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Nutriquest: Diet Therapy Education Through Third-Person Shooter Game

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Abstract

Nutrition education plays a crucial role in maintaining health and preventing disease; however, conventional methods such as lectures tend to be passive and unengaging, especially for adolescents. This study aims to develop an interactive educational game as an alternative medium for delivering diet therapy education. This research employed a Research and Development (R&D) approach using the Software Development Life Cycle (SDLC) with a waterfall model, consisting of analysis, design, implementation, and testing stages. The game, NutriQuest, was developed for the PC platform in the third-person shooter genre and is designed based on the Mechanics, Dynamics, and Aesthetics (MDA) Framework to integrate learning content with gameplay. Players explore the game environment, interact with food objects to obtain nutritional information, and complete quizzes to evaluate learning outcomes. Application testing included black box testing, learning media validation, material validation, and user testing. Results showed that all system functions operated properly. Learning media validation achieved a score of 94.7%, while material validation achieved a score of 68.9%, indicating suitability for educational use. User testing involving 23 adolescents yielded a positive response with a score of 91.30%. These findings indicate that NutriQuest is feasible and effective as a game-based learning medium for diet therapy education and can increase user engagement and understanding.

Keywords: *Diet Therapy; Educational Game; Health Education; MDA Framework; Third-Person Shooter.*

1. Introduction

A person's health condition is closely related to their lifestyle. Food is a basic necessity for survival, but if not chosen carefully, it can actually pose a threat to health, especially for individuals with certain medical conditions. The importance of nutrition is in line with the ancient principle associated with Hippocrates, which emphasizes that lifestyle and nutrition are the foundations of human health. Therefore, understanding nutrition is a vital principle in human biology to prevent the development of disease and accelerate the recovery process.[1]

Although nutrition plays a vital role, efforts to convey this information are generally carried out through conventional health education channels. Lectures are the main method of teaching nutrition in the community. However, the effectiveness of this method has begun to be questioned. [2] Research shows that lectures are not always interesting, difficult to attract the audience's attention, and ineffective in encouraging behavioral change, especially among the younger generation who are easily bored.[3], [4]

The limitations of the conventional approach have encouraged innovation in the delivery of nutrition education. Specifically, by integrating game-based edutainment technology, nutrition education can be more dynamic and relevant, adopting various learning styles and motivating students to be more actively involved in learning.[5] This allows them to overcome the boredom that often occurs with conventional educational approaches.[6] Several studies show that Game-Based Learning (GBL) has a significant positive impact on the learning ecosystem. They say that GBL greatly motivates students, eliminates boredom in conventional learning methods, and increases interest and engagement in learning.[7] In this approach, serious games can be defined as games designed for purposes other than mere entertainment, and serious game interventions have become popular over the years in addressing unhealthy eating behaviors.[8]

Several systematic reviews indicate that most studies using serious games yield positive results and are suitable for disease prevention strategies. This also applies to eating- related behaviors. Games that serious games promoting health, especially healthy eating habits, have become a good alternative for audiences who are increasingly indifferent to television or print advertisements.[9] In addition, in improving nutritional understanding, this game-based approach has proven to be significantly more effective than lecture methods.[10]

The findings of this review highlight the current state of research on serious games and eating behavior. The synthesized evidence confirms how serious games can significantly change healthy eating behaviors and actual food intake in people of various age groups. The increase in nutritional knowledge resulting from these games helps maintain healthy food choices and, thus, increases negative attitudes toward unhealthy food choices such as sweets, junk food, and fatty foods.[8]

Based on these findings, this study aims to develop interactive educational games using *the Mechanics Dynamics Aesthetics Framework*, which employs a more systematic framework in designing games that not only convey information but also create fun and meaningful gaming experiences.[11] Previous studies also confirm that nutrition education plays a major role in increasing knowledge, shaping attitudes, and ultimately determining healthy eating behaviors.[6]

2. Research Method

This study used the Research and Development (R&D) method with the Software Development Life Cycle (SDLC) model using the waterfall model. Fig.1 shows the stages of the waterfall model applied to the development of the application in this study.

