DESIGN AND DEVELOPMENT OF CMI SOFTWARE (CMIS) IN TEACHING AND LEARNING COMMUNICATIONS AND NETWORKS

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ABSTRACT

The study focused in the development of computer-managed instruction software to aid teaching and learning Communications and Networks for the teachers and students of the Bulacan State University. The CAI Design Model (CDM) was utilized in the study. Four major phases were implemented consisting of (1) analysis or assessment phase, (2) designing phase, (3) development/formative phase, and (4) evaluation and revision phase. Some of the important features that are included in the software are: (1) motivation towards learning, (2) retention of knowledge, (3) systematic record-banking, (4) individualization of learning pace, (5) integrity of subject matter content, (6) self-direction, (7) immediate response, (8) flexibility, and (9) access control. The topics included in the software were solely based from the course syllabus prescribed by the Commission on Higher Education. The acceptability of the software was determined using five dimensions: (1) subject matter content, (2) readability, (3) usability, (4) instructional design and (5) portability. Considering the important features of the software, CMIS is recommended as an instructional aid and reference material for students taking up the course.

Keyword: *CAI design model, computer-aided instruction, computer-managed instruction, communications and networks, instructional software development, teaching and learning using technology*

1. INTRODUCTION

Recent technological advances have created the possibility for newer ways of learning and teaching. The education reform is one of the important issues we are confronting today. One of the applications of information technologies is the modern education based on computer and network technology. This application will not only bring the innovation of education method, but also result in the fundamental innovation of education thoughts, conception, theory of teaching and learning, and even the whole education system. And the modern education technology is the breakthrough point of the education reform (Liu and Wang, 1999). The pace of both technological development and the introduction of new technologies into educational settings have dramatically accelerated during the past decade. The combinations of computation, connectivity, visual and multimedia capacities, miniaturization and speed have radically changed the potential for technologies in schooling. These developments are now making it possible for technologies to be designed and deployed to produce powerful and kinked technologies that can substantially address some of the core problems of education. Among these educational technologies, Computer-Assisted Instruction (CAI), Computer-Aided Instruction (CAI), Computer-Managed Instruction (CMI), Electronic-based Instruction (EBI), Computer-based Learning (CBL), Computer-based Teaching (CBT), Internet-based Instruction (IBI) and Web-based instruction (WBI), collectively known as Computer-based Education (CBE) is considered to have the highest potential of raising the effectiveness of teaching and learning. Computer-based

education, diverse and rapidly expanding spectrum of computer technologies assist the teaching and learning process. Computer-assisted (or aided) Instruction is an interactive instructional technique whereby a computer is used to present the instructional material, direct the user to additional material which meets the needs of the leaner and monitor or track learning that takes place. CAI tools, such as word processors, spreadsheets, and databases, collect, organize, analyze, and transmit information. They also facilitate communication among students, between students and instructors, and beyond the classroom to distant students, instructors, and experts. It is also used to describe Internet-based instruction through use of web pages, bulletin boards, listservs and newsgroups, video and real audio, graphics and hands-on application.

Being one of the premier and leading universities in Central Luzon and entire the country, Bulacan State University (BulSU) aspires to improve the quality of life of people and promote socio-economic development. The university commits itself to develop graduates capable of responding to the needs of the region and the demands of the global standards. It aims to pursue excellence in its programs through higher professional, technical and special instructions. BulSU ensures the attainment of empowered and globally competitive graduates through; promotion of quality and relevant educational programs responsive to meet international standards, generation and dissemination of knowledge in the broad range of disciplines relevant and responsive to the dynamically changing domestic and international environment, broadening of the access of deserving students to educational opportunities and optimizing the social, institutional and individual returns and benefits derived from the utilization of higher education resources. As one of the key institutions of the university, the College of Information and Communications Technology (CICT) would like to contribute to the attainment of the goals of BulSU. The college primarily provides instructions, trainings and learning experiences in the different fields of computer education which demands new skills and better system from a broad spectrum of disciplines and interests where integrity, competence, quality work, professionalism, work values and self-confidence are distinctively sculpted by the strict meaningful pursuit of high ideals for a more interconnected world through networking with a deep commitment to a broader common good. CICT envisions itself to be a center of excellence in information and communication technologies (ICTs). It aims to produce high level of expertise, excellent and competent individuals capable of bringing our country to a bright future and nurtures them towards becoming responsible individuals with a sense of self-fulfillment. The college aims to realize this vision through contributing to the national development through research and technology, producing competent graduates equipped with greater knowledge and skills in the application of information technology (IT), and keeping abreast with the changes and advancement in information and communication technology.

Thus, the researcher would like to present computer-managed instruction software (CMIS) in teaching and learning Communications and Networks. The college is primarily catering computer education and the subject is the showcase of communication technologies. Hence, the development of this software as a supplement to traditional education system exhibits the use of modern advancement in ICT. The researcher, as an educator, would like to take part in the realization of the university goals and present the software to the IT students for them to be able to grasp with the rapid changes in the world's education system.

