JURNAL RISET PEMBELAJARAN KIMIA
Volume 10 Edisi 2 Bulan Februari 2025, halaman 1-9
https://journal.student.uny.ac.id/index.php/jrpk

DEVELOPMENT OF EDUCATIONAL GAME MATERIAL NOMENCLATURE OF HYDROCARBONS AND ITS DERIVATIVES AS ANDROID-BASED CHEMISTRY LEARNING MEDIA

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Abstract. *Understanding of broad and abstract concepts, especially on hy-drocarbons and their derivatives, makes it necessary to use learning media. Educational game learning media is a game-based media with educational purposes that are easily accepted by students. This study aims to develop educational games on hydrocarbon materials and their derivatives and determine the feasibility of the developed media. The method used in this study uses a 4-D model developed by S. Thiagarajan (1974). In the development of the 4-D model, there are 4 stages that are applied, including: define, design, develop, and disseminate. However, the research and devel-opment carried out is limited to the develop due to cost and time considerations. Edu-cational game development requires software Unity Engine 2D and CorelDraw 2019 The research data were obtained from the results of media and material valida-tion and trials to students in the form of quantitative data and qualitative data. The results of the research that have been carried out are in the form of educational games on hydrocarbon nomenclature materials and their derivatives in the form of applications that can be played on Android. The results of media validation in the developed educational game obtained an average score percentage of 77% (Decent). The results of material validation obtained an average score percentage of 79% (De-cent). The results of testing on students in all aspects obtained an average score per-centage of 89% (Very Decent)..*

Keywords: educational game, hydrocarbon nomenclature and its de-rivatives, 4D model

INTRODUCTION

Chemistry is often referred to as the center of science, because basic knowledge of chemistry is important for someone who studies biology, physics, geology, ecology and various other sciences[1]. One branch of chemistry that is closely related to everyday life is organic chemistry, especially on hydrocarbons. Hydrocarbon material discusses compounds composed of carbon atoms and hydrogen atoms. The specificity of the carbon atom, such as the ease with which it binds to other carbon atoms, causes the carbon atom to be able to produce new compounds. There were difficulties in the hydrocarbon nomenclature sub-chapters experienced by students. Another study conducted by found that students had difficulty in general concepts of hydrocarbons such as analyzing groups of hydro-carbon compounds, and determining the names of hydrocarbon compounds[2]. It is difficult for students to understand and remember the structure of various functional groups and the naming of functional groups (IUPAC and trivial) on carbon compounds[3]. A very broad and abstract concept that contains terms makes it difficult for students to understand the material

which results in low student interest in hydrocarbon nomenclature material and continues on hydrocar-bon derivatives. The lack of student interest in the material reduces interest which will affect the success of students in understanding the material.

Learning success is influenced by student motivation[4]. Student motivation can be grown by using learning media[5]. Learning media have various choices depending on the characteristics required. The use of technology in the learning process has the opportunity to improve the quality of the experience[6], expand the range of learning[7] and can produce various innovations and creativity so as to increase effectiveness and efficiency in learning[8]. Effectiveness in learning is shown by the achievement of commu-nication goals, while efficiency is shown by saving time, costs, and energy[9]. One of the integration of technology in learning media is the use of android-based learning media. The choice of android as a learning medium is because android is the most is widely used and open source[10]. The use of Android now varies based on interests, one of which is used as a game[11].

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In everyday life, games are used as a means to fill spare time and relieve fa-tigue[12]. The use of games in an unwise manner causes players to become addict-ed, this actually creates new problems, especially for players who are students whose study time should be used to study subject matter but is diverted to playing games. Because of its nature to overcome boredom and fun, games have been de-veloped for various aspects, one of which is in the educational aspect. Games with the purpose of educational content in them are known as educational games. The pattern of educational games is learning by doing, where players are challenged to encourage players not to repeat mistakes at the next stage[13]. There was an increase in student learning outcomes and activities due to the use of educational games in Science Biology lessons[14]. Based on these characteristics, there are opportunities for educators to make games as a medium in learning to package material to be more interesting and attrac-tive to students. The development of educational games in chemistry subjects has begun to be widely carried out, such as on buffer solution material[15] and on hydrolysis material to produce products that are valid and suitable for use[16].

