A Multimedia Computer Aided Learning Software

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***Abstract*—This paper identifies the concept of effective multimedia computer aided learning software to tackle students fear or inability to figure out solutions. This also discussed of how to solve mathematical problems which are basic building blocks for virtually all sciences. The presented arguments are detailed utilizing the waterfall model as its methodology for the design and implementation of a multimedia computer aided learning software where each process takes a product input, transforms this product input and produces another product as output. The overall paper has discussed the insight and the methodology is discussed with evidence to support the argument.**

Keywords—Computer aided learning, multimedia, university mathematics, self-test, mobile devices

I. INTRODUCTION

Computer assisted/aided learning (CAL) can be defined as any use of computers to aid or support the education or training of people it is a fact that students have changed radically [1]-[2]. Teachers must be prepared for new ways of structuring tasks, establishing exchanges, guiding, monitoring interaction, evaluating performance, and mastering the relevant computer applications [3]-[6]. Rather than passively listening to the lecturer in class, through the use of the internet and CAL tools students can easily participate in more interactions by reading and listening to authentic materials with visuals and animations, posting and replying messages, writing and replying emails [7]-[9]. Learning is no longer restrained in time and space; rather, through the internet, learners are offered opportunities to communicate and learn collaboratively whenever and wherever they want and at their pace [10], [11]. Furthermore, they are more engaged in their own learning process by taking control over the process according to their needs, lacks and wants [12]. As CAL gives them the chance to work independently, they may be able to define their specific objectives, use the materials effectively, specify time and space for their learning, assess their results and redirect their process and define new objectives according to the feedback and results they receive [13]-[15]. The aim of this paper is to develop Computer-aided learning software using advanced university mathematics as a case study in its design and implementation of CAL software and is poised to tackle students fear or inability to figure solutions and to solve mathematical problems which are basic building blocks for virtually all sciences. The advantages of the proposed system lie in the following aspects. First, it improves the quality of the education through animated multimedia and text based educational content. Secondly, it improves the interest of student in studies and thus increase attendance and retention. Thirdly, it improves student learning capacity and makes the student familiar with computers and educational software. Fourthly, it makes learning effective, interesting and proves the necessary aid to empower lecturers.

II. ANALYSIS OF THE EXISTING SYSTEM

Some of the earlier CAL systems are powerful and impressive like that of the Programmed Logic for Automatic Teaching Operation (PLATO) and Time-Shared Interactive Computer Controlled Information Television (TICCIT) that was designed to teach higher-order concepts using an instructional design. The TICCIT system attempted to test the effectiveness of computer-aided instruction (CAI) against the traditional classroom format. Both the TICCIT mathematics and English course students reported "significant achievement" over the traditional classroom formats; however, more students favored lecture classes over TICCIT math courses, and fewer students completed the TICCIT math courses as compared to the standard. The CAI research highlighted factors beyond the instruction materials which influence effectiveness. For example, Chambers concluded that many "students simply did not complete the mathematics CAI course, apparently because the faculty paid little or no attention to their needs". The faculty's minimal interaction may be attributed to fear of technology or inadequate training. Most instructional development plans today analyze the needs of all users, both students and instructors, and try to build in adequate support. However, the TICCIT math students did not receive sufficient feedback about their progress, and consequently made poor control decisions about what and when to study, practice, and test.

A. Problems of the Existing System

The following were the problems associated and identified with the existing system:

- The development of these systems was very expensive, and was only possible due to government intervention.

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- The ease of software use was absent because the user needs to possess programming knowledge than be a mere computer literate.
- Lack of embedded feedback mechanism either into the program itself or through instructor training.
- Absence of evaluation of how much learner control is appropriate given the skill base of the targeted learners.
- Lack of availability of quality lecture materials, which have poised a lot of problem to a good number of students and staff.
- A job that could be handled by one staff was been handled by more than one staff leading to overhead cost.

