

Table 3. The order of increasing interest in learning among students after playing the game Lom's Ethnic Journey

No.	Indicator	Rank		Criteria	Rank
1	The presence of students' enjoyment in learning mathematics and physics while using games.	4	1.	The feeling of joy when working on problems.	1
			2.	The influence of the clarity of the material on the feeling of joy in learning.	2
			3.	The impact of learning media on the feeling of joy in learning.	3
2	The focus and concentration on learning mathematics and physics.	2	1.	The level of concentration in studying.	1
			2.	The attention to detail in the material and problems while studying.	1
			3.	Feeling mentally prepared to focus entirely during study time.	2
3	The willingness to learn mathematics and physics.	1	1.	The level of willingness to start studying.	2
			2.	The feeling of perseverance in working on problems.	1
			3.	The willingness to review the material until it is fully understood.	3
4	The efforts made to realize the desire to learn mathematics and physics.	3	1.	The frequency of preparing oneself before starting to study.	2
			2.	The frequency of managing time for studying.	1
			3.	The frequency level in trying to solve problems independently before asking for help.	2

DISCUSSION

The development of the edu-game media "Lom's Ethnic Journey" on mathematics and physics material aimed at students is intended to enhance their interest in learning mathematics. This is because interactive and enjoyable edu-games can improve students' interest in learning (Ferlina & Fratiwi, 2024; Sahronih et al., 2022). The increase in students' interest in learning is due to the current condition where students are more inclined to be interested in smartphones rather than study materials, which forces educators to seek alternative teaching media to engage their interest in learning (Erfan et al., 2020). Students' interest in learning is assessed based on indicators such as enjoyment in studying, focus of attention and thought on learning, willingness to learn, and efforts to realize the desire to learn (Slameto, 2010; Ula, 2023).

From the results of the expert review (Table 1) and one-to-one stage (Table 2), this edu-game media is declared valid. Based on the expert review phase, the game is valid regarding mathematics and physics content, gameplay, and the cultural history of the local village. Thus, the game is deemed valid. This is because, to meet validity, it must pass expert testing in terms of content, media, and other aspects (Aruna et al., 2021; Purwanti et al., 2022). In general, as reviewed in the expert review, from content, design, and technical quality (Hamdunah et al., 2016; Tessmer, 1993). In addition, the validity is also based on the results from one-to-one interviews conducted with students of the State Manufacturing Polytechnic of Bangka Belitung (Pratama et al., 2024).

In terms of content, the materials, example questions, and exercises presented to align with the learning objectives, and the information about the local village culture included in the game accurately reflects its culture. Additionally, the language used falls within the categories of efficiency and effectiveness. From a design perspective, the appearance of the learning video is already contextual and interactive. Interactive and contextual learning videos can enhance a person's interest in learning (Anggraeni et al., 2021; Jundu et al., 2020). From a technical quality perspective, the systematic provision of material, examples, and exercises, as well as the clarity of illustrations, can influence a person's interest in learning. Based on the expert review's results, this educational game can assess the increase in students' interest in learning.

From the results obtained in the one-to-one stage, this game is declared valid. From clarity, the material is presented clearly, along with images and videos. From the aspect of appeal, the game concept presented is interesting because it incorporates lives in the game, which makes

students more engaged and diligent in solving math problems, and the presence of educational videos can help students understand the material with greater focus. Overall, at this stage, students feel happy while learning using the game "Lom's Ethnic Journey." They pay close attention to the material and questions, feel diligent in working on the problems, and prepare themselves before starting to learn.

This game is declared practical from the results obtained in the small group stage. In terms of effectiveness, the material presented in the form of a game like this is already effective because the explicit content and exciting gameplay challenge students with the game-over feature when lives are lost, making them more focused on answering questions. From the aspect of appeal and applicability, students are interested in the material presented as it is relevant to their needs, and the introduction of history from the Bangka Belitung region makes this game even more engaging. Overall, at the small group stage, the clarity of the material affects the students' feelings of enjoyment; they feel they can concentrate better while playing this game, they think diligent in working on the questions, and they intend to manage their time to be able to play this game again in the future.

The results obtained during the field test phase indicate that the edu-game media "Lom's Ethnic Journey" could increase interest in learning mathematics and physics compared to before using the edu-game media. This is because learning through games has a potential effect on influencing a person's interest (Suharti et al., 2023). Regarding user acceptance, 86% of students could use the game easily without issues. The media edu-game can be played well on each student's smartphone, making it suitable for student learning activities (Octaviano et al., 2023). This game can be played anywhere in terms of organizational acceptance of applicability. It can be played individually or in groups, enhancing students' interest in mathematics and physics. This is because the flexible implementation of its use, such as learning media that can be played alone or in groups, can influence a person's interest in learning (Kurnia et al., 2021). In addition, games that can be played anywhere and anytime can also affect learning interest (Hafidz & Arini, 2022).

Based on the results of the indicators (Table 3), the most significant increase occurred in the indicator of increased willingness to learn, followed by an increase in focus and attention towards learning, an increase in students' efforts to realize their desire to learn, and finally, an increase in students' feelings of joy while learning through games. The greatest criteria obtained for each indicator are the increased perseverance of students in solving problems, increased concentration in studying and heightened attention to details in the material and questions, increased frequency of students in managing their time for studying, and increased feelings of joy while solving problems. Additionally, the criteria that still require attention include the level of willingness to review material until fully understood, the mental readiness to focus entirely while studying, the frequency of preparing oneself before starting to study, the frequency of efforts to solve problems independently before seeking help; and the influence of learning media on the feelings of joy in learning.

CONCLUSION

The media edu-game "Lom's Ethnic Journey," developed for students to learn mathematics and physics, can be considered valid, practical and effective based on the results from expert reviews, one-to-one assessments, small group evaluations, and field tests. Users generally do not encounter issues when using this educational game on most smartphones, but some types experience bugs. The use of this edu-game media can enhance students' interest in learning mathematics and physics. This is due to increased indicators and criteria of learning interest. The most significant increase in indicators is the student's willingness to learn, and the most crucial criterion is the heightened perseverance of students in solving problems. The limitations of this study, which will serve as material for future research, are that the mathematics learning videos will be presented in a more engaging animated format, and physics, virtual experiments are needed that students can conduct to experience hands-on experimentation. In addition, creating a more extensive set of questions, adding a video replay feature for each question, incorporating a checkpoint display, and fixing bugs or freezes of smartphones.

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Author contributions

The authors made significant contributions to the study's conception and design. The authors was in charge of data analysis, interpretation, and discussion of results. The final manuscript was read and approved by the authors.

Conflict of interest

The authors declare that there is no potential conflict of interest.

Data availability statement

All data are available from the authors.

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