Based on the problems that have been described, the researcher aims to conduct research and development of educational games with the title "Develop-ment of Educational Games for Hydrocarbon Nomenclature Materials and Their Derivatives as Android-Based Chemistry Learning Media". The purpose of this research is to develop educational games on the material of nomenclature of hydrocarbons and their derivatives as an android-based learning medium for chem-istry and to find out the feasibility of the educational games that have been devel-oped. Game application creation is done using software Unity 2D and CorelDraw 2019.

METHOD

The method is an activity process in the form of collecting data and providing interpretations related to the research objectives[17]. The research method used is the 4-D research and development method proposed by S.[18]. In the development of the 4-D model, there are 4 stages applied, including: definestage, designstage develop, and disseminate. The stages of the 4-D model by Thiagarajan can be seen in Figure 1.

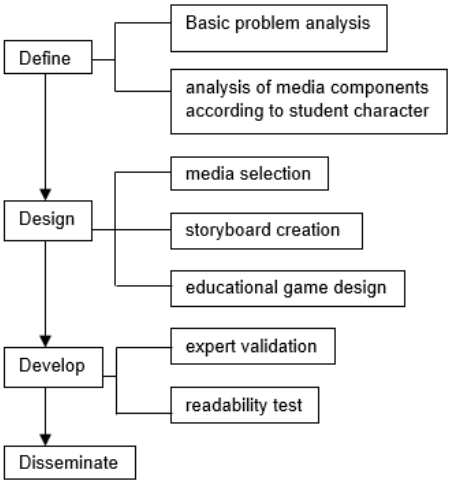

Figure 1. 4-D model by Thiagarajan

However, research and development on educational game products for hydrocarbon nomenclature materials and their derivatives based on Android only uses three stages up to the develop due to cost and time considerations. The educational game development procedure is described as follows.

The first stage is the define . At this stage it is done to limit educational games. To facilitate the needs analysis, several steps were carried out, namely (1) front end analysis, carried out to find out the basic problems in learning and solutions to these problems. In this analysis, it was found that there is a need for learning media in the chemistry learning process; (2) student analysis, carried out to adjust the learning media developed to the characteristics of students. In this analysis, it was found that the appropriate learning media for the current chemistry learning process are android-based educational games with class XI students as the subject; (3) concept analysis, carried out to produce material discussed in learning media based on Core Competencies (KI) and Basic Competencies (KD); (4) task analysis, carried out to outline the main tasks that must be mastered by students; (5) the formulation of learning objectives, aims to determine the studies that will be displayed in educational games based on learning objectives that are in accordance with KI and KD.

The second stage is the design or designing. The design stage is carried out so that the product is systematic based on the analysis that has been carried out in the first stage. This stage consists of (1) preparation of benchmark reference tests; (2) the selection of media in the form of game learning media on android-based nomenclature material for hydrocarbons and their derivatives; (3) the selection of formats in the form of selecting backgrounds, backsongs, fonts, images and colors to produce interesting games; (4) initial design of learning media in the form of stages of making flow chart and storyboard, compiling materials, and compiling game that done on Unity 2D application. The flow chart educational game can be seen in Figure 2.

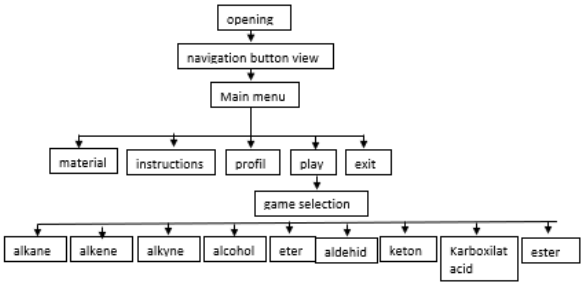

Figure 2. Flow Chart Educational Game

The third stage is the develop . At the development stage, a series of validation processes are carried out which are used as benchmarks before testing the product to small groups. Validation consists of media validation and material validation of the developed product. Validation was carried out by two chemistry lecturers at the State University of Malang and one chemistry teacher for class XI at SMA Negeri 1 Talun.