III. Analysis of the Proposed System

The proposed system is executable windows based learning system with in-built quality lecture materials and videos. Its relevance is due to the fact that it is electronically accessible even without an internet connection which seems to be a problem to a good number of students that own personal computers. Students or e-learners will be able to browse and receive self-explanatory lecture notes and videos as if they were in the class room. A self-test section is also included where scholars can take test based on selected topics and be scored afterwards as a feedback to the user. This obviously will help students to acquire degree in the institutions.

A. Benefits of Proposed System

- Pedagogical Improvement and staff renewal: Teaching staff are able to preset information using a variety of tools in order to better relate to the content to the concrete realities of a given field of study.
- Individualized instruction: Learning is significantly more effective and efficient when instruction can be tailored to the unique needs of each learner.
- Providing instructions on demand even without an internet connection. The computer can provide virtually unlimited accessibility to educational material. The computer's availability is not constrained by the same factors that place a limit on a teacher's time.
- Flexibility: Participants can easily work in collaborative groups without rearranging everyone's schedule as one might do in a traditional face-to-face course.

Figure 1 shows the high level model of the proposed system.

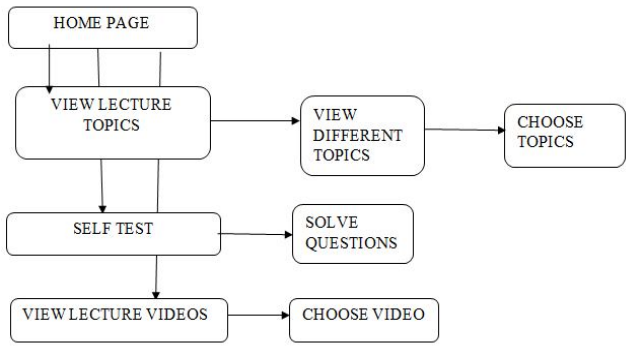

Fig. 1. High level model of the proposed system

IV. Methodology

Waterfall model is adopted as the methodology by this paper in which each process takes a product as input, transforms this product and produces another product as output. The verification and validation (V & V) boxes below represents the testing activities conducted during development to ensure the accuracy of each product. Figure 2 shows the waterfall model.

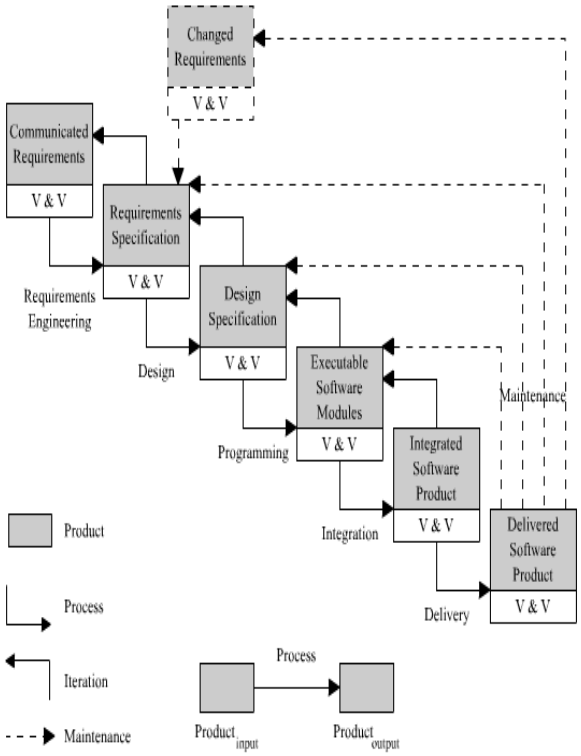

Fig. 2. Waterfall model

V. System Design and Implementation

A. Language Justification

Reasons why PHP was chosen over other programming languages in this paper are as follows;

1) Simple & Easily to Learn: One of the easiest languages for building websites is PHP scripting languages, which allows developers to quickly grasp on web development.

2) PHP with supports: one can find full support whenever one getstuck with any problem or error while writing in PHP scripting language.

3) Speed: It is much faster than any other scripting language, because it does not require a lot of system's resources.

4) Easy Maintenance: Every developer wants to develop applications using web programming languages that are more easy to find and fix any error or fail. So, Php with each reqest it cleans up and then starts over.

