ABSTRACT

ICT tools are transforming almost every aspect of society. More and more institutions of higher education are responding by integrating various computer based applications in the instructional processes. This study examines the use of ICT and the factors involved in the integration of ICT tools in teaching and learning of Information Systems (IS) in an effort to identify if the use of ICT tools by the educators are satisfactory, the benefits of using ICT tools, the success factors and obstacles encountered in integrating ICT tools in teaching and learning of IS. A tool is developed based on the Computer Managed Instruction (CMI) concept to fill in the gap left by existing ICT tools to support IS instructional processes. The study adopts multiple data collection techniques which include: (a) a literature review was undertaken to understand the definitions and characteristics of the various computer based applications; (b) a questionnaire was designed to identify the extent of use of ICT tools and the factors associated with the use of ICT tools in teaching and learning of IS; (c) interviews were undertaken to further investigate in-depth on the use of ICT tools for IS instructions; (d) document analysis of student assignment questions was performed to further understand the requirements for IS instructions; (e) a second questionnaire was designed to collect data on a specific aspect of IS education (that was identified in the interviews). It seeks the requirements of IS teaching community to manage the problem identified; (f) A CMI-based tool is developed and tested with end users. The results of the questionnaires are reported using descriptive statistics; factor analysis was conducted on obstacles and success factors identified. The outcomes of the study are: (a) the use of ICT tools among IS educators is normal or common as indicated by the ICT tools used among the survey respondents. The ICT tools used are word processing software, presentation software, spreadsheets, search tools, the Internet and LCD projectors. As such, the majority of the
Malaysian IS educators could be categorised as ‘late majority’ described in the Rogers diffusion of innovations for the majority of the ICT tools presented. IS educators sampled have positive perception towards ICT tools and agreed that the use of ICT tools in IS instructions has benefited themselves. The five most significant obstacles and success factors toward the use of ICT tools in teaching and learning of IS were identified and discussed. Factor analysis was conducted and six factors emerged from the data for obstacles and four factors for success items; (b) The findings of interviews showed that generally the IS educators required a CMI-based tool to assist them to manage activities such as tests, assignments and student discussion. The requirements were identified through interviews, a survey and documents analysis; A CMI-based open source system is developed to assist IS educators to manage instructional processes. The system was evaluated by twelve educators and positive feedback was given; (c) The findings of the second questionnaire revealed the IS educators’ requirements for assessment, record keeping and reporting of students’ contribution to Internet forums. The findings of the second survey were implemented using open source forum software; and tested and evaluated by a group of end users. The results of the evaluation indicated that generally the assessment formula is accurate to use to measure the students’ contribution to the forum software.
ACKNOWLEDGEMENTS

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I also express special thanks to my husband, my two children and my parents; who gave beyond that usually required of a family.

Wee Mee Chin
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<th>Full Form</th>
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<tbody>
<tr>
<td>CAI</td>
<td>Computer Assisted Instruction</td>
</tr>
<tr>
<td>CEI</td>
<td>Computer Enriched Instruction</td>
</tr>
<tr>
<td>CMI</td>
<td>Computer Managed Instruction</td>
</tr>
<tr>
<td>CSV</td>
<td>Comma-Separated Values</td>
</tr>
<tr>
<td>DBMS</td>
<td>Database management system</td>
</tr>
<tr>
<td>FAQ</td>
<td>Frequently Asked Questions</td>
</tr>
<tr>
<td>FTP</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>HTML</td>
<td>Hyper Text Markup Language</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>IE</td>
<td>Internet Explorer</td>
</tr>
<tr>
<td>IS</td>
<td>Information Systems</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>LCD</td>
<td>Liquid Crystal Display</td>
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<tr>
<td>LMS</td>
<td>Learning Management System</td>
</tr>
<tr>
<td>PHP</td>
<td>PHP Hypertext pre-processor</td>
</tr>
<tr>
<td>SMS</td>
<td>Short Message Service</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
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Chapter 1

Introduction to the Study

1.1. Introduction

This chapter provides an overview of the study. It begins with an overview of the research background, and follows with the explanation on the context of this study. It then provides details of the problem statement, research objectives and the research questions. The chapter then presents the nature of the study, the delimiters, the operational definition of terms, and an outline of the structure adopted for the remaining sections of the thesis.

