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Development of an Educational RPG Genre Game for Greedy Algorithm Material in 11th Grade Informatics Students

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Abstract

This research is motivated by the difficulties of grade XI students of SMA Negeri 1 Bangkalan in understanding the greedy algorithm material in Informatics subjects. This material requires computational thinking skills because it combines theory with programming code. Learning that only relies on PowerPoint presentations before practice makes the classroom atmosphere less interesting and tends to be boring. As a solution, an RPG genre educational game was developed as a learning medium for greedy algorithm material in grade XI Informatics. The development of this game uses the ADDIE model which includes the stages of Analysis, Design, Development, Implementation, and Evaluation. The results of the analysis showed that there was no game-based learning media for this material, so the development was carried out as a learning innovation. The game that was developed received a very feasible assessment by media experts 93% of lecturers and 96% of teachers and material experts 99% of teachers and 93% of lecturers. Trials on individual, small, and large groups showed feasibility levels of 96%, 93%, and 95%, respectively. Based on these results, it can be concluded that this educational game is very good to be used as a learning medium for greedy algorithm material at the high school level.

Keywords: ADDIE, Android, Educational Games, Greedy Algorithm.

INTRODUCTION

Over time, information and communication technology has undergone rapid development, providing significant conveniences across various sectors of life. The field of education is one sector that has experienced a positive impact from this advancement. The Law of the Republic of Indonesia Number 20 of 2013 concerning the National Education System states that education is a conscious and planned effort to create a learning environment and a learning process that enables students to actively develop their potential. The objective is to ensure that students possess spiritual values, self-control, personality, intelligence, good character, and the necessary skills for themselves, society, the nation, and the state.

According to Pradanita & Sumbawati, (2020), one aspect of technology currently undergoing rapid development is digital games. A game constitutes a form of multimedia-based entertainment designed attractively to allow players to experience enjoyment and achieve emotional satisfaction. When games are utilized as a learning tool, they are referred to as educational games. Educational games possess several characteristics, including: challenges, gradual difficulty levels, high visual appeal and interactivity, a pleasant learning atmosphere, non-didactic nature, and an experience-based approach. Furthermore, educational games also provide feedback, involve social elements, encourage cooperation, and require specific skills. The combination of animation and narrative within educational games plays a role in enhancing student engagement. Consequently, educational games hold significant potential for fostering student learning motivation.

One popular genre of educational games is the RPG, or Role-Playing Game, which focuses on the development of user-controlled characters. A key feature of RPGs is a complex storyline with interconnected characters. Players control the main character, while other characters appearing in the game's plot but not controllable by the player are known as Non-Playable Characters (NPCs). The presence of narrative elements and character interaction makes RPGs compelling as a simulation and role-based learning medium (Fathurridho & Fauzy, 2020). Previous research has substantiated the effectiveness of utilizing RPG-based educational games in improving student learning outcomes. For instance, a study conducted by Jumadi (2024) demonstrated that the implementation of RPG-based learning media was capable of enhancing students' understanding of network topology concepts and was feasible for application in the learning process. Furthermore, at the primary education level, Ardiansyah et al. (2023) concluded that the use of RPG-type educational games effectively increased student engagement and strengthened their comprehension of plant anatomy material.

Although various studies indicate positive results from implementing educational games, the reality on the ground, particularly in 11th Grade at State Senior High School 1 Bangkalan, still presents several challenges. Based on the researcher's observations, the learning process faces constraints, one of which is the limitation of technological facilities, specifically the inadequate number of computers, leading students to more frequently use smartphones as a learning alternative. Although this device offers greater flexibility, its effectiveness diminishes when material is still delivered conventionally, such as through PowerPoint presentations.

This condition is further supported by the results of interviews with the Informatics subject teacher, which revealed that students are more engaged in learning when the instructional media is interactive. However, learning in 11th Grade is currently still dominated by the use of PowerPoint, which is less capable of sustaining student attention, especially during afternoon lessons. This results in low student comprehension of complex material like the greedy algorithm, which has a high level of abstraction and requires strong logical skills for understanding.