1.1 Significance of the Study

The development of the computer-managed instruction software is expected to play a vital role in computer education, specifically in the subject Communications and Networks. The output of this study aims to aid faculty members of the CICT and the students of Bulacan State University. This study can ease teachers from traditional tasks associated with teaching, allowing them to have more time to attend to the individual needs of the learners. The development of the software can also assist teachers in implementing any or all the four essential phases of instruction; (1) presenting information, (2) guiding the student, (3) proving student practice and (4) assessing student learning. Today, teachers are utilizing computers in their classrooms more than the basic productivity tools of word processors, spreadsheets and databases. A new breed of software, instructional courseware, may be exactly a tool to spark students' interest to learn subjects like Communications and Networks. CMIS can provide greater teaching

and learning effectiveness through its audio-visual effects. Difficult concepts will be made easier to understand. It will transform complicated lessons in an easy-to-understand presentation and an entertaining approach. The software aims to deliver effective English-language based training to students. CMIS can dramatically increase students' access to information. The software can adopt the capabilities and preferences of the individual student and increase the amount of personalized instruction a student receives. Many students can be benefited from the immediate responsiveness of the computer interactions and appreciate the self-paced and private learning environment. Moreover, computer-learning experiences can engage the interest of students, motivating them to learn and increasing independence and personal responsibility for education. It can also be used by students for private study on individual PCs following the instruction-taught lesson. It can also serve as additional reference material for students from other colleges taking up Communications and Networks. It can increase the cost-effectiveness of the instructional staff by reducing the classroom teaching content of the course resulting to potentially increase the profitability of the institution. The development and acceptability of the CMIS is expected to be a substantial contribution to the field of educational research. We have to admit that the university world is in a state of change, shifting from traditional system to a more advance approach integrating technologies to attain a better education. The result of this study can also serve as a reference for other researches and development for the advancement of the world's education system..

1.2 Theoretical Framework

The use of information technology to support teaching, training, learning, entertainment and education in general emerged several decades ago. Many claims about the relative value of the educational software have been made. Although it has been difficult to prove the advantages of educational software over conventional teaching, training and learning, its use has increased anyway and many attempts have been made to develop instructional software products for different subjects, in a wide variety of educational settings and of course different target groups. The development of the CMIS is theoretically based in the Instructional Design theory. This theory is the study of how to best design instruction so that learning will take place. It differs from the Learning theory which is the study of how people learn. Basically, the Instructional Design theory is drawn from the Learning theory. Instructional design according to Briggs, Gustafson and Tillman (1991), ensures congruence between objectives, instruction and evaluation. They identified six principles of this theory; (1) objectives, instruction and evaluation are related and congruent and each affects other, (2) components must be related, (3) process of instructional design must be systematic but flexible to allow changes and cyclical development, (4) instructional design should be research-based, (5) must be open to testing and improvement, and (6) compare final design to an alternative or at least to the objectives- "Does it work?". The two broad fields of the instructional design theory are *directed instruction (instructional system)* and *constructivism*. The *directed or the instructional systematic design* implies the considerations for the needs of the learners, activities which help in the achievements of the goals, the instructional media, assessment tools, and revisions. *Constructivism*, on the other hand, is the outgrowth of the earlier theories such as discovery learning. This approach makes learning more relevant to students by embedding it in real situations. Emphasis is on the process learning rather than searching for the answer. In the classroom settings, instructional adjustments are easily and naturally implemented, an informal lecture can be instantly changed into group discussion without prior planning. There are times that there is no plan for the lessons which should be taken up. With the use of the modern technology incorporated with the constructivism theory, it properly provided the types of learning and modes of interaction that will achieve the subject goals. Basically, the approach should follow an analysis of the learning goals, learner needs, budget time frame, access to technology, advantages of particular technologies, limitations and constraints. The theoretical foundation of creating best design instruction to enhance learning is adopted in the construction of the computer-managed instruction software.

1.3 Conceptual Framework

The paradigm shown in Figure 1 is implemented in the construction and development of the computer-managed instruction software. **Context, Input, Process and Output (CIPO) Model** is adopted in designing the software. This model outlined the significant framework and each part plays vital role. The **context** within which

the CMIS was designed primarily consisted of the educational philosophy of the Bulacan State University and the vision, mission, goals and objectives of the CICT specifically, as mentioned in the introduction of this study. The necessary **inputs** are driven from syllabus and course outline, textbooks, references, video clippings related to the topics, web-based materials, programming tools, video and graphics editing tools, sound recorder/editor and computer hardware, including peripheral devices. The textbooks are used as the sources of the contents in the discussions. Other reference materials such as web-based information, video clippings and other related sources were also used. The **process** was properly documented which includes all the steps from planning, the development proper and the assessment of the instructional software. The development process of the CMIS utilized the CAI design model (CDM). Four significant phases composes the adopted design model; (1) assessment or analysis, (2) design, (3) development and formative and (4) evaluation and revision.