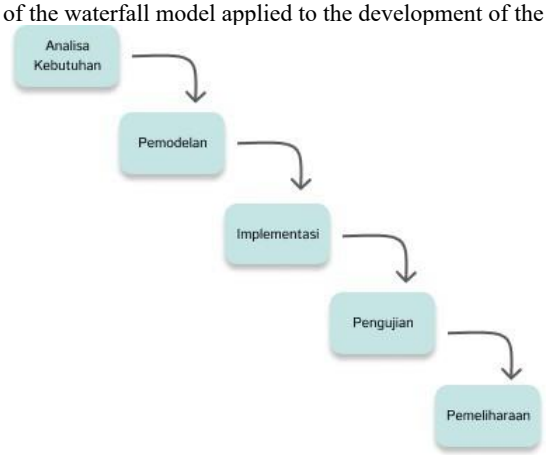

Fig. 1: Waterfall Method

2.1. Analysis

At this stage, data and information sources are sought as material for system design. System requirements analysis begins with the collection of data and information needed for system design, which is done through literature studies.

2.2. Modeling

This stage is carried out before program development to provide an overview of what the system requires. The design begins with the creation of flowcharts and use cases, followed by the creation of mock-ups.

2.3. Game Design Framework

To create an immersive educational experience, this game development uses the Mechanics, Dynamics, and Aesthetics (MDA) Framework approach. This framework was chosen to align the system logic with the user experience, ensuring that the game rules designed are able to produce interactions and playing sensations that are in line with learning. The following is the application of the three MDA components in the game as described in Table.1.

Table 1: MDA Framework

Component Types	Sub-components	Application in Games
Mechanics	Genre & Topic	The game is designed as a third-person shooter with an adventure theme, where players must identify and explore recommended and non-recommended foods based on specific health conditions.
	Goal	The ultimate goal of this game is for users to understand the right food choices for specific health conditions.
	Platform	PC
	Rating	The game is intended for all ages.
	Level	Easy and medium levels.
	Concept & Art	3D Design
Dynamics	Storyline	The storyline in this game focuses on the player as an individual who explores their environment to learn about foods that are recommended and not recommended for certain health conditions.
	Character	The main character is represented as a human avatar played from a third-person perspective.
	Game Control	Control the game using the game mode (WASD keys) to indicate direction, the E key to interact with NPCs, and the I key to explore food.
Aesthetics	Sensation	This game provides an interactive and enjoyable learning experience for players.
	Challenge	A quiz containing a series of questions to evaluate the player's mastery of the material.

2.4. Testing

The testing phase is conducted to verify the system's suitability in terms of functionality, content, and user experience. The testing series consists of 5 main stages: 1) Black Box Testing, which aims to validate the logic and performance of features in the game to ensure that the output matches the input provided. 2) Compatibility Testing, conducted by installing the application on various PC devices with different specifications to test hardware compatibility. 3) Expert Validation, which involves subject matter experts to review the nutritional

content for accuracy against references, as well as media experts to evaluate interface aspects such as color composition, layout, and readability. 4) User Acceptance Testing, conducted on teenage respondents aged 10 to 19 years.

3. Result and Discussion

The game implementation was built on the Unreal Engine platform, utilizing the Blueprint feature for programming logic. The main reference used in compiling the material in this game comes from the book " Asuhan Gizi dan Keperawatan pada Hipertensi" which contains basic nutritional principles and dietary guidelines for hypertension.[12] This source was chosen so that the content in the game has a strong scientific basis and is in accordance with applicable nutritional practice standards.

The NutriQuest game flow begins when the application is launched (Start), then the system displays the main menu that gives players the option to start the game (Play) or exit the application (Exit). If the player chooses Play, the system will direct the player to the main game area, where the player can interact with NPCs using the E key to obtain directions or supporting information, as well as interact with food objects using the I key to display nutritional information and the suitability of food for dietary therapy. After the exploration and interaction process is complete, the player is directed to answer questions in the form of a quiz as a learning evaluation stage. The quiz results are then processed by the system to determine whether the score obtained has met the minimum score set. If the minimum score is achieved, the game is declared complete (End), while if it is not met, the player can continue the learning process until the completion criteria are met. The flowchart can be seen in Fig.2.

