Android-based Dental Anatomy Learning Application Using Mayer's Multimedia Learning Principles

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Abstract

Anatomy learning methods are still dominated by using books, in which the material is presented in pictures and writings. The anatomy learning method using books is carried out by redrawing parts and memorizing the location and its terms. Thus, students have difficulties when they forget and want to find terms on the anatomy because it is uneasy and takes a long time. This research aims to create a system to study anatomy, especially dental anatomy, through an android-based application, and provide ease of anatomy of tooth learning using Mayer's principle of multimedia learning on application. Based on system testing and user testing results, this application can be used as a medium of information and learning about tooth anatomy. It is evidenced by black-box testing and questionnaire results.

Keywords: Dental Anatomy, Educational Application

1. Introduction

Anatomy comes from the Greek *ana* and *tome*, meaning to cut or separate. Anatomy is the study of human body structures and the relationships between one part and another[1]. From a medical perspective, anatomy consists of various knowledge about the shape, location, size, and various human body structures.

Most anatomy learning is performed using books, with the material presented in pictures and writings. This method is conducted by redrawing each section and memorizing the location and terms. It makes it difficult for students to forget and look for terms in the book's anatomy section because it is uneasy and takes a long time. Some students may have different ways to prevent it, such as coloring the writings or pictures using a highlighter or marking the page. However, most students are lazy to do so.

Several solutions are offered to facilitate anatomy learning; an example is the creation of a smartphone application dealing specifically with anatomies such as the circulatory system, the respiratory system and others. However, the application offered is still unable to be used as a learning method using multimedia because they were made similar to the book, thus requiring application development.

According to Mayer[2], multimedia is a material presentation using words and pictures. Words are presented in written or spoken forms, and images can be presented in static or dynamic graphics. In his book, Mayer mentions that 12 multimedia learning principles can be applied in learning methods using multimedia.

Learning application of human circulatory system based on android can be built using Eclipse. This provides material about the human circulatory system that is intended for junior high school students. This application aims to help students be more accessible in learning biological materials, especially in the fabric of the human circulatory system[3].

In the research application of human body anatomy learning with a clipping method based on android can be used for medical students to be implemented to android-based mobile

devices by cutting images. This android-based human body anatomy was a learning app to discuss the blood vessels, respiratory tract, and gastrointestinal tract[4].

Denature journal that discusses the application of mobile learning anatomy of the human body based on android can display human body organs with categories of the respiratory system and sensory system. The respiratory system application program contains material in which the user selects the respiratory system's type comprising an explanatory image of the material[5].

Currently, there are only a few dental anatomy apps available on the play store. It encourages researchers to create and develop an Android-based dental anatomy application as a multimedia learning method that can be used as an alternative medium for studying dental anatomy. The application was created using several Mayer Multimedia Learning principles, such as the Coherence Principle, Spatial Contiguity Pricing, and Multimedia Principle. Using these three multimedia learning principles, the authors present the dental anatomy material in images and text simultaneously and sort out the necessary and unnecessary material.

Therefore, the researchers tried to develop an application as a means of learning to study human anatomy based on Android mobile. This project was then made with the title "Android-based Dental Anatomy Learning Application Using Mayer Multimedia Learning Principles".

2. Method

Application development in this research utilized the waterfall model System Development Life Cycle (SDLC) method. This waterfall model comprises six stages: architectural planning, needs analysis, designing using UML, application development, testing, and implementation. The dental anatomy learning application concept is that users can easily learn anatomy and practice using a smartphone. Dental anatomy learning application has three menu categories: material, search and bookmarks[6].

This study conducted two tests, system testing and user testing. The researchers employed the black-box testing system for system testing and a questionnaire based on a Likert scale for user testing. The respondents were 20 dentistry students. This research was conducted at Universitas Muhammadiyah Yogyakarta in December 2017.

In system testing, the functional software tests were carried out to obtain a series of input conditions following the functional requirements of a program. The State Transition Table test was designed to check the validity of transitions between states.

In user testing, several answer criteria were given to respondents using a Likert scale measurement to measure their attitudes, opinions and perceptions regarding social phenomena. Respondents were asked to use the information system as a whole and choose one choice from the answers in the questionnaire. There are five choices of answers given, ranging from strongly agree to strongly disagree. The quantitative data were changed based on the weighted scores of one, two, three, four and five. The division of categories and measurement scores on the Likert scale is presented in Table 1[7]..

Table 1. Likert Score Table

No	Category	Score
1	Strongly Agree	5
2	Agree	4
3	Quite Agree	3
4	Disagree	2
5	Strongly Disagree	1

The percentage of results was used to provide answers to the feasibility of the aspects studied. The maximum expected value is 100%, and the minimum is 0%.

