

Development of Computer-Assisted Instruction for an electrical circuit course

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ABSTRACT: This study aimed to: 1) develop Computer-Assisted Instruction (CAI) for an electrical circuit course; 2) determine the effectiveness of the CAI; 3) determine the effect on learning; and 4) determine user satisfaction of the CAI. The tools used for this study were: 1) the CAI for an electrical circuit course; 2) a test of learning achievement; and 3) a questionnaire for students' satisfaction, with 30 students as the sample. It was found that the developed CAI has effectiveness higher than the defined criteria, 80/80. The pre-test scores and post-test scores showed that the students had a learning achievement 60% higher than the defined criteria (60%). The students' satisfaction towards this CAI is *very satisfied*. Therefore, it can be concluded that this developed CAI for the electrical circuit course could be utilised as an effective self-learning tool.

INTRODUCTION

Computer-Assisted Instruction applies information technology within education using teaching materials, which can be further developed as an Interactive Multimedia Computer-Assisted Instruction (IMMCAI). Hence, students can self-learn anytime, anywhere. This student-centred learning material is more attractive and understandable. Therefore, the teachers can pay more attention to presenting the content through multiple channels, which can obtain more attention from the students and be more easily understood.

BACKGROUND AND MOTIVATION

The Electrical Circuit course includes the structure and operation of electrical devices, which are very complicated and, hence, difficult to explain to students. It was decided to develop the CAI for this course to improve the effectiveness of course management and students' learning. This should lead to a more effective application of the know-how in practice.

RELATED WORK AND THEORY

Bhumin Hongma developed the CAI for electronic devices and electrical circuit course, and found that the developed CAI has an effectiveness higher than the defined criteria of 80/80; the learning achievement of 63.94 was higher than the defined criteria of 60; and an average users' satisfaction was of 4.47, which falls into the *very satisfied* level.

THE APPROACH

The development of CAI for the Electronic Data Processing course followed the IMMCAI development procedure introduced by the Faculty of Industrial Education at King Mongkut's University of Technology Thonburi, as shown below:

1. The analysis phase aimed to understand all related content and details that could be presented in the instruction and to re-order the contents for better learning.
 - The *Brainstorm Chart* step surveyed and searched for related content for this course. The brainstorm was done by staff and content experts. First, the topic of the course was placed at the centre of the chart. Then, written down were the closely related topics using linking lines to show relationships. After that, the content experts checked for accuracy, and revisions were made.

- The *Concept Chart* step was done after the brainstorm chart step. The written topics were analysed again to review and revise the relationships, hence, the production of the concept chart.
 - The *Content Network Chart* step presented the fully analysed concept chart as the content network. The content experts then checked again for accuracy.
2. The design phase was as follows:
 - After the *Content Network Chart* was done, content was separated into modules and presented as a draft course flowchart.
 - The Learning Management System (LMS) Chart was drafted to administer the CAI learning process, starting with registration name, user name, password, etc. Learning status, log report, learning path and test results could be viewed once logged in. These can improve the students' learning achievement.
 3. The *Module Presentation Chart* presented the continuity and defined the standard for each module to match the objectives defined earlier. This included course introduction, course presentation and course activity. This process was done by considering presentation topics and media to match the objectives. Once completed, the experts checked again for accuracy.
 4. Content scripts were prepared in the development process, and all scripts were ordered as per the content network chart. After completion, the learning achievement test was developed, which had several steps, such as test analysis, content and test design, and quality measurement for effectiveness and efficiency.
 - Implementation began with selecting the software and preparing all media resources. Once completed, the CAI was implemented.
 5. The learning achievement test was based on behavioural objectives using Rainelle and Hamilton's theory. If the average was equal or greater than 0.5, the test was definitely accurate and could be used to test samples. Tests can be stored in a repository. The steps were as follows:
 - Test analysis: this weighs each behavioural objective to determine suitability. Six indexes are considered. They are memory, understanding, adaption, analysis, synthesis and evaluation.
 - The Testing Management System (TMS) used for this study was pre-test, sub-test and post-test. Tests were stored in one database and categorised, based on behavioural objectives; they can be retrieved based upon behavioural objectives.
 - Tests were prepared and stored in the repository. They were reviewed and then checked for correctness and accuracy by experts. The test print-out was then used in a sample trial.
 - Test quality was determined by testing 30 students. Results were analysed to determine the quality of the test, including difficulty, discrimination and reliability.
 - The application inventory database in the experiment was used to test the efficiency of the lessons and the effectiveness of the learning; it included both pre- and post-tests. Randomly selected tests from the database library were examined to verify consistency with the behavioural objectives. Students' learning was facilitated by doing the tests on a computer.
 - A quality assessment of the multimedia lessons used a Likert's three-level query scale estimation (rating scale) with 5 - very high, 4 - good quality, 3 - fair quality; less than 3 is a failure and the material should be updated.
 - Query learner satisfaction was determined using a Likert's five-level scale (Rating Scale) with 4.50 to 5.00 - extremely satisfied, 3.50 to 4.49 - quite satisfied, 2.50 to 3.49 - moderate satisfaction, 1.50 to 2.49 - little satisfaction, and 1.00 to 1.49 - no satisfaction.