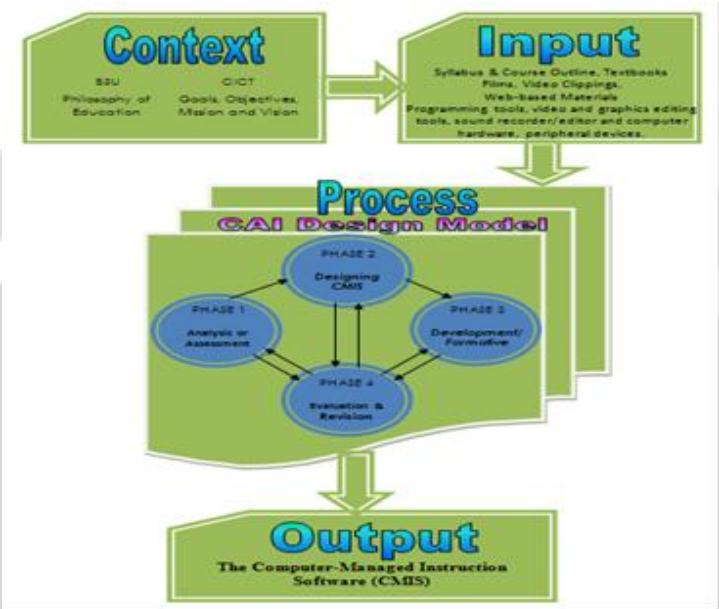


Figure 1.
Paradigm for the Development of the Computer-Managed Instruction Software in Teaching and Learning Communications and Networks

Finally, the fourth phase in the model, the **output,** comes up with the computer-managed instruction software in teaching and learning Communications and Networks.

1.4 Statement of the Problem

The major purpose of this study is to develop computer-managed instruction software in teaching and learning Communications and Networks..

Specifically, the study sought to answer the following questions:

1. What are important features of Computer- Managed Instruction Software?
2. What are the considerations and limitations of Computer- Managed Instruction Software?
3. What design models may be used in the development of Computer- Managed Instruction Software?
4. How acceptable is Computer- Managed Instruction Software in terms (a) Subject matter content, (b) Readability, (c) Usability, (d) Instructional design and (e) Portability?

1.5 Scope and Delimitations

The study focused on the development of the computer-managed instruction software. This aimed to produce an instructional material in teaching and learning Communications and Networks which integrates the

advancement of our technology in the field of education. It is designed for students of the Bulacan State University in learning Communications and Networks. The content of the software was solely based from the current prescribed syllabus of the course provided by the Higher Education Department. Networking practices and actual installations are not included in the scope of CMIS. The development process made use of the programming tool Delphi. Other software used are Text editor, Adobe Photoshop, MS Word, Notepad, Sound recorder, MS Access, Macromedia Flash and MS Paint. Evaluation is given at the end of each lesson. Random questions are provided. The learner will be able to continue to the next lesson if he has passed the examination presented on the previous lesson. The learner must be able to answer at least fifty percent (75%) of the total quiz items. Immediate feedback is given for wrong answer but does not identify the correct answer. The ultimate purpose of immediate feedback is to correct wrong thinking by allowing them to review the topics. To test the acceptability of the software, the researcher asked three adept people to use the software and assess according to the specified criteria. The researcher chosen (1) a faculty who has finished her MSIT degree at the Hannam University in Korea and an expert in teaching and developing multimedia applications, (2) an expert in computer-based education (CBE) holding the degrees in PHD, MSIT and MAE major in CAI, and (3) a professional software developer from the Management Information System Department, to test the software and determine the acceptability. Three 3rd year BSIT students were also randomly selected to use the software during the dry run implementation. The software was designed and developed to aid and supplement traditional teaching techniques and not to totally replace the role of the teacher.

II. RESEARCH METHODS

The study is descriptive in nature. Thus, its concern is the construction of a tangible contribution for the improvement in the technology of our education system. The study primarily focused on the process of implementing procedures for the development of instructional software. It involves all the vital procedural steps from the formulation of the objectives, selection of the design model of the study, identification of the target clientele and the available sources of data, selection and development of the data collected, and of course, the evaluation and revision of the output. Descriptive method of research allows researchers to understand situation and necessities more fully and develop more worthwhile and useful studies. It usually involves observation and description of variables as they are distributed to the population (Crowl, 1993). Quality observation is at the heart of the descriptive research (Heppner et. Al, 1992). The study also made use of another technique known as the Research and Development method (R&D). This method is seen to be a very effective vehicle in the advancement of the education technology. The main essence of the method involves the development and validation of the instructional and educational materials. The R & D technique is designed to (1) examine the findings of the past researches, (2) innovate and develop the material based on new findings, (3) test the innovation, and (4) revise the material. In examining the findings of the past researches, this study analyzed the content of the documentary materials that already exist and is available as sources. This technique is referred to as documentary analysis.

III. FINDINGS OF THE STUDY

3.1 Problem #1: Important Features of the Computer-Managed Instruction Software

The computer-managed instruction software has several important features; (1) motivation towards learning, (2) retention of Knowledge, (3) systematic record-banking, (4) individualization of learning pace, (5) integrity of subject matter content, (6) self-direction, (7) immediate response, (8) flexibility, and (9) access control.

Motivation towards learning. Motivation is the primary factor in instructional models. Reiber describes five principles for computer-based education derived from constructivism and the first is to provide a meaningful learning context that supports intrinsically motivating and self-regulated learning. Motivation dimension ranges from ***extrinsic***, outside the learning environment to ***intrinsic***, integral to the learning environment. Intrinsically motivating instruction is very elusive regardless of the delivery system, but virtually every new approach to come along promises to be more motivating than any that have come before. Computer-managed instruction software is

the latest type of interactive learning system that is supposed to motivate learners intensively because of the integration of sounds, images, text, animation, frame transition and user-friendly interface. CMIS aims to sparks the interest of the learner towards learning and uphold the focus until the end of the lessons.