In response to these identified problems, the proposed solution is to design and develop RPG-based educational game media specifically engineered to facilitate students' comprehension of the greedy algorithm concept. This will be achieved through an interactive simulation approach, where students assume the role of the main character faced with a series of progressive missions that must be

completed by applying the logical principles of the greedy algorithm. This media is developed for a smartphone-based primary platform, considering the predominant use of smartphones among students. Thus, this educational game serves not only as a solution to the limitations of technological resources but also supports the achievement of competencies in F Phase learning, where students are required to understand and apply the greedy algorithm accurately and efficiently in problem-solving.

METHOD

This research employs a Research and Development (R&D) approach. According to Sugiyono (2022; 297), the R&D method aims to produce a product and test its effectiveness. The R&D method was utilized to develop an educational game specifically designed for 11th grade students at State Senior High School 1 Bangkalan, with the aim of supporting a more interactive and effective learning process. The development of this educational game employs the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation.

The first stage is Analysis, this is the initial step in data collection, aiming to identify the needs and problems that form the basis for the research development. The researchers conducted an analysis of the curriculum, student needs, learning problems, material analysis, and developer requirements.

The second stage is Design, this stage primarily focuses on developing the initial game concept, which includes creating the flowchart, sequence diagram, and storyboard to serve as the visual and structural foundation for the development process. These elements function to provide a comprehensive overview of the game's flow, features, and interaction mechanisms.

The third stage is Development, this is the production phase of the educational game on the greedy algorithm material. The game was created using CorelDraw 2020 and Unity 2D software. The resulting product will then proceed to the next stage, Implementation**.**

The fourth stage is Implementation, this is the process of applying the developed media within the testing scope, which involves validators (material and media experts) and educational game users. According to Suryani et al. (2018; 146), the user scope is divided into three types of trials: individual trials (3 students), small group trials (9 students), and large group trials (24 students). Deficiencies or revisions suggested by the experts and student responses will be addressed in the Evaluation stage.

The fifth stage is Evaluation, this is the final step of the ADDIE development model, which involves conducting an evaluation of the developed product. The evaluation results from the validators and users will be presented in the form of quantitative and qualitative data.

The research instruments employed validation questionnaires and student response questionnaires. The validation questionnaires included material and media validation. The blueprint of the material validation questionnaire instrument (Febrianti et al., 2021) is presented in Table 1, and the blueprint of the media validation questionnaire (Febrianti et al., 2021) is presented in Table 2. The student response questionnaire was used during the trial phase. The blueprint of the student response questionnaire (Febrianti et al., 2021) is presented in Table 3.

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Table 1. Blueprint of the Material Expert Validation Instrument

Aspect	Indicator
Content Feasibility	Alignment of material with student competencies
	Clarity of material delivery
	Material coherence
	Alignment between cognitive development and the level of difficulty faced by students
	Practice questions relevant to the Greedy Algorithm material
	Alignment of Greedy Algorithm material with student needs
	Completeness of the material presented
Language	Appropriateness of material simulation provision
	Alignment of language use with cognitive level
	Use of images appropriate to the material
Simulation and Practice Questions	Alignment of questions with the material taught
	Alignment with the answer key
	Questions tailored to student abilities
	Accuracy of feedback in simulation questions

Table 2. Media Expert Validation Instrument Blueprint

Aspect	Indicator
Educational Game Components	Attractiveness of the initial display
	Alignment of the title with the material content
	Clarity of instructions
	Completeness of identity
Display Arrangement	Attractiveness of the educational game design
	Ease of button usage
	Text is easy to read
	Visual design utilizes attractive colors
	Attractive and appropriate layout
Interactivity	Arrangement of music used is appealing
	Language used is easy to understand and engaging
	Its usage involves students
Overall Assessment	Educational game's ability to attract student interest
	Role of the educational game as a learning resource
	Educational game aligns with student needs
	Educational game supports the achievement of learning outcomes

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Table 3. Student Response Questionnaire Instrument Blueprint

