



Development of Interactive Digital Learning Multimedia Applications as Independent Learning Module in 2-Dimensional Game Programming Courses

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Abstract

Learning activities at the Creative Media State Polytechnic after the pandemic period, especially in the design department of the game technology study program, were held in blended learning. Blended learning activities can be very effective and efficient in their implementation if the learning process is well prepared. Therefore, this study aims to produce a interactive digital learning application that can be used as an independent learning module so that students can learn without being assisted by anyone just by using this independent learning module. The approach taken is the ADDIE development method. The ADDIE development model consists of five stages, namely analysis, design, development, implementation, and evaluation. Expert response to this learning application is a crucial thing to do. This application is evaluated by an expert with a background in graphic design, learning media, and communication. This application was tested on 30 students from 3rd semester game technology study program. This research was conducted during January to October 2022. The results showed that this application was the first application made to support independent learning in the 2D game programming course at the Creative Media State Polytechnic, and received a very good response.

Keywords:

Development Research, Game Programming, Independent, Learning Module

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INTRODUCTION

The Covid-19 pandemic has had a significant impact, one of which is in the implementation of learning. All educational institutions, educators and students must be able to adopt with technology and improve their digital competences in line with the new global trends and realities in education (Onyema, et al., 2020). Educators are required to be able to organize face-to-face learning online using the currently developed technology. Some of the online face-to-face platforms that are widely used are zoom and google meet (Surani, Kusuma, & Kusumawati, 2020). Student awareness of online learning practices during the pandemic was highest on the WhatsApp group platform, then Zoom, and finally Google Classroom. It's mean that if the educators implement online learning then the educators should first use the WhatsApp platform, then Zoom, and finally Google Classroom (Fahrudin, et al., 2022).



Problems arise in the higher education learning process, such as students having trouble interacting with other students or lectures. Therefore, in helping students interact and improve the learning environment, educators can form social media groups to communicate between students and others to improve the atmosphere of the learning environment (Amin, Alimni, & Lestari, 2021). In addition to the interaction between educators and students, students' understanding of learning material is of course the most important thing. When learning outside the classroom, educators should provide self-contained learning modules that are easily accessible to students. One of the independent learning carried out by students is using interactive multimedia applications based on Android. Interactive multimedia can empower the educational process through increased interaction between teachers and students. The use of technology in the development of learning media has an important role in improving the quality of teaching and learning outcomes for students.

The game technology study program that received an operational permit in 2019, is trying to improve the quality of learning, one of which is by increasing the availability of multimedia to support learning. 2-dimensional game programming is one of the core courses in the game technology study program that hones students' skills in the competence of making and developing 2-dimensional educational games. These courses require high logical and critical thinking skills from students. Based on the analysis and discussion during the lecture, many students had difficulty understanding the 2-dimensional game programming lecture.

Students who are new to programming courses think that learning programming is something complicated. In response to this, a guided tutorial strategy is needed to gradually change the paradigm. Visual media and creative tasks are one of the tools that are requested by digital natives in learning activities. Previous research on the use of multimedia in programming learning shows that students who are categorized as digital native students are interested in visual media and creative tasks (Saeeda Naz, Iqbal, Irfan, Junaid, & Naseer, 2014). The integration of multimedia as a reflection tool in learning is very important to maintain student motivation and involvement in programming classes (Annamalai & Salam, 2017)

The application of multimedia technology in the development of learning media is able to integrate aspects of knowledge and skills. The success of multimedia technology has revolutionized teaching and learning methods (Rajendra & Sudana, 2017). In studies on the use of multimedia in education, it has been agreed that multimedia increases student success, positively influences student attitudes, and makes learning more enjoyable and understandable (Ilhan & Oruç, 2016).

Based on the theory and problems that have been described previously, it can be concluded that the use of multimedia learning in programming courses can help students to understand the material better. Therefore, this research was carried out to produce The First Android-Based Interactive Learning Multimedia Application product as a new Learning Media of independent learning in Game Programming Courses. The interactive learning multimedia application will be developed as a learning video feature that can be accessed when the user is online. Students can

play learning videos according to their needs. In this learning multimedia application, interactive quizzes are also included so that it will increase students' understanding of the content of the material being studied.

