

Computer Assisted Learning (CAL): A Learning Support System Solution

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Received December 20, 2020; Accepted February 28, 2021

ISSN: 1735-188X

DOI: 10.14704/WEB/V18I1/WEB18090

Abstract

This study tries to provide a solution by engineering existing information re-sources, designing it into a support system to facilitate lecturers or teaching staff to create, load and present multimedia teaching materials, both to groups and personal, network-based or stand-alone. The use of HTML language as a basis for web-based applications and the use of local networks can make Computer Assisted Learning more flexible and have unlimited functions on the architecture de-signed by researchers to use the function data methods as a data framework stored by CAL. Broadly speaking, this research is divided into three stages, namely pre-development data collection, development and implementation, and post-development data collection. Pre-development data collection is intended to obtain a preliminary study of the core problems being faced, while the development and implementation phase focuses on modeling software design into diagrams and making programming code to implement the design that has been made. While the stages of post-development data collection are for the improvement of applications made, drawing conclusions, and suggestions for further re-search topics. From the results of this study, several conclusions were obtained, the CAL that was built made it easier for students in learning and CAL was built by utilizing HTML Sheets as a medium for presentation of teaching material because it was very effective for displaying teaching materials in the form of text, images, animation, audio, and video.

Keywords

Design, Support Systems, Computer Assisted Learning.

Introduction

The technology was created to facilitate the activities of human life, including teaching and learning activities (Ahmad & Wali, 2019). In the world of education, the use of information technology has long been applied, such as e-learning is commonly used by lecturers or teaching staff (Al-Emran, Elsherif, & Shaalan, 2016; Hamid *et al*, 2015). In addition, various learning methods or models that utilize computers have been used such as Computer Assisted Learning (CAL) (Gašević, Dawson, & Siemens, 2015; Su & Cheng, 2015), and other such models such as; Computer Assisted Instruction (CAI) (Su & Cheng, 2015), Computer-Based Instruction (CBI) (McCoy *et al*, 2016), Computer Assisted Language Learning (CALL) (Katushemerewe & Nerbonne, 2015), Computer Managed Instruction (CMI) (Laiola Guimarães, Mattos, & Cardonha, 2016), and Computer-Based Education (CBE) (Boevé *et al*, 2015) Computer Assisted Learning (CAL) is a computer application as an integral part of the learning system of the teaching and learning process that aims to help students in their learning through two-way interaction patterns through computer terminals and multi directions that are expanded through computer networks (both local and global) and also expanded its functionality through multimedia interfaces (Ahmad & Wali, 2019). Computer Assisted Learning (CAL) has evolved quite a long time, from simple forms such as drill-and-practice (Clarke, 2001) and tutorials (Heift & Schulze, 2015) to complex forms such as computer-aided intelligence teaching (Popon, 2019) or intelligent systems (Uskov, Howlett, & Jain, 2015). To get optimal results, teaching tools in computer-aided teaching must provide possibilities so that the user can process information as deep as possible (Ahmad & Wali, 2019; Hamid *et al*, 2015). Processing information in a very helpful way to store information in one's memory, which will affect the length of time the memory (Chauhan, 2017) will be the information. This information processing is strongly influenced by the instructional design (Kearns, 2016) of teaching tools and the use of appropriate learning strategies (De Witte, Haelermans, & Rogge, 2015) by the users of teaching devices (Sung, Chang, & Yang, 2015).

In implementing CAL, hardware, software and brainware are certainly needed (Ediningrum, 2018), as well as the willingness of the lecturers or teaching staff themselves (Koch, Rankin, & Stewart, 2016), the willingness to be encouraged by supporting facilities (Lai *et al*, 2015), to prepare teaching materials to be presented with the CAL learning model are also considered as an additional workload (Shadiev *et al*, 2015) for some lecturers or teaching staff. The use of existing software packages, can not be optimal and less effective in presenting visual multimedia. The efficiency of time and energy is something that must be considered in efforts to apply the CAL learning model in order to be successful. For this reason, a support system is needed to implement the CAL

learning model. This study tries to provide a solution by engineering existing information resources, designing it into a support system to facilitate lecturers or teaching staff to create, load and present multimedia teaching materials, both to groups and personal, network-based or stand-alone. The use of HTML as a basis for web-based applications (Wali *et al*, 2019) and the use of local networks (Fathurrahmad *et al*, 2019) can make CAL more flexible and have unlimited functions.