Retention of knowledge. One of the most important factors in designing software is the consideration for the cognition and retention of knowledge. The design of the screen presentation uses approach that increases cognition. The CMIS is expected to aid students to construct knowledge of the subject. Cognition, a synergistic partner of motivation, is another facet of learning. Unlimited access to instructional software improves comprehension of concepts. The students will be able to retain what they have learned in CMIS. It allows the learner to access the lessons and provide one-to-one learning to ensure they master material before moving on the next phase.

Systematic Record-banking. The database would serve as the record of the learner's progress. Using the computer-managed instruction software to administer the integrated test in each lesson offers the advantages of automatic scoring, sequentially generate test items, testing the student's convenience, cross reference of the test items to learning objectives, and ease of test bank maintenance.

Individualization of learning pace. The impact of individual differences is a major factor in the effectiveness of computer-based education. CMIS was designed to adapt the abilities and preferences of individual student and increase the personalized instruction a student receives. It can provide for the adaptation of instruction to the characteristics and capabilities of individual users. All or parts of the software can be repeated or restudied as required or as preferred. The tool can be used without supervision. It also provides flexibility for students so that they can learn at their own speed at the time that is best for them. Flexibility is defined as, enabling the learners to learn what they want (frequency, timing, duration) and how they want (pacing of the learning process). The software can reduce the time of lectures without harming the quality of the teaching.

Integrity of subject matter content. The presentations of the lessons are logically sequenced based on the prescribed course syllabus. The implementation of the CMIS includes all the lessons which should be covered for the particular session. Accessing the same lesson at different time and different terminal (provided of the same specifications) is assured to have the same presentation. It accomplishes the same sequence and subject contents.

Self-direction. In computer-based education, learner control refers to the alternatives that allow learners to make decisions about what sections to inquire, or what directions to follow through interactive material. The popular wisdom is that learner control makes computer-based education more effective by individualizing the instruction and making it more motivating. In CMIS, the learner has the option to direct himself to the information within the software as needed in a situation. The software provides the possibility of reviewing the previous lesson as preferred by the learner. The learner also has the control over the volume of the sounds, the timing of the transition of the frames and quit from the software once finished with the session.

Immediate Response. The researcher adopted the concept of Sidney Leavitt Pressey regarding the use of immediate feedback for the learner's answer. He believes that immediate correction of errors served a teaching function, enabling students to practice test items until their answers were correct. It was supported by Skinner's definition of a good program in a teaching machine which made efficient use of the principle of active responding by providing students with immediate feedback on success or failure. In CMIS, evaluation and assessment are given at the end of the lessons. It is designed to assess if the learner meets the required level to be able to continue to the next lesson. CMIS provides feedback both for correct and wrong answers. These feedbacks for incorrect answers are provided to correct wrong thinking. As recommended by Persichitte, feedbacks are positive and corrective. The software does not reveal the right answer allowing the learner to review the previous lesson. The old maxim that "experience is the best teacher" reflects a belief that we learn in life through trial and error (CTGV, 1992). Incorrect responses provide opportunities for the learners to learn from their mistakes.

Flexibility. Just like how teachers want to keep abreast with the latest in their field of specialization, CMIS is also designed not to be stagnant with its contents, allowing the software to be effective and up-to-date in terms of data communication trends. Change is the only constant thing in this world. Information technology continues to advance each day making what is new today an obsolete tomorrow. Communications and Networks is one of the information technology subjects that requires reconsideration of the emerging advent technologies in the current contents of the course. CMIS is designed with the content and quiz editor to keep the learner abreast with the latest of IT. The administrator is the only one that can edit the subject matter content of the software. CMIS may be used in stand-alone computers or in a LAN, making it easier to upgrade using a database server.

Access Control. The CMIS was designed to implement some safety measures in terms of the different types of access with the software. For the purpose of preventing unauthorized access and modification with the software, login procedure must be first accomplished by the user. To ensure the safety of the students' accounts, the software is designed with the account name and security password. The administrator has password allowing him to take control of the editing and upgrading, while new user must register to create account and existing user needs to log before accessing his account. This will (1) avoid unnecessary access of other users to open the student's account, (2) preclude accidental deletion or addition in the contents to ensure integrity of the lessons, and (3) secure evaluation records.

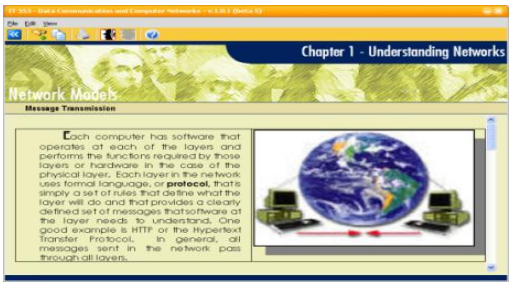
3.2 Problem #2: Considerations and Limitations of Computer-Managed Instruction Software

In the development of CMIS, the following was carefully taken into consideration to ensure the efficacy of the software as aid in teaching and learning. Specifically, four vital aspects were recognized to be the major considerations in the development of the software. These aspects were taken into account during the formative evaluation. These fall into four basic categories; (1) instructional adequacy, (2) cosmetic features, (3) program adequacy, and (4) curriculum adequacy.