5) It is free and open source and easy to integrate.

B. Input Specification

Generally, input specification describe the type of records within a program and or software file, the sequence

of the type of records, the fields within a record, the data within the field, control fields etcetera. For this Learning system, it contains well over 200 different lecture topic material, all in ".pdf format (Portable Document Format)" with pictures where necessary for illustrative purposes as well as over 20 lecture videos averaging about 30 minutes of playtime, all of which covers several fundamental and essential mathematical concepts well formatted and arranged step-wise the best way for easy understanding. Figure 3 shows the sample course topic page.

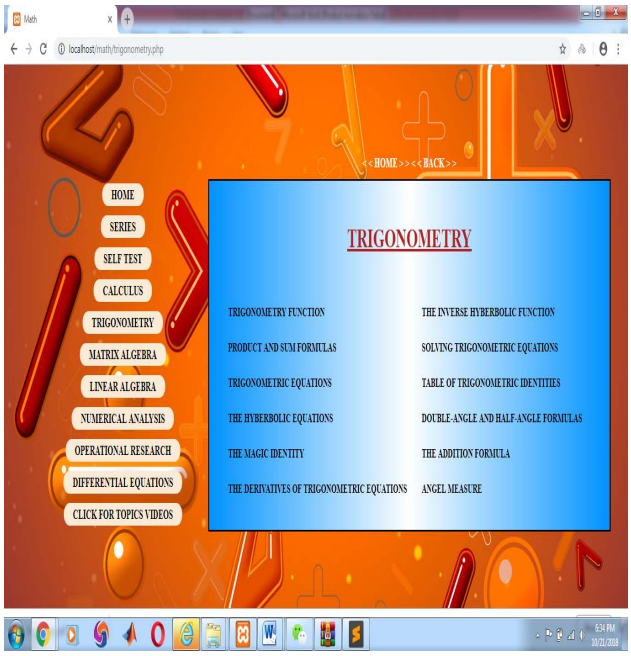

Fig. 3. Sample course topic page

The Self-Test section covers for student learning progress and assessment. With a sample of about 30 questions, the student user can actually take a quick test on random questions to the student's ability. By merely selecting one of the four options configured via "radio-buttons", the student chooses an answer from a list of options which later the system returns a result to the user as shown in figure 4.

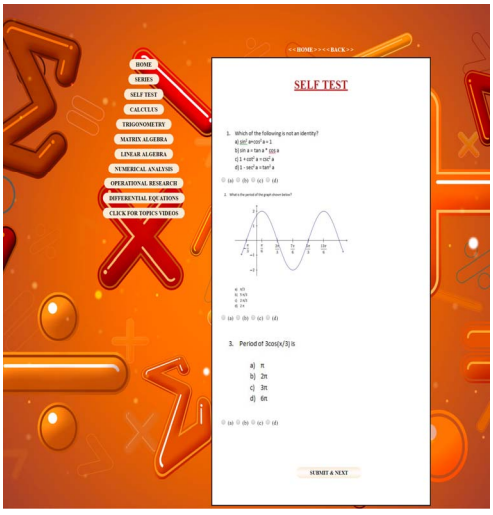

Fig. 4. Self test page

C. Output Specification

Output specifications describe the records and fields in the output files and the conditions under which output operations are processed. Basically, reports and displays that users see which are all the contained materials, lectures and videos inclusive. They can be used for personal as well as group studies. With an "export-book" function included in the software, any material can be sent to anyone who demands it as shown in figure 5. The receiver can choose between a portable document format (.pdf) after which a successful download will be done to the download folder. All text documents are in .pdf format and range between 4 - 20 pages each and all videos in .mp4 formats. Also, no restrictions and constraints whatsoever are placed on this software product and its circulation. This is shown in figure 6.