METHODS

This study aims to produce interactive learning multimedia applications for 2-dimensional game programming courses. Sampling was carried out by non-random (non-probability) sampling with purposive sampling technique. The population in this study were all students who studied 2D game programming. The sample in this study were 30 students in 3rd semester of game technology program. This is based on the problems raised in this study to help students in learning 2D game programming. The questionnaire served as a research tool. Data collection is carried out by direct observation when the stages of product implementation in learning process. The data analysis method used is a qualitative analysis using the Likert method. This research was conducted during 2022 from January to October.

Application development uses the ADDIE (Analysis, Design, Development, Implementation, Evaluation) approach. The ADDIE approach to the development of learning media refers to the ADDIE approach from Kurt (ADDIE Model: Instructional Design, 2018) also from Branch (Branch, 2013) describe in Figure 1.

The research procedure used in this study is described in Figure 1. The first stage is the analysis stage. At the analysis stage, the activities carried out are needs analysis in study programs related to learning media, analysis of learning materials that will be raised in learning multimedia applications, validation of gaps between learning resource needs and current online learning conditions, and analysis of software and device requirements hard to develop products. The second stage is the design stage. At the design stage, the activities carried out are the selection of learning materials for applications, application design, application interface design, trial design and evaluation instruments. The third stage is the development stage. At the development stage, the activities carried out are application development, validation by media experts.

Alpha testing carried out by developers, revision of test results, beta testing carried out by involving 30 students of game technology study, revision of test results and Apk builds. The fourth stage is the implementation stage. At the implementation stage, the activities carried out were implementing applications in learning by involving two classes of 3rd-semester students of the game technology study program. Before learning begins, a pre-test is given to students. After the pre-test, learning is carried out using applications that have been developed. After the learning was completed, a post-test was conducted and data was collected through a questionnaire to obtain data on students' perceptions of the learning applications used. The last stage that is passed is the evaluation stage. The activities carried out at the evaluation stage are evaluation of the use of applications in the learning process, as well as evaluation of perceptions of applications developed using questionnaire data that has been filled in the previous process.