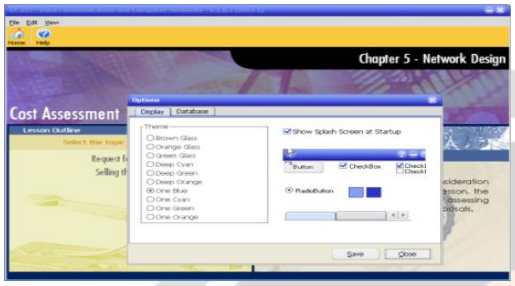
Instructional adequacy is the extent to which CMIS lesson provides the necessary kinds of support and features to accomplish the objective at hand. After the software has been developed, testing implementation follows to check whether the directions for lesson control are clearly stated. The lessons were also assessed if these are consistent with the outcomes specified in the objectives. Instructional sequence was ensured to be easy to follow and empirically based. The lessons in the software were checked if these could be readily understood and free from vague and ambiguous text. The basic logic of the lesson was designed to be levelheaded. Efficiency and adequacy of the lesson procedures and activities were carefully examined. Important terms, concepts and information were highlighted to be amplified effectively. The lessons were chronologically presented according to their significance in the different parts and sections of the entire course. The lessons were ensured to provide opportunities for meaningful interaction between the student and the lesson content. The pacing procedures were designed to be appropriate for the learners and the learning tasks. The lesson activities, content and procedures were devised to motivate students to perform. Required and desired record-keeping capabilities are integrated in the lesson. Appropriate lesson control options were provided.

The ***cosmetic*** features of CAI lessons is said to be the dominant basis for evaluation. True, visual appeal is an important consideration in lesson design, but it is certainly, not the dominant concern. One of these cosmetic considerations is the visual appeal such as the use of color, sounds, graphics, images, and animations. Effective use of screen spaces, elimination of crowded and crammed text and other components, and prevention of typographical errors were also deemed significant in cosmetic consideration of CMIS.

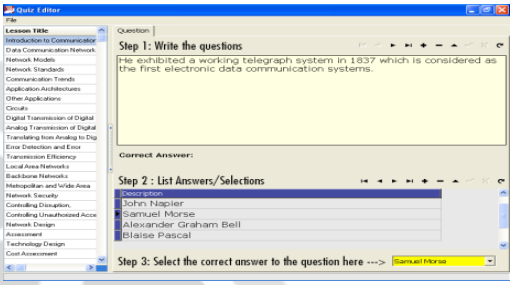
Main Page with the Course Overview Pop-up Screen



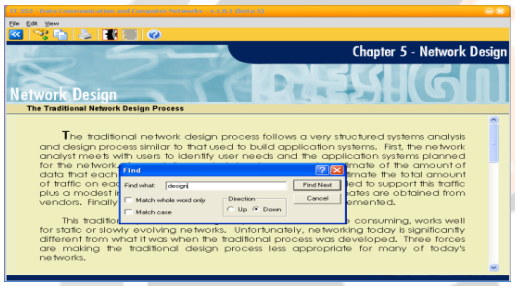
Lesson Presentation



Theme Editor



Quiz Editor



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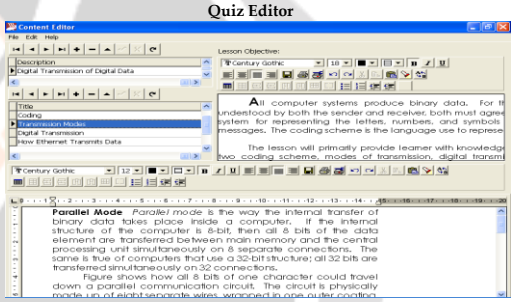
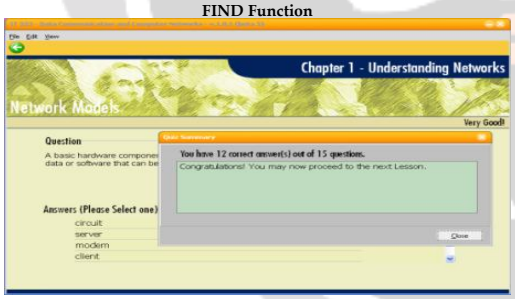
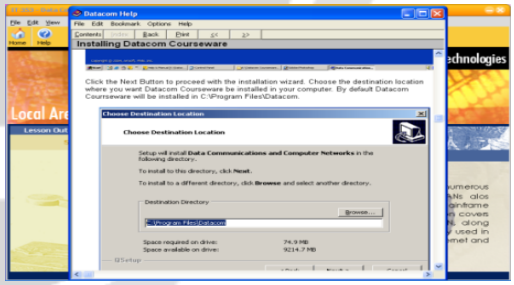


Content Editor



Result of the Lesson Quiz



Installation of the Software

Figure-2.
Screenshots of the Developed Computer-Managed Instruction Software (CMIS) in Teaching and Learning Communications and Networks

Program adequacy is often evaluated through the process called debugging. Debugging is the process where lessons are executed, with the resulting input, output and control decision examined for accuracy. One of the primary concerns in evaluating program adequacy is the program execution. It is ensured to be executed consistently and as intended. Another concern is the security of the student's account and disk. Appropriate responses had been carefully anticipated. All the vital components are systematically located and the program is free from unnecessary loops.