Meanwhile, the product trial was conducted on 11 students of class XI MIPA 1 SMA Negeri 1 Talun. The data from the validation and trial results are in the form of quantitative data and qualitative data. The validation results are analyzed to determine the feasibility of the product and materials to revise the product to make it better.

To determine the feasibility of the product, validation is carried out on the product that has been developed. Validation was carried out to media experts and material experts, which consisted of two lecturers and one teacher. If the product is said to be feasible, then a trial is carried out on students. The results of the validation and testing are interpreted from the assessment score containing a Likert scale of 1 to 5 and then the percentage of the score given is calculated using the following calculation formula.

Percentage score = (total score obtained)/(maximum score) x 100%

The percentage score obtained from the results of validation and testing is then interpreted to analyze the feasibility of the product. The product developed is said to be feasible if it gets a score percentage of 61%. The criteria for the percentage of feasibility test scores can be seen in Table 1.

Table 1. Interpretation Criteria for the Percentage of Feasibility Test (source: Riduwan, 2012.

Percentage	Criteria
0% - 20%	Not feasible
21% - 40%	Feasible
41% - 60%	Less feasible
61% - 80%	Decent
81% - 100%	Very decent

RESULT AND DISCUSSION

Results

Product the results of research and development in the form of educational games on the material of nomenclature of hydrocarbons and their derivatives based on android as a medium of chemistry learning[18]. The resulting educational game is an application that can be run on Android, so that the game can be played flexi-bly without being limited by space and time. The use of educational games only needs to install the application on Android and can be played without the need for an internet connection.

The development of educational games on the nomenclature of hydrocar-bons and their derivatives is made using the Unity 2D application. This application is easy to use for beginners who want to develop varied learning media. In addition to using the Unity 2D application, the creation of educational games is also sup-ported by several other software such as CorelDRAW 2019 to create the display design used. The results of the development of educational game applications on hydrocarbon-derived materials and their derivatives are named Hy-bon. Hy bon consists of several parts of the display. Before entering the game display, a naviga-tion button display is presented which aims to provide player information about the various buttons contained in the game. The display of the navigation buttons is shown in Figure 3.

Figure 3. Display of the Navigation Buttons

The initial display of the game consists of the title and various buttons that will connect to the display of hydrocarbon nomenclature material and its hydrocar-bon derivatives, the display of how to play, and the display of developer infor-mation. The initial view before starting the game is shown in Figure 4.

Figure 4. Initial appearance

Game can be played by players who have not or have get material for no-menclature of hydrocarbons and hydrocarbon derivatives and can be used not according to the order of material as in the learning syllabus. A summary of the material presented in Hy-bon is shown in Figure 3 and the choices of games that can be played are shown in Figure 5.

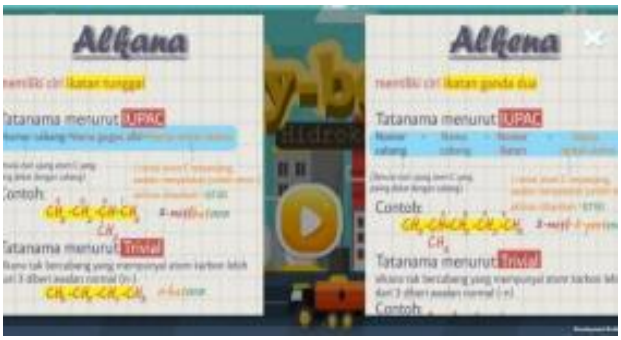

Figure 5. Display of Summary of Materials

Figure 6. Display of Game Options The

Aim of the game is to capture compounds according to the compound group selected in the game selection. The game will end when the allotted time has expired, which is 30 seconds and or the player is wrong in choosing a compound that is not in the compound group. After the game is finished, a display of the use of compounds in everyday life is presented. One display of the game is presented in Figure 5. and a display of the use of compounds in everyday life is presented in Figure 6.

Figure 7. Game Display

Figure 8. Display of the Use of Compounds in Daily Life

Discussion

Quantitative data from the validation results of the developed product me-dia obtained an average percentage score of 77%. According to Riduwan (2012), the development of educational games on hydrocarbon nomenclature material and its derivatives based on Android is in the percentage range of 61% - 80% so it is included in the feasible category. The percentage score of the results of media validation by validators for each aspect can be seen in Table 2.