Research Methods

Research Design

Broadly speaking, this research is divided into three stages, namely pre-development data collection, development and implementation, and post-development data collection. Pre-development data collection is intended to obtain a preliminary study of the core problems faced, while the development and implementation phase focuses on modeling software design into diagrams and making programming code to implement the designs that have been made. Whereas the post-development data collection stage is for enhancing applications made, drawing conclusions, and suggestions for further research topics.

Research Locations

This research will mainly be conducted at the AMIK Indonesia Software Engineering Laboratory. In the laboratory, there are computers that can be used to develop software supporting the CAL system on a windows operating system. In addition, this research will also involve students outside the laboratory to conduct application trials.

Research Model

The research model used is qualitative research, meaning that the data collected and used for research are not statistical data. In qualitative research, the data processed is in the form of words collected by interview or group discussion methods. This method is widely used for software development because it can produce data system requirements that are more descriptive and easily implemented into software.

Data Collection and Analysis Techniques

Data collected in qualitative research is textual data in the form of words and sentences. The most widely used method for collecting qualitative data in this research is through literature studies and group discussions. In this research, the initial data collection used to obtain a list of system requirements is to conduct a literature study on the CAL Support

System, Programming Language, and Windows Operating System. Furthermore, the literature study data is a list to be analyzed between the standard CAL Support System to be achieved and the existing CAL Support System. Furthermore, a study of the CAL Support System documentation was also carried out and an analysis of the development patterns of additional components (plugins) that could be accommodated by the CAL Support System. This is needed to determine the communication strategy between the CAL Support System and the software developer that will be developed on the Windows operating system.

While the final data collection after the implementation process will be done by making a checklist of features that are planned and fulfilled, as well as performance tests to get data about hardware requirements for system implementation. Then the prototype was tested on students to get feedback in the form of questionnaires and also direct interviews. The results of the questionnaire will be entered into a tabulation and simple calculations are carried out to obtain quantitative data about the success of the system. While the interview data will be documented and categorized to distinguish evaluations for program improvement that can be carried out in this study or will be used as input in further studies.

Results and Discussion

Research Description

This research provides a solution by engineering existing information resources, engineering software into a support system to facilitate lecturers or teaching staff to create, load, and present multimedia teaching material, both for groups and individuals, network-based (online) and independent. The results of this study are a support system in the form of a Support System for technical operations in an effort to apply the Computer Assisted Learning model especially on the AMIK Indonesia campus, and if successful it will be developed later for use by the wider community.

CAL Support System Software Design

The operational procedures of the system are designed as follows:

1. For lecturers

The template package is ready to be loaded, consisting of

- 1 opening page
- 14 page for 14 lectures
- E-book collection
- image gallery

- Audio player and text box
 - Video player and text box
2. For the library
Provided an integrated system for all pages that have been loaded by lecturers or teaching staff, its function is
- As an index page
 - Storage, and
 - Management
3. In the Classroom.
Providing projectors, sound systems and computers (notebooks) and internet browsing programs to access the CAL system in the library and present it in the lecture hall. But if there are network barriers, presentations can be done offline

System Architecture and Workflow Design

Based on the workflow outlined in the above concept, a simple work pattern can be described as illustrated in the following scheme:

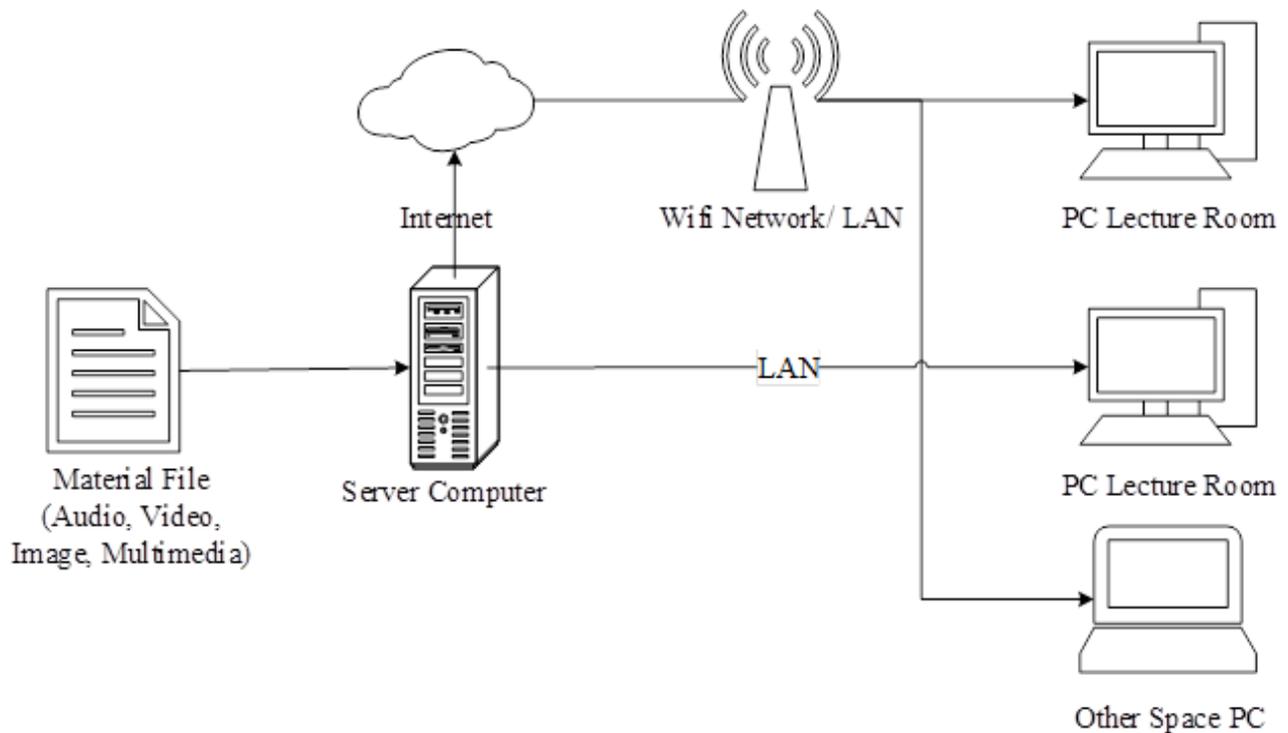


Fig. 1 CAL Architecture Concept

Each completed template page is loaded into the library server computer that has been installed by the Lecturer Assistant application system and then distributed through the network to the lecture hall for use in providing lecture material.

Implementation of CAL

- **Index Page Design**

The main function of this page is as a means to load (Embed) all HTML files in that folder. this page is placed on the library server, which is in CAL-SS_AMIK / system / folder.



Fig. 2 Index Page Views

There are 4 (four) supporting page index files: menu.html, body.html, footer.html, and head.html. The coding technique is the iframe and frame function that is set to call each file in each subfolder so that it can open the Assistant_lecturer.html file in an integrated manner.



Fig. 3 Display of Assistant_lecturer.html File in Index.html file

- **Design an HTML Template File**

The function of the template file, in this case, is as a file that will be modified by the lecturer by containing teaching materials in the form of text, images, animation, PDF, audio and video. To meet your needs, a menu is provided. However, because the software design in this study uses the function data method, which enforces functions and data separately. Then the placement of files in the directory must be really considered.



Fig. 4 Front Page Assistant_lecturer.html

Sheets for writing teaching materials, this file can be modified using Ms. Word only, as well as in terms of loading tables, graphics / images, animations, and graphics. Making it easier for users. For once a lecture meeting is given 1 (one) page, so there are 13 pages available for lecture meetings and 2 pages for question presentation (semester and end of semester exams). Placed in subdirectories.