One of the most important factors affecting the long-term acceptability of a lesson is the degree to which the lesson procedures, activities, and formats are consistent with accepted standards. To the extent possible, the lesson must be compatible with the styles of the teachers and students, easily incorporated into existing curriculum activities and structure and compatible with the kinds of lesson activities and procedures already in place. This is referred to as the ***curriculum adequacy*** of the software. Lessons must be consistent with other related lessons. Procedures must be consistent with the expectations of the users. Lesson designs should provide possibility for expansion. Lessons must be examined to avoid obsolescence. The software is flexible.

Aside from those four, the researcher also considered the characteristics of an effective CAI, as summarized by Hannafin and Peck. These characteristics are: (1) based on instruction objectives, (2) matches learner characteristics, (3) maximizes interaction, (4) individualized, (5) maintains learner interest, (6) approaches the learner positively, (7) provides a variety of feedback, (8) fits the instructional environment, (9) evaluates performance appropriately, (10) uses computer' resources wisely, (11) based on the principles of instructional design, and (12) has been evaluated thoroughly.

The researcher also considered the nine universal steps of instruction suggested by Gagné, which should be found in any instructional context. These steps are; (1) g*ain attention*, (2) d*escribe the goal*, (3) *stimulate recall of prior knowledge*, (4) *present the material to be learned*, (5) *Provide guidance for learning*, (6) *Elicit performance* "*practice*", (7) *Provide informative feedback*, (8) *Assess performance test*, (9) *Enhance retention and transfer***.**

Since CMIS is tutorial in nature, the researcher recognized the considerations proposed by Persichitte. These considerations are according to the four basic phases of instruction:

(1) For presenting information - The software must be appropriate for particular audience and provide clear and adequate directions for the learner. It must use acceptable methodology for presentation (either linear or branching). Prior knowledge must be stimulated. There must be appropriate content scope and sequence and a limited learner control.
(2) For guiding the student – There has to be an appropriate length of content presentation and varied student responses necessary. The software must use appropriate text layout and effectively use instructional prompts.
(3) For practice by the student – There must be items for measuring the content progress. Colors, sounds, graphics must hold the learner's interest. The learner must have the control to view previous screens, to stop, pause, continue or restart. The software must provide intelligent judgment for timed responses and remediation. Feedback must be positive and corrective.
(4) For assessing student learning – recording-keeping must be automatically and student progress report must be accessible to the instructor.

Finally as limitations of the CMIS, only posttests are given since the learner cannot proceed to the next lesson without passing the evaluation of the preceding lessons. Networking practices and actual installations are not included in the software.

3.3 Problem #3: Design Model Used in the Development of Computer-Managed Instruction Software

The CAI Design Model (CDM) was used as the archetype in the development of the computer-managed instruction software as illustrated in Figure 1. There are four vital phases comprising this model. (1) Analysis or Assessment Phase, this involves analyzing thoroughly the problem. (2) Design Phase. This phase includes identifying components of CMIS, specifying relationships among components of CMIS, specifying the structure of CMIS, providing a flowchart for the development, and developing evaluation items to be used to determine whether the design of CMIS is acceptable. (3) Development/Formative Phase, (4) Evaluation and Revision Phase. Each phase essentially needs to be given a careful emphasis to be able to come up with an effective instructional software.

Phase 1- Analysis/Assessment. In this phase, the researcher carefully conducted needs assessment. The researcher thoroughly examined the general problem of the study. This examination led the researcher to come up with the specific objectives which will comprise the general problem. The researcher gathered and analyzed all the raw data needed in the development of the software. The researcher considered the philosophical foundations of Bulacan State University and the mission, vision, goals and objectives of the College of Information and Communications Technology. This was done for the purpose of ensuring that the development of CMIS will be a tangible contribution in the realization of the university and institutional ideals. Course syllabus and outline were deliberately analyzed to determine the topics which will be included in the software and the lesson objectives that must be incorporated in CMIS. Interviews with the students taking up the subject and the faculty teaching the course were also done to identify the needs of the intended users. Target clientele was ultimately considered and special attention was given to the techniques that will encourage learning. The researcher utilized a flowchart of the traditional methodology that is being implemented in teaching Communications and Networks. The topics to be included were detailed and even the appropriate evaluations after each lesson were designed. The researcher identified possible materials and references which can be the sources of the contents of the lessons in the software. In this phase, the researcher also ensured that all necessary procedures and information for the design of the software were achieved.