OVERVIEW OF THE SYSTEM

The pre-test scores and post-test scores showed that the students had a learning achievement 60% higher than the defined criteria (60%) using CAI. Therefore, the CAI can be used for teaching. Furthermore, the CAI development aimed at quality, with the following objectives:

- There was quality control at every step of operations planning and development. Guidelines were developed for IMMCIP (introduced by Assoc. Prof. Pairoj et al), which has five main steps and 16 sub-steps. Every step revealed problems and defects. Inspections and format presentations by experts occurred throughout. At completion, the CAI was as specified.
- Students could select any content using special menus.
- Content was carefully designed to aid student understanding.
- Students could trace back to review their learning activities and results or even re-run them.
- The test was designed in a multiple-choice format.
- Evaluation: once students complete their lessons, they improve their understanding of electronic devices and circuits, which can then be applied in practice.

CONCLUSIONS

The research findings from the development of CAI for an electronic circuit analysis course can be summarised as follows:

- Thirty students with no knowledge of circuit analysis were pre-tested. They then used CAI to study the units. The results were analysed to determine the effectiveness of the lessons. Analysis showed that the effectiveness of the lessons was better than the defined criteria of 80/80.
- Pre- and post-testing demonstrated the effective learning of students using CAI.
- Satisfaction analysis of computer teaching was carried out. The researchers distributed a questionnaire to measure satisfaction levels of students toward CAI, and which measured presentation format, content, and enhancement of understanding and the quality of the lessons. The level of student satisfaction with the CAI was found to be *very satisfied*.

REFERENCES

1. Kiadkirdsuk, S., Sombunsukho, S. and Terathananakul, P., Development of computer instruction package training of ISO9000. *Proc. 6th Inter. Conf. on Developing Real-Life Planning Experiences: Technologies for Education*.
2. Terathananakul, P., Kiatkomol, P. and Yampinitch, S., Design and Producing Computer Assisted Lesson for E-Learning (2003).
3. Sombunsukho, S., Lertkulvanich, S., Cheungsamo, J., Paiboonpalayoy, N. and Wimondrisupap, S., Multimedia development for Web site promoting Thai herb learning. Organised by IADIS International Association for Development of the Information Society, Co-Organised by The University of Dublin Trinity College, Dublin, Ireland, 13-16 July (2006).
4. Sombunsukho, S., Lertkulvanich, S., Sirinantachai, N. and Kongsupapsiri, P., Multimedia development for Thai culture education case study: a Web site development for teaching Thai desserts cooking. *Proc. World Conf. on Educational Multimedia, Hypermedia & Telecommunications*, Lugano, Switzerland, 21-26 June (2004).