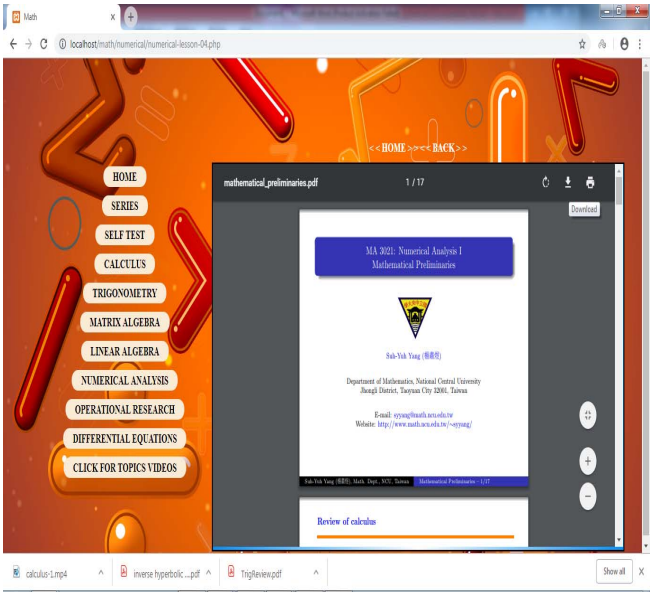

Fig. 5. Exporting book to phone

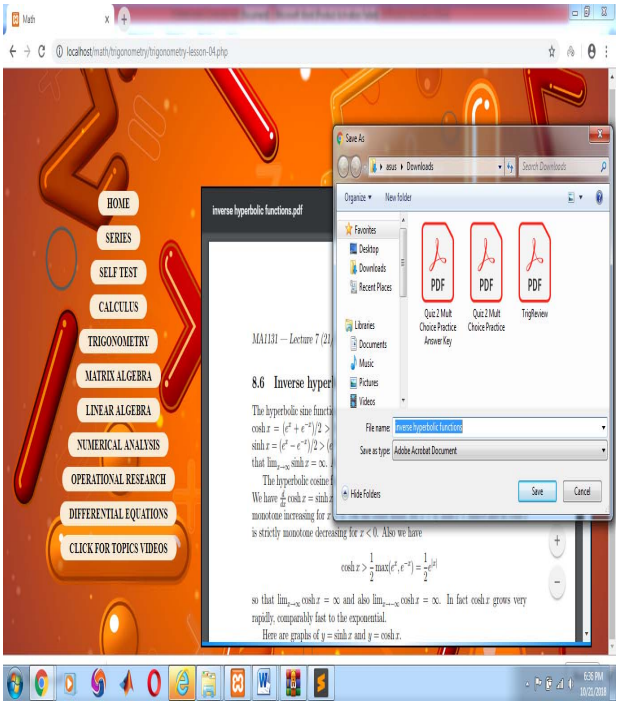

Fig. 6. How to export book to phone

VI. System Requirement

The new system is designed to be implemented with the following minimum software requirements:

A. Software Requirement

- Operating System: All versions of Microsoft Windows operating system (Windows NT/2000/ME/XP/Vista/7/8/10) , MAC OS, LINUS
- Web Browser software: Any version of Internet Explorer/Mozilla Firefox/Opera/Safari/Google Chrome or any other web browser.

B. Hardware Requirement

- Pentium II series processor
- 512 MB RAM size for both 32 and 64-bit architectures.
- 3.0 gigabytes (GB) of available hard disk space.
- 15'' color monitor, preferably a flat screen monitor.
- Graphics hardware acceleration requires a DirectX9 graphics card.

VII. Database Specification

Files in a DB are sorted relationally and stored in tables and can be queried to retrieve information stored.

1) Design Decision: For this paper, there was no need to incorporate the file access to a database because a more direct file access method is available in PHP and also for the fact that a relational database file structure was necessary. The key notion is the use of the user interface (UI) such that the user and the computer are engaged in a communicative dialogue whose object is to accomplish some task.