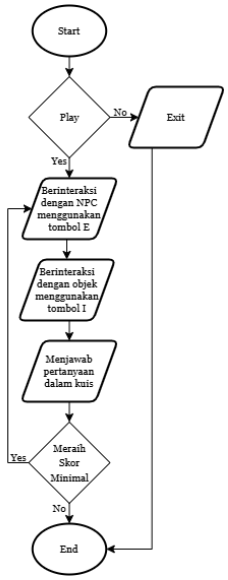

Fig. 2: Flowchart

Based on the design that has been carried out, the next stage is the implementation of the user interface. The following is a presentation of the visual display of the game, which includes the main page, game interface, quiz page, and feedback. The main page, which includes the features needed to start the game, can be seen in Fig.3. There are three buttons on the main page: the Play button to start the game, the Tutorial button to display the game instructions page, and the Exit button to exit and close the application.

Fig. 3: Main Menu

The Tutorial page contains game instructions explaining which buttons to use to play the game. To control the player character, use the AWSD buttons, the E button to interact with NPCs, and the I button to view pop-up information on objects. All of these explanations can be found on the Tutorial page, which can be seen in Fig.4.

Fig. 4: Guide Page

On the game page, players can explore the game area to find and interact with food objects that have interaction markers. When players interact with these objects, the system will display a pop-up containing nutritional information about the selected food, as shown in Fig.5.

Fig. 5: Game Start Page

After players finish exploring, they will take a quiz as shown in Fig.6. Each correct answer will take the player to the next question, while an incorrect answer will automatically close the quiz page. Players can try again by re-interacting with the available quiz trigger. Players are declared finished when they successfully answer 5 quiz questions and achieve the minimum score that has been determined.

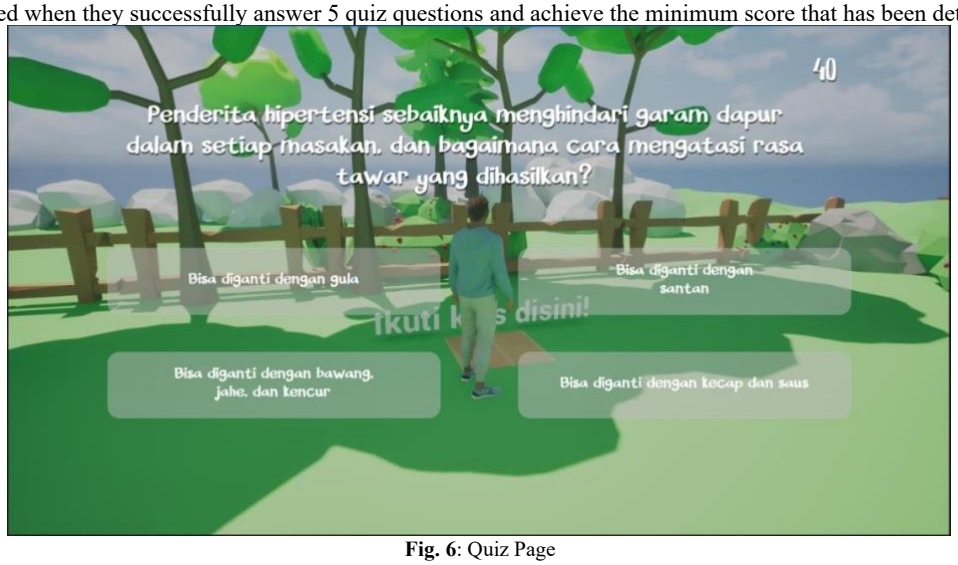

Fig. 6: Quiz Page

3.1. Application Testing

Application testing consists of 4 testing stages, namely black box testing, learning media testing by Nutrition Science learning experts, material testing by Nutrition Science learning experts, and user testing.

3.1.1. Black-Box Testing

Black box testing is conducted to determine the success of the application. *Black box* testing focuses on the functioning of the application, such as the running of the system in the application, GUI (user interface) errors, data structure, and performance errors when the application is used. The results of *black box* testing can be seen in Table.2.