Aspect	Indicator
Educational Game Components	Attractive display of the educational game
	Alignment between material content in the educational game
	Animations displayed in the educational game
	Clarity of objects in the educational game
	Alignment of music with the educational game's content and display
Display Arrangement	Material presented is easy to understand
	Educational game layout is appropriate and attractive
	Educational game design is appealing and uses attractive colors
	Arrangement of music used is appealing
	Buttons or navigation in the educational game are easy to use
Material Presentation	Ease of understanding the material in the educational game
	Use of clear and easily understandable language
	Diversity of attractive images
	Text contained in the educational game
	Use of simulations relevant to the material presented
	Questions and problems aligned with the material taught
Overall Assessment	The use of the RPG educational game genre facilitates my mastery and comprehension of reading numbers and symbols related to the media
	The use of the RPG educational game genre facilitates my mastery and comprehension of graphical forms, images, and so forth related to the media
	The use of the RPG educational game genre facilitates my mastery of analysis results for predicting and making decisions concerning learning.

Data were analyzed using qualitative and quantitative descriptive analysis techniques. The validation questionnaire percentages were calculated using a scoring method based on the Likert scale. Presented in the following Table 4:

Table 4. Likert Scale Guidelines

Criterion	Score
Excellent	5
Good	4
Moderately Good	3
Poor	2
Very Poor	1

The questionnaire percentage results (**K**) were calculated using **formula (1)** (Febrianti et al., 2021).

$$K = \frac{F}{NxIxR}\ x\ 100\% \quad (1)$$

Description:

K: Validation percentage

F : Total sum of respondent answers

N: Highest score on the questionnaire

I : Total number of questions on the questionnaire

R : Number of respondents

Based on the calculation results, the educational game's feasibility conclusion was obtained using the Likert scale criteria shown in Table 5.

Table 5. Product Feasibility Criteria

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Category	Percentage (%)
Very Not Feasible	0-20
Not Feasible	21-40
Less Feasible	41-60
Feasible	61-80
Very Feasible	81-100

RESULTS AND DISCUSSION

The initial stage in the ADDIE model is Analysis, where researchers must comprehend and establish objectives so that the resulting product aligns with the needs and characteristics of the users, as well as the learning goals. In the research conducted at State Senior High School 1 Bangkalan, it was discovered that students encountered difficulties maintaining focus during learning, limitations in computer access, and a lack of modern learning media capable of supporting the classroom learning process. Therefore, it is crucial for researchers to consider student characteristics to understand their needs and preferences in learning. This needs analysis assists researchers in evaluating aspects that require improvement in accordance with the school curriculum, ensuring that the designed learning solution is more effective and capable of boosting student motivation.

The second stage in the ADDIE model is Design, which involves planning various aspects of the educational game media creation. The media developer must create a flowchart, sequence diagram, and storyboard as the primary guide for the visual flow and structure of the educational game media to be developed. The game design incorporates three main menus, they are Learn, Simulation, and Play, and one additional menu is Options. The Learn menu contains learning material and competency achievements, Simulation provides interactive activities such as drag-and-drop coding, whereas Play contains three levels of evaluative gameplay that can be played with increasing difficulty, supported by game hints. In Level 1, the mission to be completed is to find 2 books; in Level 2, the player must find 3 laptops; and in Level 3, the mission to be completed is to find 5 trophies. The presence of coins is beneficial for increasing the player's life, where exchanging 5 coins will grant 1 life.