The division of eligibility categories is portrayed in Table 2.

Table 2. Application Eligibility Category

No	Category	Percentage
1	Very Worthy	81% - 100%
2	Worthy	61% - 80%
3	Sufficiently Worthy	41% - 60%
4	Unworthy	21% - 40%
5	Very Unworthy	<20%

Score T x Pn	
T	= The total number of respondents who voted
Pn	= Choice of Likert score numbers

Eligibility Index = Total Score / Y x 100	
Y	= Likert highest score x number of respondents

3. Results

The test method using black-box testing, namely through the State Transition Table method, is demonstrated in system testing results in Table 3 [8] [9].

Table 3. System Testing Results

No	Input	Expected Output	Status
1.	Displaying the entire list of dental anatomy on the homepage	The system will display the entire list of dental anatomy on the homepage.	Valid
2.	Displaying an error message of "Failed to retrieve data, Check your connection!" if the smartphone is not connected to the internet network	The system will display the message of "Failed to retrieve data, Check your connection!"	Valid
3.	Displaying the name, scientific name, and image by selecting one of the dental anatomy lists on the homepage	The system will display the name, scientific name, and image.	Valid
4.	Displaying the "Bookmark successful" message when clicking the bookmark button	The system will display the "Bookmark successful" message.	Valid
5.	Displaying a list of dental anatomy when the user enters a keyword in the search for scientific names and names	The system will display a list of dental anatomy in the search for scientific names and names.	Valid
6.	Displaying an error message of "Data not found" if the keywords do not match the data in the application	The system displays an error message of "Data not found".	Valid
7.	Displaying bookmarked data by clicking on the bookmark on the homepage	The system will display the bookmarked data.	Valid
8.	Displaying the "delete" message when clicking and holding one of the dental	The system will display the "delete" message.	Valid

No	Input	Expected Output	Status
	anatomy lists on the bookmark page		
9.	Deleting existing data on the Bookmark page when clicking the "delete" message	The system will delete the data on the Bookmark page.	Valid
10.	Displaying the message and the "Delete All Bookmarks" option when clicking the delete button	The system will display the message and the "Delete All Bookmarks" option.	Valid
11.	Erasing all data on the Bookmark page when selecting the "Yes" option	The system will delete all data on the Bookmark page.	Valid

User testing was calculated based on the Likert scale formula, which was the calculation of the feasibility of question number one in the questionnaire:

Score T x Pn

T = The total number of respondents who voted

Pn = Choice of Likert score numbers

- Respondents who answered Strongly Agree (5)

    13 x 5 = 65

- Respondents who answered Agree (4)

    5 x 4 = 20

- Respondents who answered Quiet Agree (3)

    2 x 3 = 6

- Respondents who answered Disagree (2)

    0 x 2 = 0

- Respondents who answered Strongly Disagree (1)

    0 x 1 = 0

Total Score = 65 + 20 + 6

$\qquad$ = 91

Eligibility Index = Total Score / Y x 100

Y = Likert highest score x number of respondents

Eligibility Index = 91 / (5 x 20) x 100

$\qquad$ = 91/ 100 x 100

$\qquad$ = 0.91 x 100

$\qquad$ = 91

Therefore, the percentage of application eligibility was obtained with an index of 91%, belonging to the "very worthy" category for question number one. The results of the application feasibility test are presented in Table 4.

Table 4. Application Eligibility Testing

No	Question	Answer					Eligibility	Category
	Score	5	4	3	2	1	%	
	Answer	SA	A	QA	D	SD		
1	Is the application easy to use by users?	13	5	2	0	0	91%	Very Worthy
2	Can the information displayed in the application be captured easily and clearly?	12	6	2	0	0	90%	Very Worthy
3	Does the application have a user-friendly appearance?	8	8	4	0	0	84%	Very Worthy
4	Is the search application feature beneficial for users?	10	9	1	0	0	89%	Very Worthy
5	Does the bookmark feature of the application help users?	8	8	3	1	0	82%	Very Worthy
6	Is the teeth anatomy learning application beneficial?	11	5	3	1	0	86%	Very Worthy

It can be concluded that the Android-based teeth anatomy learning application using Mayer's multimedia learning principles can help users learn dental anatomy more easily[10]. Data processing using a questionnaire obtained an average percentage of 87%. Thus, with these results, the application built by the author falls into a very worthy category[11].

4. Conclusions

The following conclusions were drawn based on the research and activities carried out during the development of the Android-based dental anatomy learning application.
1. This Android-based teeth anatomy learning application is a tool to learn dental anatomy.
2. The Android-based teeth anatomy learning application eases to learn dental anatomy.

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