Application of Linked List Algorithm Based on Multimedia

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Abstract. This research aims to make multimedia-based interactive learning media applications so that learning is more effective and the students are more interested in understanding the material presented. This research was conducted at Universitas Komputer Indonesia (Unikom) regarding the college curriculum. The interview method is proposed to lecturers and students so that researchers get identification problems and solutions to overcome these problems. This application was created using Adobe Flash CS 6 and Wondershare QuizCreator 4. The contents of this application display data management simulations using a linked list with interesting animations so that it can help lecturers and students in the learning process. On the results of testing and questionnaires, it obtained a percentage of 85% of 30 respondents who stated this application can be used as an interesting learning media.

1. Introduction

Linked list (Indonesian: Senarai berantai) is one of the techniques of storing, organizing, and managing data in a computer storage medium so that the data can be used efficiently [1]. Information Systems study program students at Universitas Komputer Indonesia (Unikom) have difficulty in studying and understanding Data Structure courses, specifically the Linked List material. In the 1st semester, students get courses in Algorithms & Programming and Basic Programming Lab, generally, lecturers teach C / C++ programming languages. When entering the 2nd semester and students get the Data Structure course, researchers find several obstacles in learning this course. Not many students understand this subject because not all students pass the previous course. Meanwhile, the study program has not implemented yet a prerequisite course system. Regarding the subject matter in the 1st semester, it was discussed by other researchers. While our group examined the 2nd-semester subject.

Multimedia is a combination of text, images, animation, audio, and video to convey information [2,3]. Learning is a process carried out by humans who previously could not be able to [4,5]. Interactive is a two-way communication carried out by at least two humans or objects [6,7]. Interactive learning multimedia is an application that can facilitate humans in learning by combining multimedia elements that are dynamic [8,9]. Interactive learning multimedia applications are expected to solve the problems above [10], besides, it is expected to improve student programming skills [11]. This is necessary because, in the following semesters, the programming subject has a higher level of difficulty.

The purpose of this research is to assist lecturers and students in learning the algorithm linked list material. The interview method is proposed to lecturers and students so that researchers get identification problems and solutions to overcome these problems.
2. Methods

2.1. Object of research

The object of research was the 2nd semester students of the Information Systems Study Program in Universitas Komputer Indonesia (Unikom), Jl. Dipati Ukur No.112-116, Lebakgede, Coblong, Bandung, West Java 40132.

2.2. Research methods

Interviews were conducted with lecturers supporting the Data Structure courses. After that, the researchers conducted interviews and distributed questionnaires to 30 students. After the researchers finished creating the interactive learning multimedia application, the researchers distributed the questionnaire back to the students. The aim is to find out how much the impact of before and after if there is a multimedia application.

2.3. Multimedia development methods

In general, multimedia application development is a slice of education, science and technology (see Figure 1). The aim is to maximize the educational potential of technology and science.

![Figure 1. Education with Media (EducMedia) [12]](image-url)

The research method is based on developing the method below (see Figure 2). There are five core processes, including (1) Groundwork, (2) Content Design, (3) Multimedia Development, (4) User Test, and (5) Improve. Processes 4 and 5 are keep repeating.
3. Results and discussion

3.1. System planning
The application is built using Adobe Flash CS 6 and Wondershare QuizCreator 4. The programming language used is ActionScript 2.0 (AS 2.0), while the type of questions used include: multiple choice, multiple response, fill in the blank, matching, and sequence. The application content includes: learning objectives, subject matter, competencies, quizzes, and information. This application only runs on PCs / Laptops with Windows Operating Systems.

3.2. System overview proposed
The proposed system only changes the conventional way of learning by using a computer, therefore, the role of the lecturer is irreplaceable. This application is proposed to be applied in the classroom during learning activities and continue to be studied at home by students. Therefore, researchers offer free DVDs to lecturers and students so that all parties can study this material wherever and whenever. This application is expected to help the learning process and increase the knowledge about the linked material. The application storyboard can be seen in the following figure (see Figure 3).
3.3. System Implementation
The system implementation consists of software and hardware. As discussed in this section, it is the implementation of software, hardware, and applications.

3.3.1. Software Implementation
To support applications that are created, software is needed. The minimum software requirements that must be installed on a computer to run this application are as follows: Windows Operating System with a minimum of Windows XP SP2 and PDF Reader (needed to open the file "MANUAL BOOK.pdf").