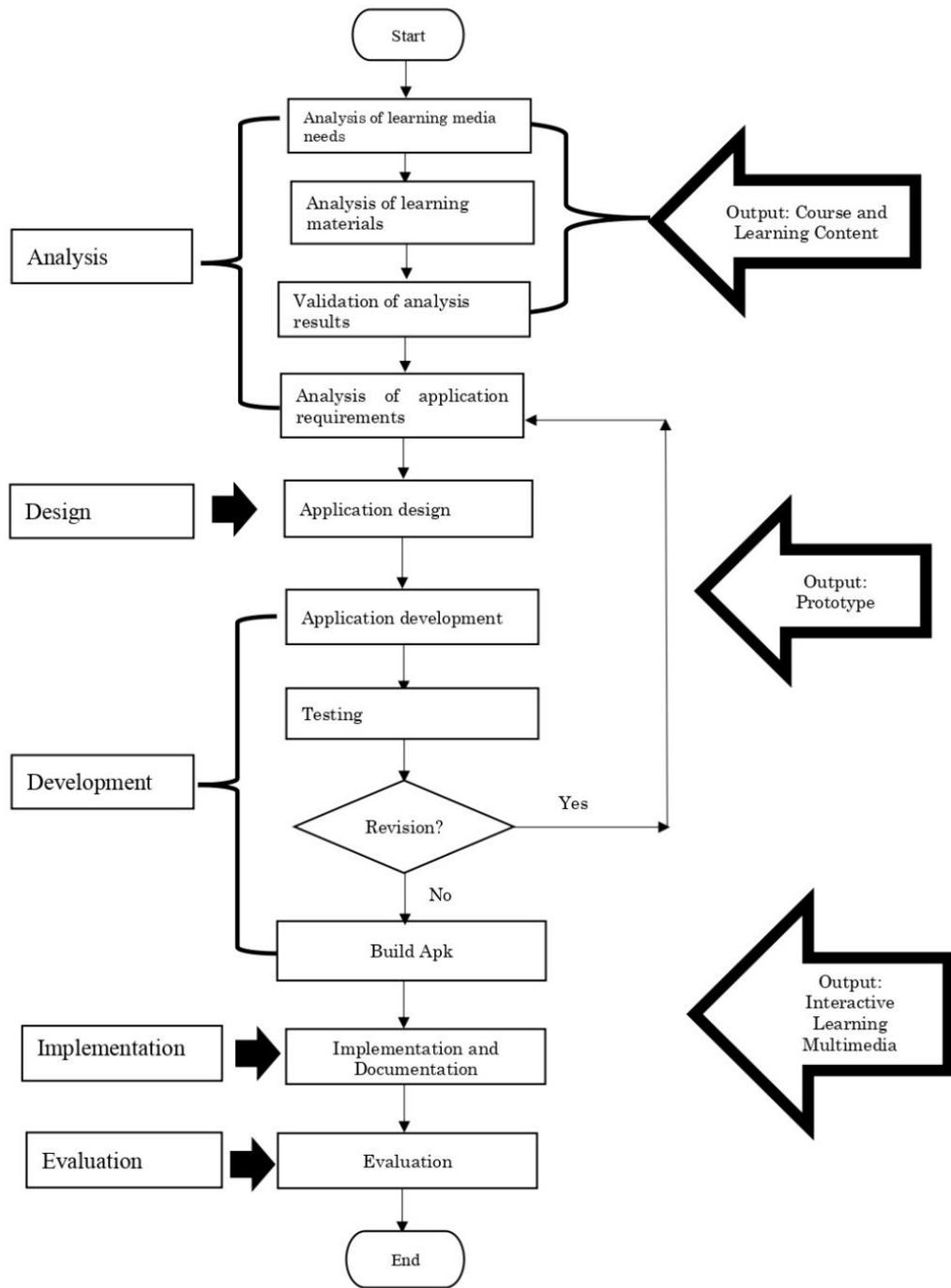


Figure 1. Research Procedures Based on ADDIE Model

RESULTS & DISCUSSION

Results

1st Stage: Analysis

Analysis of study program needs in learning media

The first stage in this research activity is the analysis stage. The analysis stage is a very important stage in the development process. At this stage, the author contacted and discussed with the creative media state polytechnic quality assurance agency and the head of the game technology study program. This activity was carried out to obtain information about the need for learning media in the game technology study program. From this activity, information was obtained that many practicum courses do not yet have learning media that support students' independent learning. One of the practicum courses in the game technology study program is 2-Dimensional game programming. Based on the results of the discussion, the researchers intend to develop interactive learning media to support independent learning in 2-Dimensional game programming courses.

Analysis of learning materials that will be raised in learning multimedia applications

The 2-Dimensional Game Programming Course consist of topics that must be submitted to achieve learning outcomes that have been determined by the study program. topics that must be conveyed in this course are object transformation, collision detection, animation, audio in games, user interface games, making platformer game projects, making puzzle games and making educational games. These materials are taught both online and offline. From the existing materials, the subtopic of making a platformer game was chosen as the material content that will be raised in the interactive multimedia that will be built. The platformer game is the first game that is taught thoroughly from project setting to finalization.

Validation of the chosen learning materials

The material contained in this course really needs reinforcement apart from the material explained by the lecturer in class. The selected material is material about the practice of making platformer games. The practicum material for making platformer games is a comprehensive material that provides a systematic learning experience on how to make platformer games, from project setup to scoring function creation. This comprehensive material requires independent learning media that can be used by students independently without being accompanied by lecturers or instructors. In validating the material, the researchers discussed with their colleagues and fellow practitioner lecturers who both teach game programming courses.

Analysis of application requirements

The developed application must qualify as an independent learning module. This module must be able to facilitate students to study independently without being accompanied by a tutor or others. Based on this, features are needed that are able to

accommodate this. Multimedia is a combination of text, graphics, audio, video and animation. In the developed multimedia application, the following features will be created:

1. Features that can provide information about learning outcomes, course descriptions, assessment systems and assessment criteria.
2. Learning videos that can be accessed through mobile-based applications. Through these learning videos, students can repeat again, if there is material that is left behind or that still needs time to understand it.
3. Structured learning module. Text-based module developed to accommodate when learning videos cannot be played. This text module is made systematically according to the procedures that will be carried out in the platformer game development process.
4. An interactive quiz to measure the level of students' understanding after following the learning process using an application that has been developed.

