



Development and Implementation of Educational Games as Science Learning Media

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Abstract

Background: Science learning using computer-based learning multimedia can increase student learning motivation. One of them is the use of digital educational games. However, the use of computer-based science learning media is still limited. This research aims to develop digital educational games as a learning medium for classifying living things. **Methods:** Learning media development refers to the ADDIE model (Analyze, Design, Development, Implementation, and Evaluation). **Results:** After a series of tests, the product is considered "good" and suitable for learning. **Conclusions:** Digital Education Games show that the media developed successfully increases student learning motivation. This media still needs improvement so that it can increase student learning motivation for science students.

Keywords: Learning media; development; digital educational games; material classification of living things.



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Introduction

Learning media is believed to help teachers to deliver their material to students. An interesting learning media can increase the interest and motivation of its users to learn, which ultimately makes its users fully understand the material provided (Rodgers & Withrow-Thorton, 2005). Learning media that can keep students active in learning will create a smart learning environment and, therefore, can aim to propose innovative uses of pedagogical approaches and emerging technologies to support effective learning experiences (Pesare et al., 2016). Learning media does not only use books. It can also be digital-based or ICT-based media.

Learning media assisted by technology and information (ICT) can be used to make learning interesting and positively impact academic performance in the form of learning motivation and student learning outcomes (Chuang, Y.T., 2014). The use of this type of learning media has the potential to help improve students' academic performance in the form of learning outcomes in the cognitive realm (Chuang, T.Y. & Chen, 2007) and learners' learning motivation (Calimag, J. N., Mugel, P. A., Conde, R. S., & Aquino, 2014; Hess, 2014). Learning media can make children active in the learning process, one of which is by using games.

Game elements allow players to foster experiential learning in an interactive way and a safe and risk-free environment (Oliveira et al., 2021). Many important game concepts, such as motivation, relate to different theoretical foundations, such as cognitive, affective, motivational, and sociocultural (Plass, Homer, & Kinzer, 2015). This game-based learning medium shows that Learners learn all the skills embedded at every level in the game, become engaged and motivated, and do not realize that they are learning. Alexander et al.

(2017), Using games for teaching and learning is not new. There is a wealth of research supporting the power of play in the development of skills and knowledge.

Digital game-based learning applications utilize constructivist educational theory, which combines educational content with computer or video games and can be used in almost any course and skill level (Kavak, 2022). Digital game-based learning utilizes games as a medium to deliver learning content, harnessing the power of computer games to engage users for learning purposes. Digital educational games are one type of game that is operated on various digital devices such as computers and consoles and mobile devices such as tablets. Digital Education Game is a digital game that combines learning materials into computer games as a tool to achieve learning objectives (Hwang et al., 2012; Prensky, 2007). Based on this statement, a digital educational game is a computer game that not only contains games that provide entertainment but also learning materials that can provide user knowledge and are used to achieve learning objectives. Educational games are defined as games that are designed and used for teaching and learning. We can combine fun and educative concepts in educational games to increase student motivation and engagement (Al-Azawi, Al-Faliti, & Al-Blushi, 2016).

The use of games in the learning process can also include the most effective socialization and learning processes common to all cultures. According to Kavak (2022), using games in this learning can increase motivation to learn. Digital educational games show substantial promise in advancing STEM education. Traditional classroom environments make it difficult to provide effective practical activities to meet educational needs, fostering students' complex problem-solving abilities due to time and resource constraints (Klopfer & Thompson, 2020). The increasing acceptance of digital gaming as mainstream entertainment has raised questions about leveraging the promise of digital gaming for educational purposes. Therefore, this study aims to develop digital-based educational game learning media to be utilized in education and increase student learning motivation.

Method

This research aims to develop learning media device products using the Research and Development method by adopting the multimedia learning model proposed by Reiser & Molenda, Branch (2009), the ADDIE model. This model employs a five-stage progression, namely (1) analyze, (2) design, (3) develop, (4) implement, and (5) evaluation.