Phase 2- Designing CMIS**.** In the design phase of CMIS, the researcher utilized the information obtained in the assessment phase. This phase involves the preparation of the requirements for the development of the computer-managed instruction software. Identification of the most suited strategy to be used in the process of developing was also part of this stage. In this stage, the researcher identified the proper chronology of the development process. In design phase, the researcher distinguished the design features of the instructional software based on the results of the assessment and analysis done in the first phase. The researcher constructed the flowchart illustrating the flow of the software. Considerations were taken meticulously in the design of the frames, which plays a vital role in motivating the learner. It was also during this phase when the proper types of evaluation and feedbacks were defined. A simulated prototype of the software was structured to envisage the operating environment of CMIS. System and programming experts were consulted for possible suggestions and recommendations in terms of interface designs and technical aspects. It was in this phase when the researcher identified the tools which will be needed in the development process such as Delphi, Text editor, Adobe Photoshop, MS Word, Notepad, Sound recorder, MS Access, Macromedia Flash and MS Paint.

Phase 3- Development and Formative. In the development phase, the flowchart of the courseware, constructed in design phase, was utilized and converted into fully-functioning computer-managed instruction software. This stage includes the process of outlining the transition of the lessons and inputting data from the reference materials to computer-based presentation. Development stage also includes the actual use of the tools identified in the design phase such as Delphi, Text editor, Adobe Photoshop, MS Word, Notepad, Sound recorder, MS Access, Macromedia Flash and MS Paint. Encoding of the main program and the consolidation of all the components constructing the software is the core part of this phase. These components include the texts, sounds, databases, frames, images, animations and buttons. Within the development process, test implementations were employed to examine syntax and logical errors. Debugging, which is the process of finding and fixing both syntax and logical errors, is one of the most crucial part of development phase. Aside from consuming a lot of time, debugging also requires additional analysis and reconstructions. At the stage of the development phase, full documentation of the process must be done. Documentation will serve as the key reference for future revision, enhancement or update of the software.

Phase 4- Evaluation and Revision. Aside from the evaluation and revision employed throughout the first three phases of the development process of CMIS, the acceptability of the developed software was also determined. Three randomly selected third year BSIT students were also asked to use the software during the dry run implementation. Results were obtained after the students had completed the examinations as presented in the table.

Table-1. Summary of Students Performance

		Student Score (%)					
Chapter	***Quiz***	***Student 1***		***Student 2***		***Student 3***	
No.	*Items*	*Raw Score*	*%*	*Raw Score*	*%*	*Raw Score*	*%*
1	*80*	*69*	*86%*	*65*	*81%*	*70*	*88%*
2	*100*	*83*	*83%*	*75*	*75%*	*87*	*87%*
3	*70*	*62*	*89%*	*58*	*83%*	*60*	*86%*
4	*30*	*25*	*83%*	*23*	*77%*	*27*	*90%*
5	*20*	*18*	*90%*	*18*	*90%*	*20*	*100%*
Overall	***300***	***257***	***86%***	***239***	***80%***	***264***	***88%***
Remarks			***Passed***		***Passed***		***Passed***

Table 1 Summary of Students Performance shows that the three students passed the examinations. The result shows a positive outcome of the dry run implementation of CMIS. Using a five-point Likert scale and a locally constructed evaluation form, the researcher opted three qualified persons to assess the acceptability of the software. The researcher chosen; (1) a faculty who has finished her MSIT degree at the Hannam University in Korea and an expert in teaching and developing multimedia applications, (2) an expert in computer-based education (CBE) holding the degrees in PHD, MSIT and MAE major in CAI, and (3) a professional software developer from the Management Information System Department. Suggestions and recommendations were also welcomed to further enhance the software. After the evaluation, the researcher summarized the statistics obtained using a table as shown in Table 2. The researcher computed the weighted mean of the evaluations and identified the equivalent of the result. And finally, conclusions on the five categories of acceptability were drawn based from this summary of experts' evaluation

3.4 Problem #4: Acceptability of the Computer-Managed Instruction Software (CMIS)

There are five criteria that were used to determine the acceptability of the computer-managed instruction software. The software was examined in terms of (1) subject matter content, (2) readability, (3) usability, (4) instructional design, and (5) portability. The researcher allowed three competent and dexterous persons to use the developed software and scrutinize according to the given criteria. The researcher opted; (1) a faculty from Institute of Computer Education who has finished her MSIT degree at the Hannam University in Korea and an expert in teaching and developing multimedia applications, (2) an expert in computer-based education (CBE) holding the degrees in PHD, MSIT and MAE major in CAI, and (3) a professional software developer from the Management Information System Department.

The researcher used an evaluation instrument categorizing twenty-two indicators into five major criteria. The assessment of the three experts were achieved using the five-point Likert scale: 5 – "very good"; 4 – "good"; 3 – "fair"; 2 – "poor"; and 1 – "very poor". The subject matter content of the software was rated "good" obtaining the mean value of 4.40 in terms of the following indicators: the topics are within the competencies prescribed for the course (4.00); the presentation contains significant values for achieving the instructional goals (4.00); the programmed materials provide an interaction which increases it instructional value (4.33); the information provided are easily understood by the target user (4.67); and it uses concepts and information that are universal (5.00). In terms of its readability, the software was also rated "very good" (4.67) for the reason that all its indicators achieved "very good" ratings. As shown in the summary of experts' evaluation in Table 2, the indicators for readability posted the following results; the use of graphics, sounds and videos to capture the attention of the user (4.67); the graphics, sounds and videos serve a clear purpose appropriate to intended audience (4.33); background and text