Table 2: Black Box Test Result

No	Action	Expected Result	Test Result
1	Main Menu	Display the Main Menu page	Valid
		Display the Play button	Valid
		Display the Guide button	Valid
		Display the Exit button	Valid
2	Guide	Display the Guide page	Valid
		Display the game instruction	Valid
		Display the Back button	Valid
3	Press the Back button	Display the Main Menu page	Valid
4	Press the Play button	Display the game start area	Valid
5	Press the E key near the NPC	Display the dialogue from NPC	Valid
6	Press the I key near the object	Display the information pop-up	Valid
7	Character passes quiz trigger	Display the quiz page	Valid
8	Pressing the correct answer	Display the next question	Valid
9	Press the wrong answer	Return to the play area	Valid
10	Player score met	Display the feedback page	Valid
11	Press the Quit button	Display the Main Menu page	Valid
10	Press the Exit button	Exit the application	Valid

The results of black-box testing on the table were successful, with all built features functioning properly.

3.1.2. Learning Media Test

The testing of learning media aims to assess whether the application is suitable for use as learning media in terms of design, text, sound, and programming. The media testing was conducted by an expert in learning media, Cella Petty Susanti, M.Pd., a lecturer at the Faculty of Tarbiyah, Universitas Darussalam Gontor. The results of *black box* testing can be seen in Table.3.

Table. 3: Learning Media Test Result

No	Statement	Score Number				
		1	2	3	4	5
	A. Media Design and Appearance Validation					
1	The game's user interface (UI) is attractive and suits the characteristics of the users.					✓
2	Visual qualities such as 3D graphics, animations, and environmental assets effectively support the game's atmosphere.					✓
3	Visual, audio, and multimedia elements reflect an educational atmosphere in line with the health theme.					✓
4	The use of color, typography, and layout elements is easy to read and does not distract the player's focus.				✓	
5	Audio quality (narration, sound effects, background music) optimally supports the user experience.					✓
B. Clarity and Interactivity						
6	Transitions between menus, scenes, and missions are smooth and easy to understand.					✓
7	Player control and interaction in TPS gameplay is responsive and uncomplicated.					✓
8	The in-game navigation system (menu, mission indicators) is clear and user-friendly.					✓
9	Interaction with objects, nutritional information, and educational elements can be accessed easily.					✓
10	The game provides visual/audio feedback that helps players understand their progress in the game.				✓	
C. Media Suitability as a Learning Tool						
11	The game provides an engaging and meaningful dietary therapy learning experience.					✓
12	Educational media (narrative, text, audio, visual) are suitable for delivering diet therapy material digitally.				✓	
13	The TPS format does not detract from the educational essence of the dietary therapy material provided.					✓
14	Integration of dietary therapy material with gameplay in accordance with the principles of multimedia-based learning.				✓	
15	Overall, the game is suitable for use as a medium for diet therapy education in the context of health education.					✓
	Number of Frequencies				4	11

Score	16	55
Total of Score	71	
Average	4.7	
Percentage	94.7%	
Criteria	Highly Recommended	

3.1.3. Learning Material Test

The material test aims to test whether the content or material presented in the application is appropriate. This test involved a Nutrition Science lecturer from Darussalam Gontor University, Amilia Yuni Damayanti, S.Gz., M.Gizi., with the test results shown in Table.4.

Table. 4: Learning Material Test Result

No	Statement	Score Number				
		1	2	3	4	5
1	The material in the form of images in this game is presented clearly.			✓		
2	The text material in this game is presented clearly.			✓		
3	Users can easily understand the material in this game.				✓	
4	The character design and visual effects are presented clearly and attractively.			✓		
5	The audio in this game is clear.			✓		
6	Users can easily learn how to play this game.				✓	
7	Educators or facilitators can easily learn how to use this game.				✓	
8	The content in this game is accurate and correct.			✓		
9	The information conveyed in the game is clear, easy to understand, and contextually appropriate.				✓	
	Number of Frequencies			5	4	
	Score			15	16	
	Total of Score			31		
	Average			3.4		
	Percentage			68.9%		
	Criteria			Recommended		

In Tab.4, testing by subject matter experts yielded good results with a percentage of 68.9% and met the criteria for suitability.