(active drive): /CAL /Presentation/01

(active drive): /CAL /Presentation/02

(active drive): /CAL /Presentation/04

(active drive): /CAL /Presentation/04

(active drive): /CAL /Presentation/05

(active drive): /CAL /Presentation/06

(active drive): /CAL /Presentation/07

(active drive): /CAL /Presentation/08

(active drive): /CAL /Presentation/09

- (active drive): /CAL /Presentation/10
- (active drive): /CAL /Presentation/11
- (active drive): /CAL /Presentation/12
- (active drive): /CAL /Presentation/13
- (active drive): /CAL /Presentation/Test-Middle
- (active drive): /CAL /Presentation/ Test-Final.

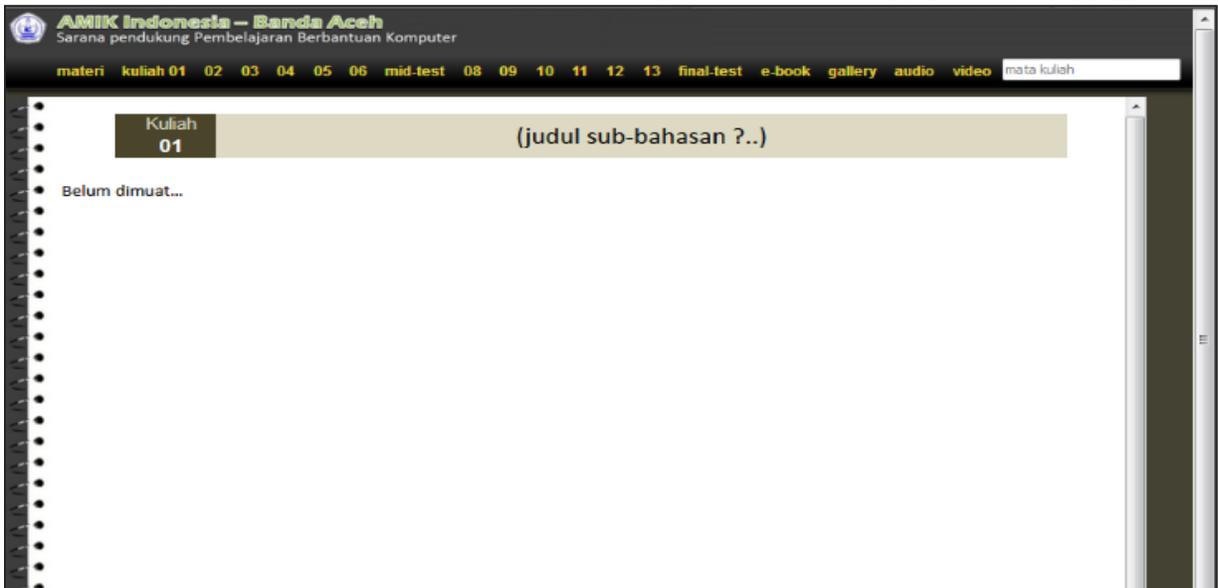


Fig. 5 Teaching material typing Page

Sheets for loading audio and sheets for loading videos. Placed in sub directories: (active drive): / CAL / Presentation / Audio.