2) Query (Access) Design: File access (Query) defines how intended files are reached based on the supplied and relevant criteria. Here, file access and navigation are all based on "Events" which can be triggered by a mouse click or by pressing the keyboard. A typical code to access a particular lecture by a mouse click is seen and explained below;

VIII. Program Testing

A top-down approach to testing was adopted. Each module is tested and the test expands as additional modules are added till the whole program is covered. Progressively, the system would be tested for errors. This form of testing is exhaustive and very time consuming. Eventually most of the obvious errors are debugged. Although detecting all of the different failure modes for this software is generally infeasible, to a reasonable extent, a well debugged and optimized program code to ensure that to a great extent the program was fail-proof was developed. Figure 8 shows a sample performance report generated by PHP and MySQL for analyzing this learning system.

A. Program Flowchart

The program flowchart is illustrated in figure 7 below which describe the processes of the proposed system.

IX. Results

By analyzing the actual use of the system through implementation and testing, it has been verified from the graph in figure 7 that the programs performance is optimal. The processor usage highest spike was about 40% and never lasted up to a second which happened only when videos were selected. No lag, crash or glitch whatsoever was noticed. Thus, the aim and objective of developing a fail-proof system has been realized. The sample output diagrams are illustrated in figure 9 to figure 13.

X. Discussion

This paper targeted the design and implementation of multimedia CAL software basically on mathematics. This is of importance due to the fact that individualized and well-structured information provided via this means can unarguably enhance reasoning and decision making abilities which is critical for any science student. A multimedia CAL program was developed using PHP language which encompasses more 300 textual materials with over 100 animations and video clips on different core and advanced math topics, a multiple option self-test section which are all easily accessible even without an internet connection. Although CAL is currently transiting from the 'acceptable' state to an 'accepted' state, if fully incorporated and effectively used in university curriculum, it will enhance the overall learning process, be more beneficial compared the traditional classroom learning which is old-fashioned, static and expensive to the institution and can also be a vital source of feedback to the lecturers.