3.1.4. User Test

User testing was conducted on teenage respondents aged 10 to 19 years. The user test results can be seen in Table.5.

Table 5: User Test Result

No	Statement	Score Number				
		1	2	3	4	5
1	I feel happy when playing this game.	0	0	1	3	19
2	This game makes me more enthusiastic about learning about healthy foods and diets tailored to my health condition.	0	0	0	3	20
3	I want to play this game another time.	0	0	1	6	16
4	The diet and nutrition content in this game is easy to understand.	0	0	1	8	14
5	This game helps me remember which foods are suitable for specific health conditions.	0	0	1	6	16
6	The material in this game is consistent with the nutritional information I have learned.	0	0	1	8	14
7	The audio in this game is loud and clear.	0	2	9	7	5
8	I really like the graphics and colors in this game.	0	0	3	5	15
9	This game is easy to play and understand.	0	0	1	5	17
10	The game ran smoothly and did not experience any technical issues.	0	0	2	3	18
	Number of Frequencies	0	2	20	54	154
	Score	0	4	60	216	770
	Total of Score			945		
	Average			4.5		
	Percentage			91.30%		
	Criteria			Highly Recommended		

3.2. The Application of 3D Games in Educational Media

The use of games as a means of education for three-dimensional diet therapy has received positive responses from users. Based on the results of the study, the majority of respondents felt that the NutriQuest game was able to present diet therapy educational material in a more interesting, interactive, and easy-to-understand manner than conventional media. The three-dimensional visualization used in the game helps users understand the concepts of food, nutritional content, and the application of diet therapy in a contextual manner. In addition, the interactive elements in the game encourage active user involvement in the learning process, thereby increasing interest and

understanding of the material presented. Thus, the results of this study indicate that the NutriQuest game has the potential to be applied as a supporting educational medium in diet therapy learning and counseling.

3.3. Third-Person Shooter Genre

The use of the Third-Person Shooter (TPS) genre in the NutriQuest game aims to increase player engagement in the diet therapy education process through interaction and exploration of the game environment. The third-person perspective provides a broader visual angle, allowing players to observe characters and food objects around them more clearly. This makes it easier for players to recognize, identify, and understand the characteristics of food objects presented in the game. Additionally, the exploration mechanism applied in the TPS genre encourages players to actively move and interact with the virtual environment, so that the learning process is not passive. With this approach, information related to diet therapy can be conveyed contextually and interestingly, which ultimately supports an increase in players' understanding of the educational material provided through the NutriQuest game.

3.4. Diet Therapy

The dietary therapy material in the NutriQuest game is designed to help players understand the concept of regulating food consumption according to specific health conditions. The material is delivered through direct interaction with food objects available in the game area. Each food object that is interacted with displays information about its nutritional content and its suitability for a particular diet therapy. In addition, the game provides 10 educational pop-ups that players can read, as well as things to consider when choosing food. Players' understanding of the material is then evaluated through quizzes provided in the game, so that it can be determined to what extent the diet therapy information has been understood after the interaction and learning process has taken place.

3.5. Respondent Analysis

The user test in this study involved 23 respondents. All respondents were aged between 12 and 15 years old, which is the target user group for the educational game developed. This age range was considered appropriate because users in this age group are in an active learning phase and have a high interest in game-based learning media.
Based on the questionnaire analysis results, it can be concluded that the educational game developed received a very positive response from users. The average score for all statements was 4.5, with most approaching the maximum score.

4. Conclusion

This study successfully developed the NutriQuest educational game based on the third-person shooter genre as an interactive medium for diet therapy education. The application of the Mechanics, Dynamics, and Aesthetics (MDA) Framework enabled the integration of educational content with engaging gameplay, resulting in a positive learning experience for users. Functional testing ensured that all system features operated as intended, while expert validation showed that the game content and interface were suitable for educational use. Further user testing showed high levels of acceptance and engagement among adolescents.

Despite these positive results, this study has several limitations, including limited coverage of dietary therapy material, a relatively small number of respondents, and a focus on PC-based platforms. Further research is recommended to expand the range of health conditions and nutritional content, involve a more diverse group of users, and develop cross-platform versions to increase accessibility and impact.

Acknowledgement

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