color are correctly combined (5.00); the sentence and vocabulary are suited for the comprehension level of the learner (4.67); and smooth transitions of frames are present (4.67). On the usability of the software, the evaluators rated CMIS 4.33 because the links works efficiently to help the user at pace. Other indicators were also given high ratings; the user interface can be easily understood (5.00); on-screen help is always available for the user so as not to get lost or confused (4.33); and interactivity is present during the learning process (4.67). One of the significant aspects of CMIS is instructional design. The four indicators depicted a collective rating of "very good". This was based on; there is congruence between objectives and teaching methods, activities and content (4.33); the software provides an evaluation of learner's performance congruent with competencies (5.00); the content of each lesson is arranged for simple to complex (4.33); objectives are presented through the learning activities of the software (4.33). The last criterion, portability, was given a "good" rating. In terms of the software's ease of installation, the evaluators rated it 5.00. Other indicators such as: software is compatible to other PC; the software is machine independent; it is transferable to any other medium, obtained 4.33, 4.33 and 4.00 respectively.

After summarizing and analyzing the data that has been obtained from evaluation, the computer-managed instruction software achieved a grand mean of 4.51 corresponding to a "very good" rating. This indicates that the evaluators strongly recommend the adoption of CMIS as an aid in teaching and learning Communications and Networks. Furthermore, the experts pointed several comments and suggestions for further improvement of the software. Evaluators positively suggested the use of additional tool tip texts and the insertion of additional information in the help option. After deliberately considering the suggestions and recommendations, the computer-managed instruction software was put into its experimental form. *See Table 2. Summary of Experts Evaluation.*

Table-2. Summary of Experts Evaluation

Dimension	***Evaluations***	
	Mean	***Interpretation***
1. Subject matter content		
1.1 The topics are within the competencies prescribed for the course.	*4.0*	*Good*
1.2 The presentation contains significant values for achieving the instructional goals.	*4.00*	*Good*
1.3 The programmed materials provide an interaction which increases it instructional value.	*4.33*	*Good*
1.4 The information provided are easily understood by the target user.	*4.67*	*Very Good*
1.5 It uses concepts and information that are universal.	*5.00*	*Very Good*
2. Readability		
2.1 The software presentation uses graphics, sounds and videos to capture the attention of the user.	*4.67*	*Very Good*
2.2.The graphics, sounds and videos serve a clear purpose appropriate to intended audience.	*4.33*	*Good*
2.3 Background and text color are correctly combined.	*5.00*	*Very Good*
2.4 The sentence and vocabulary are suited for the comprehension level of the learner.	*4.67*	*Very Good*
2.5 Smooth transitions of frames are present.	*4.67*	*Very Good*
3. Usability		
3.1 Links works efficiently to help the user at pace.	*4.33*	*Good*
3.2 The user interface can be easily understood.	*5.00*	*Very Good*
3.3 On-screen help is always available for the user so as not to get lost or confused.	*4.33*	*Good*
3.4 Interactivity is present during the learning process.	*4.67*	*Very Good*
4. Instructional design		
4.1 There is congruence between objectives and teaching methods, activities and content.	*4.33*	*Good*
4.2 The software provides an evaluation of learner's performance congruent with	*5.00*	*Very Good*

competencies.		
4.3 The content of each lesson is arranged for simple to complex.	*4.33*	*Good*
4.4 Objectives are presented through the learning activities of the software.	*4.33*	*Good*
5. Portability		
5.1 Program is easy to install.	*5.00*	*Very Good*
5.2 Software is compatible to other PC	*4.33*	*Good*
5.3 The software is machine independent.	*4.33*	*Good*
5.4 It is transferable to any other medium.	*4.00*	*Good*
GRAND MEAN	***4.51***	***Very Good***
Comments	*Evaluator A: Add tool tip texts for the buttons.* *Evaluator B: Insert additional information in the Help option.* *Evaluator C: None*	
Recommendations	*Evaluator A: The software is acceptable and recommended for adoption.* *Evaluator B: The software is acceptable and recommended for adoption.* *Evaluator C: The software is acceptable and recommended for adoption.*	

Legend: 1.00-1.49 "Very Poor", 1.50-2.49 "Poor", 2.50-3.49 "Fair", 3.50-4.49 "Good", 4.50-5.00 " Very Good"

IV. CONCLUSIONS

Based on the findings of the study, the following conclusions were drawn. CMIS has several essential features that characterized it from traditional methodology. These include motivation towards learning, retention of knowledge, systematic record banking, individualization of learning pace, integrity of subject matter content, self-direction, immediate response, flexibility, and access control. CAI design model is suited in the development of the computer-managed instruction software. The actual development and presentation of network design proposal cannot be included in the software. The Computer-Managed Instruction Software is an acceptable aid in teaching and learning Communications and Networks.

V. RECOMMENDATIONS

The following recommendations are presented based on the conclusions and findings. It is recommended the CMIS be available as additional reference material for students taking up the course as well as students from other colleges. Considering the important features of the software, CMIS is strongly recommended as an instructional aid. Related studies may be conducted to further improve and assert the effectiveness of the instructional software.

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