3.3.2. Hardware Implementation
In addition to software, hardware is also needed to build this application. The minimum hardware requirements to run this application are as follows:
1. Intel Atom 1.6 GHz of CPU Processor
2. 512 Mb of RAM.
3. VGA Card (minimum 64 Mb, 128 Mb or more recommended).
4. Hard disk of at least 80GB or more with 1 GB of free space.
5. Soundcard, Mouse & Keyboard.
6. Monitor with a screen resolution of 1024 x 600 pixels (1280x720 pixels or more recommended).

3.3.3. Application Implementation
This application is based on the Storyboard listed above (see Figure 3). A complete description of the Linked List learning multimedia application can be seen in the figures below (see Figure 4-12).

Figure 3. Multimedia storyboard learning linked list
The main application menu in the figure above (see figure 4) displays the main page of the learning application, which contains a menu of material, goals, competencies, and quizzes. The explanation of the destination menu will be discussed in the figure below (see figure 5).

The learning objectives menu in the figure above (see figure 5) displays an explanation of the important points about what students must master after participating in the learning of serial list courses. An explanation of the competency menu will be discussed in the figure below (see figure 6).
Figure 6. Competency standards & indicators

The competency menu in the picture above (see figure 6) displays the competency standards and indicators of serial list learning. Indicators are the basic foundation for assessing the ability of each student. An explanation of the material menu will be discussed in the figure below (see figure 7).

Figure 7. Linked list material menu

The linked menu material list in the figure above (see figure 7) displays an explanation of each material in the serial sequence learning. The explanation of the material displays animation so that students more easily understand the contents of the material displayed. Examples of material explanations will be discussed in the figures below (see figure 8-9).
The sample material in the figure above (see figure 8) shows an explanation of the definition of a chain listing. This material displays a combination of text, images, and animation so that students are interested in learning this material. An interesting animation will create a pleasant learning atmosphere. An example from explanation of material 2 will be discussed in the figure below (see figure 9).

The example explanation of the material in the figure above (see figure 9) shows an animation of how the data storage works using a chain listing. This audio visual explanation of material can improve students’ understanding and logic. An explanation of the menu quiz will be discussed in the figures below (see figure 10-12).
The menu quiz in the figure above (see figure 10) displays three levels of quiz that are made based on the assessment indicators of the serial list learning. Students must solve each question contained at each level of the quiz to find out the extent of student ability. An explanation of the quiz assessment will be discussed in the figure below (see figure 11).

The quiz assessment in the figure above (see figure 11) uses a range of values from 0-100. Students will get grades according to the number of questions that were answered correctly. An explanation of the example problems will be discussed in the figure below (see figure 12).
The problem example in the figure above (see figure 12) shows a problem example from the chain listing theory quiz. Students can solve problems by choosing one of the most correct answers.

3.4. Usability Testing

The usability testing is used to find out how usable the application is applied. This test was conducted in the UNIKOM Information Systems Study Program semester 2 with 30 respondents. Students are given a questionnaire about whether or not the application has been made. The questionnaire calculations are to determine the percentage of respondents using a Likert scale. The percentage of interpretation is calculated using the following formula:

$$P = \frac{\text{Value}(s)}{\text{Smax}} \times 100\%$$  \hspace{1cm} (1)

Information:
\begin{align*}
P & = \text{Percentage of Interpretation} \\
\text{Value}(s) & = \sum \text{amount} \\
\text{Smax} & = \sum \text{maximum}
\end{align*}

The statements in the questionnaire are as follows:

P1: Application is easy to operate
P2: Material is easy to understand
P3: Attractive application display
P4: Increase the desire to learn
P5: Material according to the handbook

The answer choices in the questionnaire are as follows:

1 : Very disagree (sangat tidak setuju/ STS)
2 : Disagree (tidak setuju/ TS)
3 : Quite agree (cukup/ C)
3 : Agree (setuju/ S)
4 : Very Agree (sangat setuju/ SS)
From the results above (see Table 1), obtained a percentage of 85%, it can be concluded that this application is able to increase students' interest in learning the Linked List material.

4. Conclusion
The conclusions reached from this initial research are: (1) The content contained in the application includes everything needed by students and lecturers in studying the Linked List material. (2) The contents of this application display data management simulations using a linked list using interesting animations so that they can help lecturers and students in the learning process. (3) Based on the calculation, 85% of 30 respondents prove that this application is able to increase students' interest in learning the Linked List material.

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