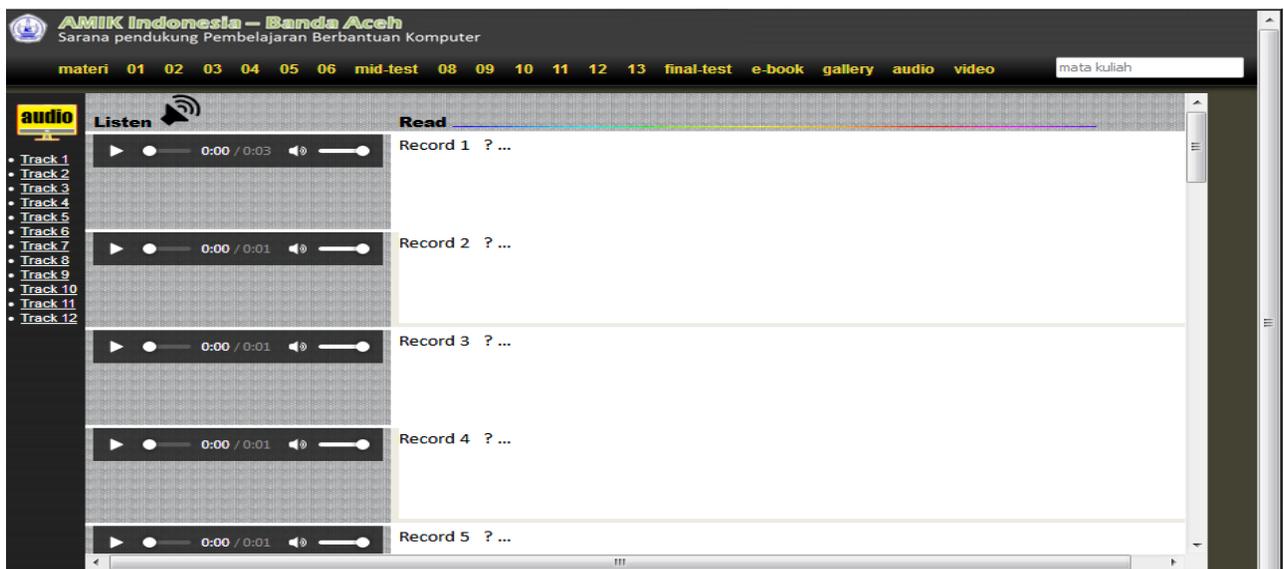


Fig. 6 Audio Page

Placed in subdirectories: (active drive): / CAL / Presentation / Video. Each video and audio in his presentation is accompanied by a text box to be filled in with writing so that the lecturer can type instructions, information or conclusions. Modifications can be made using Ms. Word. - The video page is provided with 5 sheets and 1 video collection sheet. An audio page is provided with 12 sheets and 1 audio collection sheet.



Fig. 7 Video Page

In picture 8 there is also a gallery page for loading photos / photo albums.



Fig. 8 Gallery page



Fig. 9 Figure Slide Page

It can be seen in Figure 9 that the image file is placed in the subdirectory: (active drive): / CAL / Presentation / Gallery. E-books page, for a collection of PDF files as well as a pdf reader that is already integrated in a play-in to the internet browsing program that exists today.



Fig 10 E-Books page

In Figure 10 this page is placed: (active drive): / CAL / Presentation / PDF, which contains pdf files and the CAL application loads the file and displays it on the e-book page.

Testing and Evaluations

The design results of this study must first be tested so that they can be operated effectively in the implementation phase. Test the system by using a number of testing tools on both the client-side application and the server-side application to ensure the application runs properly. Then the application is also tested on several students to get feedback from the initial prototype that was made. The tests were carried out on five devices in the form of 5 windows with the specifications listed in table 1. The table outlines the operating system, processor, and memory specifications used by each device for testing.

Table 1 Testing device specifications

No.	PC/ NB	Operating System	Processor	Memory
1	PC AMD	Win 7	Processor AMD A4 6300 3.7GHz	2 Gb
2	PC HP AIO	Win 8	Intel® Core™ i3-7100U Processor (2.40 GHz, 3M Cache)	2 Gb
3	Notebook Asus e202sa	Win 8.1	Dual-core	2 Gb
4	Notebook Asus A455L	Win 10	Intel Core i7 Generation ke-4 (8CPU) 4710HQ - 2.50GHz	4 Gb
5	Asus ROG G752VY	Win 10	i7 6700HQ	8 Gb

After the design is complete, the module is implemented. These modules are first tested individually and then together. The results of the trial can be seen in the table below.