Table 2. Media Validation Results by the Validator

No.	Aspect Assessed	Percentage of Score (%)				
		V1	V2	V3	Average	Criteria
1	Game initial					
2	Display level selection	80	80	84	81	Very Decent
3	Display alkane game	80	80	80	80	Decent
4	Display alkene game	68	80	80	76	Decent
5	Display alkyne game	72	80	80	77	Decent
6	Display alcohol game	72	80	80	77	Decent
7	Display ether game	72	80	80	77	Decent
8	Display aldehid game	72	80	80	77	Decent
9	Display ketone game	72	80	80	77	Decent
10	Display carbocylic acid game	72	80	80	77	Decent
11	Display ester game	72	80	80	77	Decent
12	aplikation	66	80	80	75	Decent
Average Score					**77%**	**Decent**

Suggestions and comments given by the validator regarding the media on the product is used to improve the product to make it more good when used. The validator's comments and suggestions along with improvements regarding media and materials in educational games for android-based nomenclature hydrocarbons and their derivatives can be seen in Table 3.

Table 3. Media Comments and Suggestions by the Validator

Comments and Suggestions	Improvements
Made the player slide is made one button 	Made the player slide is made one button 

Quantitative data as a result of material validation by experts obtained a percentage score of 79%. According to Riduwan (2012), the development of edu-cational games on hydrocarbon nomenclature material and its derivatives based on Android is in the percentage range of 61% - 80% so it is included in the feasible category. The percentage score of material validation results by validators for each aspect can be seen in Table 4.

Table 4. Percentage of Material Validation Results Scores by Validators

No.	Aspect Assessed	Percentage of Score (%)				
		V1	V2	V3	Average	Criteria
1	Alkane Material	73	80	80	78	Decent
2	Alkene Material	73	80	80	78	Decent
3	Alkyne Material	73	80	87	80	Decent
4	Alcohol Material	73	80	87	80	Decent
5	Eter Material	73	80	87	80	Decent
6	Aldehid Material	73	80	87	80	Decent
7	Ketone Material	73	80	87	80	Decent
8	Carboxylix Acid Material	73	80	80	78	Decent
9	Ester Material	66	80	93	80	Decent
10	Objectives of the Game With Basic Competencies	60	80	100	80	Decent
	Average Score				**79%**	**Decent**

Quantitative data from the results of student trials obtained a percentage score of 89%. According to Riduwan (2012), the development of educational games on the material of nomenclature of hydrocarbons and their derivatives based on Android is in the percentage range of 81% -100% so it is included in the very feasible category. The average percentage of test scores by students can be seen in Table 5.

Table 5. Average Percentage of Test Results Scores by Students

No.	Aspect Assessed	Percentage Score (%)	Criteria
	Display and Operation		
1	Suitability of images and text size	92	Very Decent
2	Use ofcolor	85	Very Decent
3	Ease of operation of the game	83	Very Decent
	Language and writing		
4	Language presentes in the game	92	Very Decent
5	Presentatoion of materials	89	Very Decent

No.	Aspect Assessed	Percentage Score (%)	Criteria
6	Instructions and objectives of the game	89	Very Decent
	Usefulness		
7	Games motivates learning	94	Very Decent
8	Games makes it easy for users to learn independently	89	Very Decent
9	Games can be a source of learning	92	Very Decent
10	Games are useful for users	92	Very Decent
	Average Score	**89**	**Very Decent**

CONCLUSION

The results of research that has been carried out in the form of developing educational games for hydrocarbon nomenclature materials and their derivatives, it is concluded that making applications educational games are carried out using Unity 2D and CorelDraw 2019 software to design the in-game display. To test the feasi-bility of the game, validation was carried out to media and material experts and trials were carried out with small groups. Based on the results of media expert vali-dation, the percentage of media experts obtained is 77%, by meeting the "feasible" criteria, the results of the material expert validation with a percentage value of 79% by meeting the "feasible" criteria, meaning that the game is feasible to be tested on small groups, and the results of trials for small groups The percentage result was 89%, with the conclusion that educational game media on hydrocarbon nomencla-ture material and its derivatives deserves to be tested at the next stage.

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