1.2. Background

The rapid advancement of Information and Communication Technology (ICT) has undeniably affected the educational sector. It was urged that higher education must take ICT seriously, turning the educational organization into “ICT Center Of Excellence” in teaching, research, application and development (Mahmood, 2003). The increased demand on the use of ICT tools in teaching and learning at the higher education level has been associated with the various benefits that it offers. Among the benefits highlighted by various researchers are that (a) ICT increases the opportunities for accessing various sources of information especially online resources (Hernández-Jorge et al., 2003; Kasturi, 2004; Littlejohn and Higgison, 2003; Merza, 2003; Osborne and Hennessy, 2003); (b) it facilitates effective and efficient communication for both educators and students, especially with the synchronous and asynchronous communication tools (Boettcher, 1994; Grégoire et al., 1996; Kasturi, 2004; Littlejohn and Higgison, 2003); (c) it makes learning more immediate and realistic (Grégoire et al.,
Introduction to the Study

1996; Merza, 2003), and (d) it reduces the educators’ workload by making course information available online (Kasturi, 2004; Littlejohn and Higgison, 2003).

In Malaysia, today, university courses delivered in a traditional face-to-face format are incorporating one or more elements of online education, including the use of e-mails, web, bulletin boards, web portfolio, blog, web based simulation and online availability of course materials such as presentation slides and links to tutorials. Seventeen (17) Malaysian public universities were reported to be equipped with Learning Management Systems (LMS) (David et al., 2004). This trend towards the increased use of online technology will likely continue in the future. As such, the nature of faculty workload is changing as faculty members are increasingly expected to utilize online technology to fully or partially deliver education (Coppola et al., 2002; Smith et al., 2001; Young, 2002). This expectation is generally more prominent in computer related courses where educators teaching computer related courses use ICT tools in instructional processes. In Malaysian universities, the traditional teaching methods such as lectures, tutorials and practical classes are supplemented with problem or projects based learning and computer assisted learning, in order to promote analytical thinking, problem solving, effective communication, use of computer and digital technology as well as life long learning (Quality Assurance Division, 2004). It is observed that the basic ICT equipment such as computers, the Internet, LCD projectors and computer application software are well equipped especially for faculties that offer computer science and information technology courses to their students. The use of ICT in instructional processes depends on an individual faculty’s attitude and the value one perceived in ICT (Spotts, 1999). The reports on the use of ICT among educators teaching computer related courses are scare (Chapter 2). The investigation on the use of ICT in teaching and learning in Malaysian higher education is still sporadic and no systematic local
studies on a specific discipline were carried out. The usage of ICT among educators in teaching and learning for a specific discipline must be examined. The usage figures could serve as an indicator if there is any further action needed to enhance the use of ICT in teaching and learning of an academic field.

1.3. Context of the Study

The advancement of computer technology and growth of the Internet is inevitably affecting the teaching and learning environment. In view of this development, various efforts have brought together academics to explore ways in which ICT could be utilised in supporting teaching and learning in higher education as highlighted in journals such as *Journal of Information Systems Education, The Internet and Higher Education, Electronic Journal for the Integration of Technology in Education* and *Journal of Information Technology Education*. This thesis focuses on the use of ICT tools in Information Systems (IS) instructions in the Malaysian context. IS is selected as a context in this study for the following reasons:

a) IS, as a field of academic study, has a good blend of Information Technology and non Information Technology courses, and IS programmes are either administratively positioned in business school (Gable and Smyth, 2006; Wang, 2007) or in computing school (Gable and Smyth, 2006; Holmes, 2003). This leads to its uniqueness for requirements and research in how ICT is used in IS instructions. The findings on the use of ICT among IS educators, who have computing and/or business and management academic background, provide new insight into how ICT tools could be used in IS courses.