2nd Stage: Application Design

The author is looking for a design reference or user interface design that is suitable for learning applications. Next, the author discusses with colleagues from the design to obtain input related to the interface that suits the needs. The interface is made adapted to the functional requirements that have been defined previously. The following is a user interface design. The user is a 3rd semester student in the game technology study program and a 4th semester student in the multimedia study program. The interface is designed as follows

1. Color selection. The color chosen is green. This color shows a natural atmosphere and represents the existence of technology in learning.
2. The interface is designed to meet the need to be able to convey learning messages in the selected courses
3. The interface is made to display features that can provide information related to course learning achievements
4. The interface is made to be able to provide features that can provide information related to learning objectives and competency standards and basic competencies of the topics presented
5. The interface must facilitate the video and text used in the digital module.
6. The quiz interface must be able to display the scores that have been achieved by students
7. Learning materials are presented either through learning videos that are not too long in duration, which raise each sub-topic on the project
8. Provide a minisite that presents digital modules on the topics raised

User interface Design



Figure 2. Loading and register screen

Why should there be a registration and login menu? This is an effort to increase awareness of students and increase engagement between applications and students. So that students are more motivated to learn.



Figure 3. Login and Home Screen

On the Home menu page Name, NIM, Class are retrieved from the database

- The title of the material is in the form of a panel, when clicked it only changes color, and does not change the scene

- b. Button CPL Study Program, CP MK, Sub-CP MK, Description of the Court, and Credits will display a Pop-Up that displays the appropriate information when clicked
- c. Button Learning material will move scene when clicked
- d. The evaluation button will switch scenes and display an interactive quiz



Figure 4 .Topic and In Modul Screen

On this page, the interactions that occur are as follows:

- a. Name, NIM, Class taken from database
- b. The title of the material is in the form of a panel, when clicked it only changes color, does not change the scene
- c. The Sub-CPMK button, assessment indicators, assessment criteria and assessment techniques will display a Pop-Up that displays the appropriate information when clicked.
- d. Button Learning material will move scene when clicked

3rd Stage: Development Process

Learning module Development

Develop the Concept of Material in accordance with the Curriculum

The author correlates the material on the subject raised in this learning application with the basic concepts that have been explained in the previous meeting. the author Develops a procedure for making a 2-Dimensional platformer game using the Unity 3D game engine. The making of a 2-dimensional platformer game in a learning application is completed by taking 10 procedures that have been defined.

Creation of explanatory content on selected subjects

Based on the previous activity stages, it has been defined 10 steps to create a 2D platformer game using Unity. The author creates application content in the form of text and graphics which is a narrative explanation of making a 2Dimensional

platformer game in Unity 3D. The procedure in developing practicum videos on selected subjects:

1. The author makes a learning video using screen cast o matic
2. The learning video consists of 11 short videos
3. The composition of the 11 videos contains 1 video overview of selected subjects and 10 learning videos about making platformer games using Unity3D
4. The author uploaded the 11 videos into the youtube channel which can be accessed at <https://youtu.be/XOOVZIXrseE>

Application Development

In developing a 2-dimensional game programming learning application, the author chose android technology because android users in Indonesia are very superior compared to iphone, blackberry and symbian. The editor used by the author is Android Studio because it is the official Integrated Development Environment (IDE) tool for developing Android applications from Google and JetBrains. The language used is kotlin because it is a modern programming language through static typing that is used by more than 60% of professional Android developers to help increase productivity, developer satisfaction, and code security. The database uses roomdatabase which is a library part of Android Jetpack which can increase productivity in Android application development.

1. Use case diagram

In this context, the researcher chooses Android Smartphone users (users) as actors. The following is a use case diagram that describes user activities:

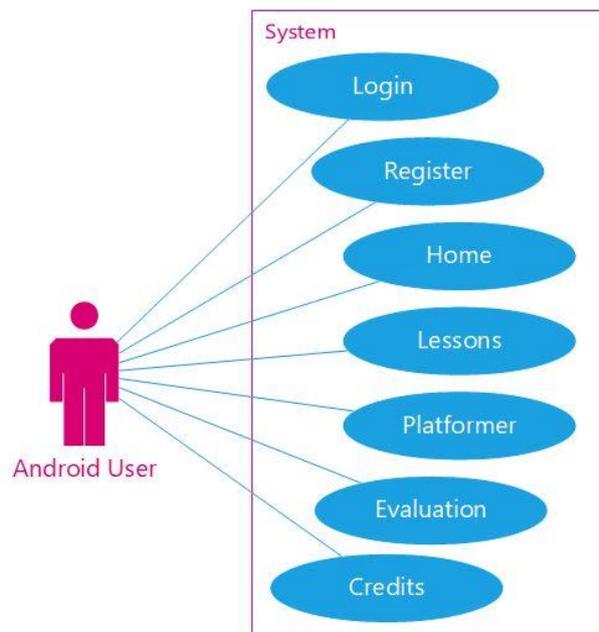


Figure 5. Use Case Diagram

Note:

In the use case diagram above, the user as an actor has a login, register, home, material, platformer, evaluation, and credits use case.