The data obtained regarding the feasibility of Digital Education Games on the Living Things Classification material consists of Media Experts, Material Experts, Teachers, and Students through questionnaires with quantitative descriptive analysis. Quantitative descriptive techniques are used to analyze questionnaire data on the feasibility of digital educational games.

Result and Discussion

Based on the analysis that has been done, it is necessary to have learning media that can attract student learning interest so that a learning objective can occur. The use of learning media is expected to increase student success in mastering the subject matter. Learning media plays an important role in determining the success of a learning process. Their learning media can make learning more interesting and enjoyable and, thus, ultimately, more effective (Aguilar-Castillo et al., 2020). The process of creating an application follows a five-stage progression:

Analysis

At this stage, material development is carried out by researchers according to basic competencies. The material chosen is based on material analysis because some materials are difficult to understand, so additional features such as images and videos are needed to make it easier and easier for students to understand the material.

Design

At this stage, the researchers focus on designing the media to be produced. After obtaining data, analyze student needs, adjust subject topics to develop learning media, and then design products. And Preparation of storyboard design, digital educational games, and classification of living things. After making the storyboard, a flowchart design is made. Rollings & Morris (2004) state that the core of game design lies in gameplay. This is reinforced by the statement by Rouse (2005) that gameplay will regulate the movement of elements and other aspects in the game when responding to the actions of game players, including when players do not perform any actions. Every game must have rules and conclusions to create challenges and balance in the game. Players must complete challenges to get the maximum score. The challenge in the game of classification of living things is in the form of a time challenge. If the time provided runs out and the player has not completed the game, the user must accept the consequences; that is, the user must repeat the previously failed game. Challenges are used to attract game players' interest in the game. This has been reported by Parsons et al. (2011), which states that games can convey more interesting information through content and challenges, and users will also interact more through challenges so that the purpose of the game is easily conveyed to game users compared to other media such as photos and videos.

Development

Two expert validators validated the development stage to get good learning resource validity. This media creation uses "Unity 2D" software. After the game developer has created and tested the digital educational game, it is validated by media and material experts.

Based on media experts' results of the questionnaire analysis for the feasibility test of digital educational games by media experts, 10 components fall into the good category, with an average score between 2,2. However, there are suggestions and comments from media experts for improving digital educational games.

Table 1. Advice from Digital Educational Game Validators

Validator	Comments and Suggestions
Media Expert	<ul style="list-style-type: none"> - The font color selection is less contrasting with the background; - Music in games should not be monotonous; - We recommend that there be examples or guides for using the game; - It's best to pop up on the right answer; - Feedback on incorrect answers provides no motivation.

The digital educational game opener, according to media experts, is interesting. This is because, in the opening, the title and logo of the game are presented interestingly. The slide design in digital educational games is of good quality because the slide presentation is interesting. Text in digital educational games can be read easily, as it has spaced, size, and typeface settings that make it easy to read. Still, media experts recommend that the font color contrast with the background. This is so that the information conveyed in the game can be read and not covered by the background. It has been reported by Sweller (1994); and Mayer (2014), who stated that text style and color that affect each other with the background color displayed can increase or decrease screen readability, thereby increasing extraneous cognitive load and interfering with learning concentration. Buttons on digital educational games are used to help users navigate to the slide they want to go to. The buttons have attractive colors, the right size and placement, and consistent size. Audio, images, and animations in digital educational games are images based on the theme of digital educational games.

Material experts carry out the results of the feasibility assessment of digital educational games based on four assessment components: competency standards, language, material and feedback with an average score of 3 in the good category. Based on comments and suggestions from media and material experts, digital educational games were revised.

Table 2. Comments and Suggestions from Digital Educational Game Validators

Validator	Comments and Suggestions
Material Experts	Need to be given feedback on game evaluations that students have done to strengthen students' understanding of concepts.