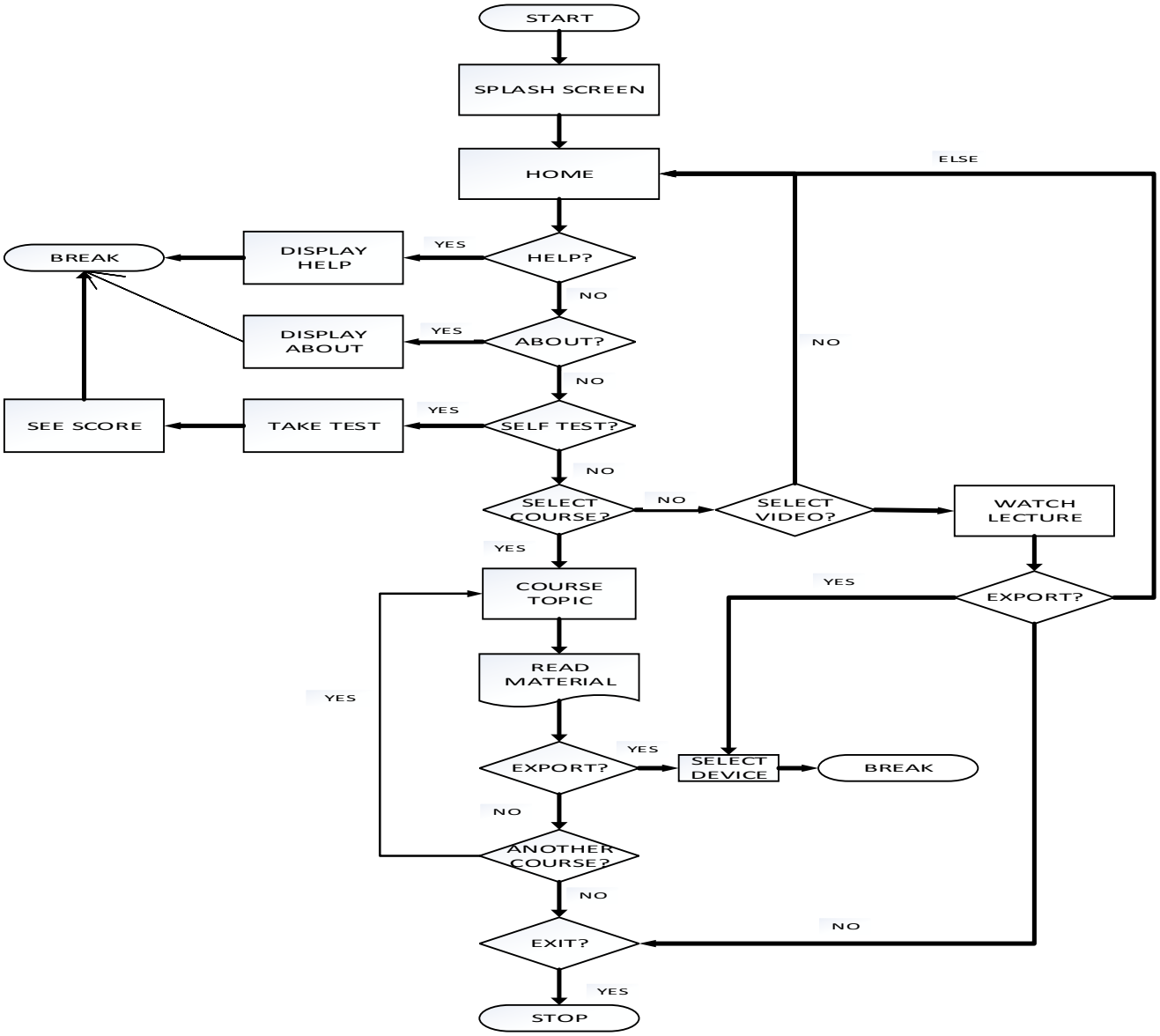

Fig. 7. Program Flowchart

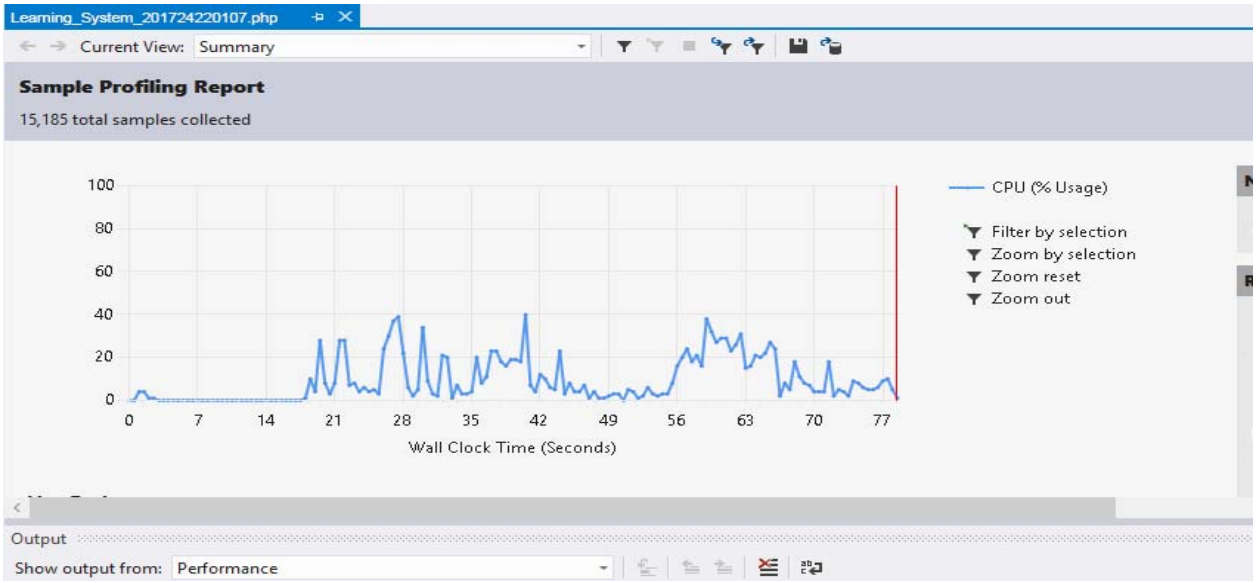

Fig. 8. Performance profilling report

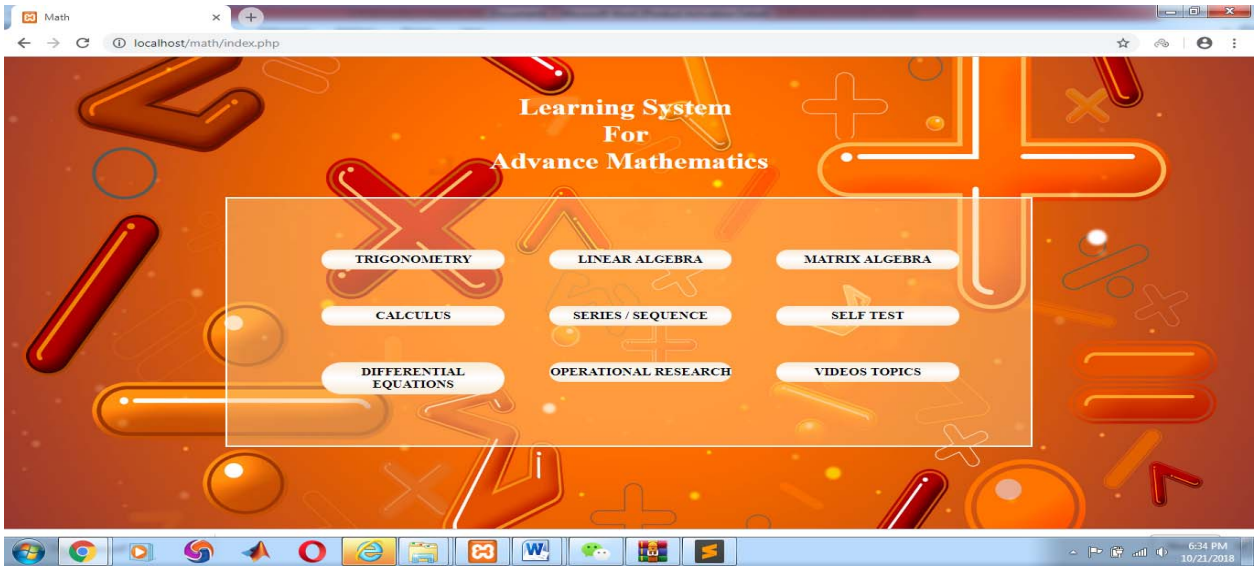

Fig. 9. Home page

Fig. 10. Sample course selection page

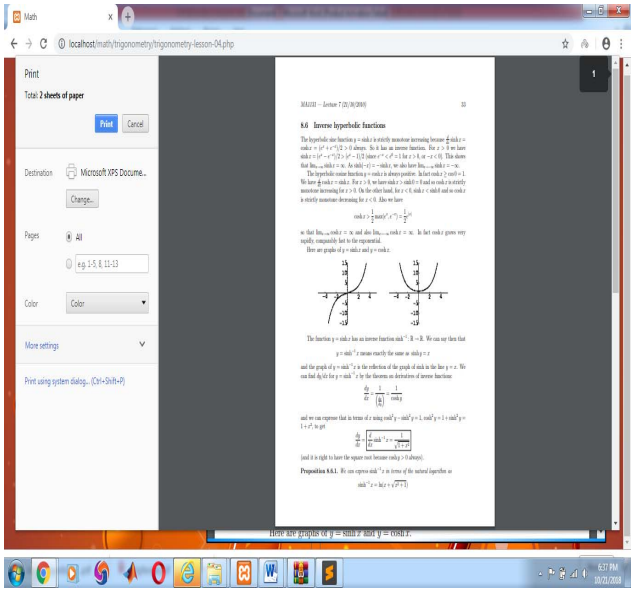

Fig. 11. About Printing option

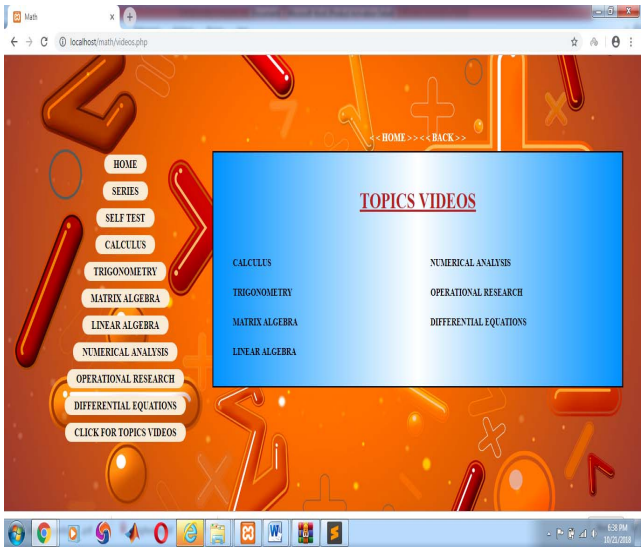

Fig. 12. Sample video page

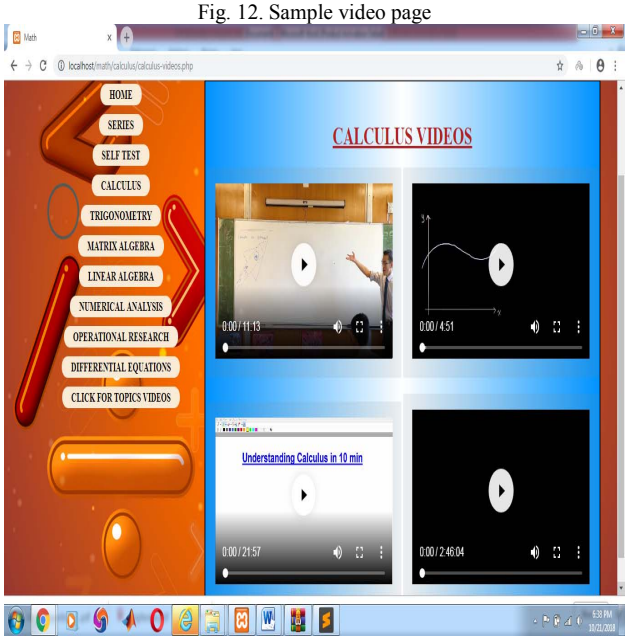

Fig. 13. Exporting a video

RECOMMENDATION

The present study explored how students perceive the use of computers and their integration into education. Specifically, a system was developed to aid and investigate what students´ attitude toward CAL is by also investigating their attitude towards computers and personal learning. As a next step, one main component left out was a facility to maintain the system's files, directories, programs and documentation.

- Moreover, ongoing classroom observations on a regular basis may be influential. Students' co-operation, if there is or should be any, can be monitored. Such first-hand observations can reveal the effectiveness of CAL in supplementing teaching and or learning.