2. Database Diagram

The following is for the Room Database design that was made:

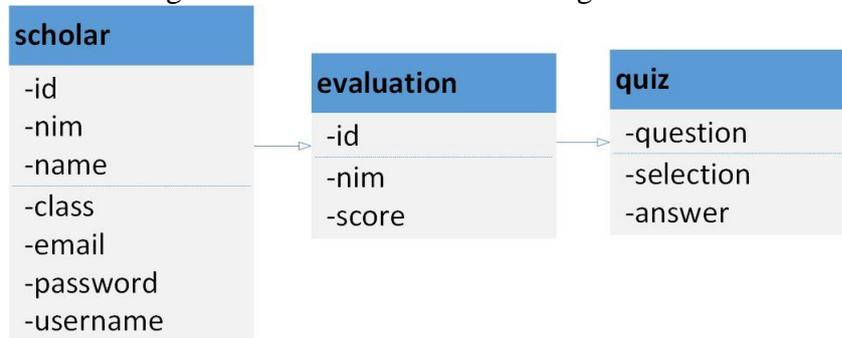


Figure 6. Database Diagram

Notes:

In the LRS diagram above, the application using the room data base has 3 tables, namely students, evaluations, and quizzes

3. Fitur Development

- A login page, each user must login first before entering the home.
- A register page, if you don't have an account to login, the user can register first.
- Material pages that can be in the form of text, images, and videos. so that it can make it easier for users to understand the material.
- An evaluation page to find out how far the user understands the material.
- A score page to find out how many scores all users get.

Alpha Testing

Alpha testing is done to test the application to several users, to find out whether there are bugs that occur or not. From this test, information was obtained that the application was successfully installed on the Android application with the Samsung, OPPO and Xiao Me brands. All features work well and can convey information well.

Beta Testing

This test is carried out on students who have the potential to use this application, namely in semester 3 students. From this test, information is obtained that students are greatly helped by this application. The following is the documentation at the time of beta testing.

4th Stage: Implementation

The implementation is carried out in class C game tech. Where students independently work on modules and the results are uploaded into SIAK. The activities carried out by students during implementation are described in the flowchart as follows:

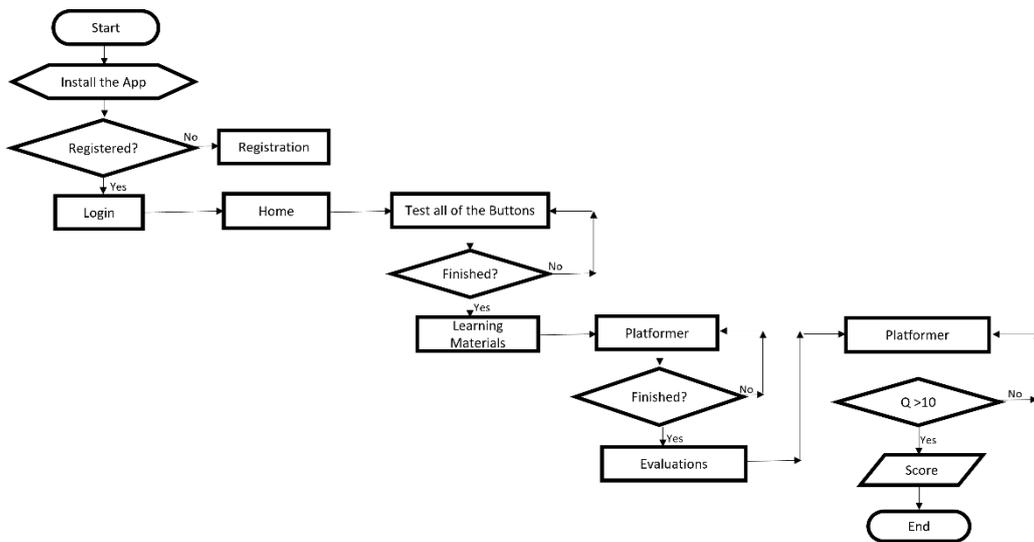


Figure 7. Implementation Procedures

The implementation is limited to the material for making platformer games as a prototype of this independent learning module application.