Table 2 Testing Results

No.	Object	Assessment
1	Index page	<ul style="list-style-type: none"> • Integration of all pages loaded quite well • Quite easy to manage • Security is still lacking • The screen is quite good • Stability is quite good • The program code is not problematic
2	Presentation page	Data is loaded longer but when used makes it easier for users
3	1) Front page template	<ul style="list-style-type: none"> • The layout is quite good • Still not interesting to start the Presentation • Stability is quite good • The program code is not problematic
	2) Template 14 pages of lectures	<ul style="list-style-type: none"> • Easy to modify • Display is quite good • Stability is quite good • The program code is not problematic
	3) Gallery page template and image slide	<ul style="list-style-type: none"> • Loading images is quite easy • For lectures, the number of pictures needs to be limited and grouped • Slideshow is quite good and easy to present • Stability is quite good • The program code is not problematic
	4) Audio page template	<ul style="list-style-type: none"> • The screen is quite good • Its use is quite easy • Modifications are quite easy • The number of sheets for recording shows is still relatively low for certain subjects • Stability is quite good • The program code is not problematic
	5) Video page template	<ul style="list-style-type: none"> • The screen is quite good • Its use is quite easy • Modifications are quite easy • The number of sheets to watch video is less flexible • Stability is quite good • The program code is not problematic
4	6) E Books page template	<ul style="list-style-type: none"> • Display is quite good • The addition and reduction of e-book materials is very easy • Stability is quite good • The program code is not problematic

With the results of the trial, the researchers followed up with some improvements, modifying the software to make it better.

Table 3 Software Evaluation and Modification

No.	Object	Assessment
1.	Front page template	The opening presentation needs to be made more interesting, it needs to be added with a slide image or communicative animation. But don't make it difficult for the user in making it.
2.	Gallery page template and image slide	Given the limited lecture time and the number of image files that will be large enough to be presented with slides it needs to be limited and grouped
3.	Audio page template	The number of pages for the recording program is still relatively less for a particular subject, so it needs to be added.

Operational Design Results

After going through all the stages above, the results of this study can already be implemented, can already be operationalized in the teaching and learning process on campus. The development of this software system requires the following hardware: a minimum dual-core CPU or laptop CPU is required; 1 CPU unit for the server in the library at least at the core duo level; a set of peripherals for a wireless network (wireless) or only using a UTP cable; To make presentations in class a simple projector and sound system are provided. Whereas a minimum software program must be in place for the operation of this package:

1. Ms. operating system Windows (version 7 and higher), Mac, or Linux
2. Play-in internet browsing program to read PDF files and multimedia players (already supported by Adobe Player)

Then for the purposes of editing and modification of digital materials, it must also be equipped with the following supporting application programs:

1. Application programs for audio recorders and editors, such as the Audacity program or other similar applications.
2. Video converter application program

Application programs for designing images and programs for creating animations.

Conclusion

From the results of this study, several conclusions were obtained, viz:

1. HTML sheets can be used as a medium for the presentation of teaching materials. Because it is very effective for showing teaching materials in the form of text, images, animations, audio, and video. And HTML sheets can be operated online or offline. And after being modified in such a way that the HTML-formatted template file is very easy to be filled/edited by the lecturer (user) because it is enough with the Ms. Word program alone.
2. However, because HTML coding is not a DBMS (Database Management System), the design method in this study is by way of functions/data (function data methods). This is intended to strive for the collection of HTML sheets that exist and will be loaded into the library server can be integrated into one unit. Technically the code used is frameset and iframe, this technique researchers use to load (embed) HTML sheets with other HTML into one sheet, besides that it is also supported by the use of tables and coding according to design needs
3. Because the function/data method distinguishes function and data. Functions, in principle, are active and have behavior, while data are passive information holders that are influenced by functions. So the researcher sorts the system according to function, where data is sent between the functions. The function is then further sorted and finally converted into source code (software program).
4. Sorting is divided based on structured directories (folders), data is stored in predefined folders which will be called by the encoding function. Thus the user (user) must also understand the directory structure where the file is stored.
5. The obstacle that arises is if the file name or file type in the structure is changed will cause the file can not be called. For this reason, it must be clearly explained to the user both in user training activities and must be written in the user's manual.

Acknowledgment

The author would like to thank the Directorate General of Research and Development Strengthening, Ministry of Research, Technology and Higher Education as funders of research. LPPM AMIK Indonesia has helped researchers in supporting laboratory facilities. Thank you also to the research team and students and AMIK Indonesia staff who helped and were willing to conduct trials and surveys of the re-searchers.

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