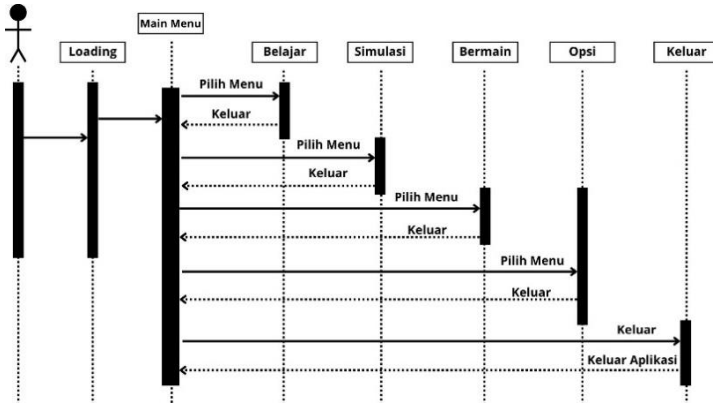
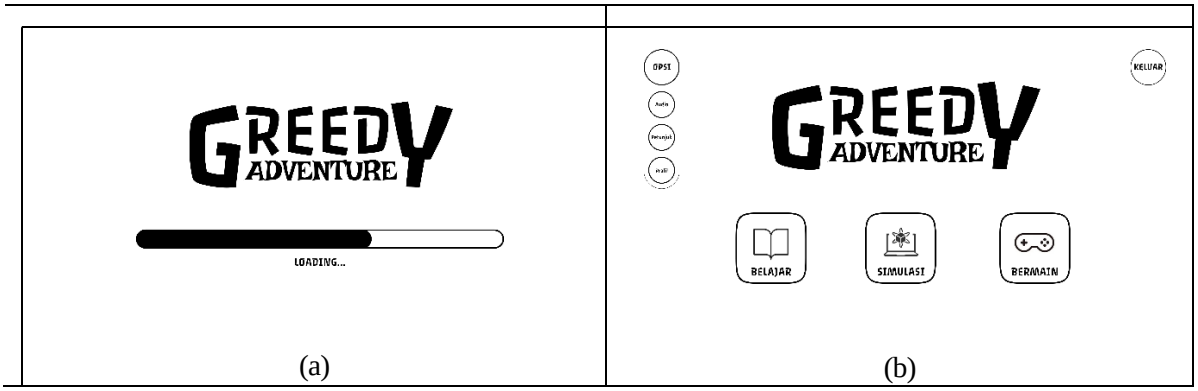


Fig 1. Sequence Diagram

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(a) (b)

Fig 2. Initial Display Storyboard

The Third Stage is Development, Media development was carried out using applications such as Unity, Figma, and CorelDraw as supporting tools for the game design. The display of the educational game development results can be seen in Table 6.

Table 6. Educational Game Development Results



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After the product development was completed, the next step was the implementation phase, which included expert validation and student trials. Validation was conducted to determine the relevance of the material and product design, which established its feasibility before the trials were carried out on the students. The recapitulation of the expert validation data is shown in Table 7.

Table 7. Results of Material Expert and Media Expert Validation

Expert	Total Score	Average	Criterion
Material Expert (Teacher)	69	99%	Very Feasible
Material Expert (Lecturer)	65	93%	Very Feasible
Media Expert (Teacher)	77	96%	Very Feasible
Media Expert (Lecturer)	74	93%	Very Feasible

The results of the student responses can be seen in Table 8 below.

Table 8. Student Trial Results

Group	Average	Criterion
Individual	96%	Very Good
Small Group	93%	Very Good
Large Group	95%	Very Good

Based on the validation results, which yielded a Very Feasible category, and the student trial results, which were categorized as Very Good, it can be concluded that this educational game is suitable for use in the learning process for the Informatics subject in the 11th Grade of Senior High School (SMA).

The Fifth Stage is Evaluation. The fifth stage is evaluation. The developed product has undergone a long evaluation process involving the media validator, material validator, and user target trials. Suggestions and criticisms regarding the research product included less color consistency in the game display, the addition of alphabetical points to question answers, and the addition of images to the questions.

CONCLUSIONS

Based on the research conducted, several conclusions can be drawn:

a. The development of this educational game uses the Research and Development (R&D) method with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). It was developed using Unity 2019 software for application creation and CorelDraw 2020 for design. The final development result is an educational game application.
b. The Greedy Adventure game is Android-based and can be accessed via a smartphone. The feasibility validity test results conducted by two expert validators, namely media experts and material experts, showed a percentage value of 93% from the Media Expert (Lecturer) and 96% from the Media Expert (Teacher). Meanwhile, the results from the Material Experts were 99% (Teacher) and 93% (Lecturer). All validators stated that the educational game is feasible for use as a learning medium.

c. Based on the assessment of student response questionnaires from three trials, individual, small group, and large group, the percentages obtained were 96%, 93%, and 95%, respectively. Thus, based on the student trial results, this educational game can be categorized as "Very Good" for use.

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