5th Stage: Evaluation

Evaluation activities are carried out to determine the extent to which learning outcomes can be achieved. The instrument used by the author is a multiple-choice assessment to determine the extent to which students understand the material given. From 2 classes with a total of approximately 40 students, the quiz scores in the learning materials presented were obtained an average of 80, which means that students have a good level of understanding of the material provided.

DISCUSSION

The development of interactive learning multimedia applications has resulted in successful applications that have been tested according to development research criteria. The product developed includes features that are able to present comprehensive information about a course. This application is guaranteed quality because starting from material analysis, multimedia needs analysis and interface design and experience guided by experts in their respective fields. The resulting system is an interactive learning multimedia application that functions as a student self-learning module that can be accessed easily, both online and offline.

The system resulting from this research is expected to be a special learning supplement in 2D game programming courses at the vocational level. There are no research products that produce 2D game learning applications that can be used as learning modules. The research that has been done focuses more on interactive learning media (Simanihুরু, Mukhtar, & Tanjung, 2020) and game-based learning multimedia (Hidayanto, Munir, Rahman, & Kusnendar, 2017) for basic programming, and developing web-based learning media to deliver web programming material (Manggopa, Kenap, Manoppo, Batmetan, & Mewengkang, 2019). This shows that the system being built is relatively new in the competence of game programmers.

This learning multimedia application has gone through expert testing to verify that the system built really meets the research objectives. The development model used is the ADDIE Model which has been widely used in developing applications. Research conducted by Hidayanto, Munir, Rahman, & Kusnendar (2017) used the ADDIE Model to find out how to design and build adventure game-based multimedia learning and its effect on increasing students' understanding of basic programming in SMK. the results show that the level of understanding of students has increased in the medium criteria. Meanwhile, the resulting media showed very good results in terms of learning and visual communication. Meanwhile, Mujib, Widyastuti, Suherman, Mardiyah, & T D Retnosari (2020) Uses the ADDIE model in their research which aims to find out how to develop it, determine its feasibility, and find out the responses of teachers and students to Construct 2 as a medium for learning mathematics on polyhedron material. By implementing the ADDIE model, it is found that the implementation of Construct 2 is categorized as very good based on the results of small group trials and large group trials. Furthermore, the teacher's response during the trial showed that the Construct 2 learning media was included in the very good category.

Interactive multimedia as an effective learning media to achieve learning goals (Syahputra & Maksum, 2020). Interactive multimedia teaching materials are very practical and effective for improving learning outcomes and are feasible to apply in the learning process (Krismadinata, Elfizon, & Santika, 2018). It can be used as interactive learning module that very effective to help improve student understanding (Tawardjono, Sulistyono, & Efendi, 2017). Interactive multimedia can also be used in learning and is effective in strengthening student character (Solihah, Septiani, Rejekiningsih, Triyanto, & Rusnaini, 2020). The use of interactive learning modules contributes to showing changes in students' positive attitudes shown by students becoming more active and motivated in the learning process (Leow & Neo, 2014). Interactive multimedia can also be used as a medium to improve basic teaching skills (Sudarman, Riyadi, & Astuti, 2020).

The developed application received a fairly good response from students. With today's growing media, more innovation is needed in the development of this independent learning module. There is still a lot of learning content in 2-dimensional game programming that has not been added. These materials are material on object transformation, collision detection, in-game animation, audio, user interface, puzzle games, and educational games. Further innovation is needed in this learning media so that it is appropriate to technological developments, although this independent learning application has had a good response from the students. They find it very helpful to understand the material with the learning video in addition to the text module. Moreover, there is an evaluation in the form of a quiz that helps students find out the extent of achievement in the material that has been studied. Among the alternative innovations that can be done is the creation of interactive videos that involve users when users access the video. One form of interaction that can be built, for example, is that users need to respond to questions given by the instructor when the video is played. It takes strategy and knowledge to build or create videos of such specifications.

CONCLUSION

This research has succeeded in providing an interactive multimedia learning application that can support independent learning in 2D game programming courses. The applications produced in this study have been tested by experts in related fields, namely media, materials, design, and communication experts so as to produce quality learning applications. This application can be used in study programs at vocational colleges that provide game programming competencies. The results of the application testing show that the student response is very good towards the applications that have been made both from the design and material aspects, so that these applications are ready to be used as independent learning media in 2-dimensional game programming courses.

CONFLICT OF INTEREST

In the research conducted, the author does not have a conflict of interest with anyone. The author developed this application because of motivation in providing quality learning modules for students, especially students of the 3rd-semester game technology study program.

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