Based on the validation of digital educational games' classification of living things carried out by media experts (Table 2.), there are several comments and suggestions for improving digital educational games; namely, it is necessary to provide feedback on game evaluations that students have done to strengthen students' understanding of concepts. Based on comments and suggestions from material experts, a revision of digital educational games for the classification of living things was carried out. Revisions are made so that the quality of educational games can improve during implementation in schools. The feedback that was previously absent is then corrected. Feedback needs to be given to game users to increase motivation to play the game. It has been reported by Annett (1969) states that feedback is important and can provide support and motivation in the educational and motivational process.

Implementation

Where students and teachers use digital educational games and then fill in teacher and student response instruments to test the practicality of learning media. The results of the implementation of digital educational games show (95%) of students stated that digital educational games are very interesting and can increase students' interest and motivation in learning about the classification of living things. The questionnaire results showed that the average score of digital educational games on the motivation aspect was 3.04, which was included in the good category. This is thought to be caused by the presentation of material for classifying interesting living things in digital educational games. In addition, the development of digital educational games can also stimulate students' curiosity. Because digital educational games' classification of living things provides visualization of material classification of living things, learning becomes more interesting.

Digital educational games' classification of living things provides visualization of material classification of living things, making learning more interesting. The results of the same study have also been reported by Hwang et al. (2013), that the application of digital educational games in the science learning chapter Butterfly Grade 6 elementary School in Taiwan increases student learning motivation and reduces the cognitive load of students so that learning goals can be achieved properly.

Evaluation

Fifth, Evaluate the implementation of learning media. And evaluate digital educational games developed by developers based on flowcharts and storyboard designs. The evaluation is carried out based on the results of the feasibility assessment by media experts and material experts.

Evaluation is carried out at every stage in the ADDIE model. The evaluation is based on the responses of educational game validators to the components of the Digital Educational Game Feasibility Test, namely the content and objectives and instructional and technical components.

Evaluation at the implementation stage by evaluating the implementation activities of digital educational games in schools. The evaluation is carried out based on the results of the feasibility assessment by students and teachers.

The results of the feasibility assessment of digital educational games were carried out based on 3 assessment aspects: the learning aspect, the material aspect, and the display aspect in the good category with details, namely the learning aspect obtaining an average score of 3.1.

Table 3. Comments and Suggestions from Digital Educational Game Validators

Validator	Comments and Suggestions
Teacher	Too much writing and lack of pictures/illustrations; Add the original image by listing the source; There is a music setting (don't be too loud).

Based on the feasibility test of digital educational games classification of living things by users consisting of Media Experts, Material Experts, Students, and Teachers, digital educational games classification of living things are included in the good category, with details from media experts obtaining an average score of 2.88, material experts obtained an average score of 3.35, students obtained an average score of 3.09, and from teachers obtained an average score of 2.84 so that it is suitable for use as learning media in creature classification material live. The following are the validators' validation results of digital educational game validation for the classification of living things. According to Ball et al. (2020), digital educational games provide an engaging learning environment that allows learners to interact with game mechanics in the virtual world, giving learners a meaningful gaming experience and greatly increasing their learning motivation. At the same time, digital educational games can serve as an effective learning environment, providing players with ample opportunities for simulation, real-world questions, and rich instructional support. In such an environment, learners can practice problem-solving skills, develop critical thinking, and cultivate STEM literacy (Kayan-Fadlemlula et al., 2022).

Conclusions

The development of digital educational games for the classification of living things has been successfully developed with the ADDIE (Analyze, Design, Development, Implementation, and Evaluation) model development model. Product feasibility testing by subject, media, and material experts, as well as testing by teachers and media experts, found that the application is "worth using." Based on the results of the questionnaire given to students who use this digital educational game, this educational game can increase student learning motivation in the classification of living things. This media still needs improvement so that it can increase student learning motivation for science students.

Declaration statement

The authors reported no potential conflict of interest.

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