- Also, involving teachers into the same research also seems even more beneficial as they appear to be the other side of the whole process. They are the inevitable and as this study also indicated they are quite an integral part of adapting CAL into curricula.
- Students' achievement levels can be tested regularly and analyzed to check if there is any improvement and if there is to what extent the skills are improved precisely by the use of this system. Thus, for an additional research both the students' and teachers' attitude on a specific CAL program can be investigated and their progress can be monitored to see if there is any change.

CONCLUSION

Obviously, students feel more confident while studying with computers. Therefore, relevant curriculum and materials should be scrutinized and adapted according to students' needs. Interesting topics accompanied by relevant CAL materials may change students' attitude towards learning in a positive way. Experienced CAL students maintain positive attitudes towards CAL, so the sooner the learners are introduced to CAL, the better for their proficiency. Again, one of the most important issues is teachers' influence; in the level of enthusiasm and commitment are the most important factors that affect the learners' motivation.

In conclusion, CAL has much to offer when it is integrated into the curriculum in a well-organized fashion. Students have positive attitudes towards it as they will be more motivated and are more likely to perform better and achieve higher levels of acquisition. When it comes to preparing students for the future on their higher education and work, teachers should keep in mind that students would need to be proficient both in computers and its interaction. Therefore, it is not only the question of technology for learning, but also the urge to assist them in developing both life skills.

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