b) There are literature on the use of ICT tools in teaching and learning of IS. However, literature search on this could not trace any report on the use of ICT tools and its related issues from the IS educators’ perspective in Malaysian context.
On the other hand, Coppola et al. (2002) found that students are generally enthusiastic about the opportunity to learn using ICT from their experiences of dealing with online undergraduate and graduate programs in Information Technology degrees in Information Systems. A survey carried out on a group of 507 students from IS and IT courses offered by a Malaysian higher education revealed that the majority of the students had positive perception on online learning and were willing to use ICT in their studies (Wee and Zaitun, 2003). This indicated that IS students’ reception on the use of ICT in learning shall be high. While it is clear that students will know how to manipulate databases, word processor, programme and use various computer applications, what is less clear is how effective educators use computers as teaching tools. As a result, the use of ICT tools in teaching and learning from the IS educators’ perspective is the main focus in this research. The findings of this research could serve as an input to further augment the knowledge of researchers, IS educators and faculty management in making decision on using ICT tools in the IS education especially in Malaysia context.

c) The researcher is an IS educator, having about ten years experience in teaching IS courses; as such, her personal interest in research related to the use of ICT tools in IS instructions has motivated the conduct of this study. The researcher had experienced the benefits of using ICT during her study in a university in United Kingdom in 1996-1997. ICT tools have been used widely in content delivery, management as well as interaction and discussion among students and educators in developed countries (Haga and Kaneda, 2005; Weller et al., 2005). However, the local research indicated that the use of ICT tools in Malaysian universities is still sporadic, as this is further elaborated in Chapter 2 of this thesis. An effective teaching and learning environment requires maximizing the use of ICT with
decisions and direct forms of teacher involvement (Committee on Developments in the Science of Learning, 2000). As such, the attention of IS educators in making any decision and taking any action regarding the use of ICT tools in teaching and learning is important. The opportunity for IS students to use ICT tools for academic purposes is limited if the IS educators overlook this.

1.4. Problem Statement

Educators today have to teach using technologies. Computers are being used to create and revise texts, to send and receive mail electronically, to present instructional texts on-screen instead of in printed books, and to access large databases of texts. Despite the facts that ICT has an important role in our society, the educational community, particularly educators have not embraced technology in the same way (Adnan and Haslina, 2005; Connolly and Stansfield, 2006; Ni Wynn et al., 2007). Past studies reported some of the primary reasons that may have hindered the utilisation of ICT among educators in developed countries and some factors that could promote its usage. Among the obstacles reported are unavailability of equipment, insufficiency of equipment, out-of-date equipment, lack of maintenance of equipment, poor network infrastructure(Wilson, 1994; Johnston and McCormack, 1996; Thomas et al., 1996; Jacobsen, 2000; Butler and Sellbom, 2002; Wilson, 2003), inadequate staff training and development(Butler and Sellbom, 2002; Johnston and McCormack, 1996; Thomas et al., 1996; Wilson, 1994), lack of technical staff support (Johnston and McCormack, 1996), vision and incentives (Spotts, 1999; Rogers, 2000; Wilson, 2003), and time factor (Jacobsen, 2000; Rogers, 2000; Wilson, 2003). On the other hand, there are a number of factors that promote the use of ICT in higher education such as executive leadership and support, faculty and academic leadership commitment, student services, technology infrastructure, and course or instructional quality (Abel, 2005). Wilson (2003) proposed
eight recommendations for integrating ICT in education. They are (a) universities must support faculties in more ways; (b) programs need to be developed to help faculty learn new technology; (c) universities should pursue creative approaches to provide faculties with more time to integrate ICT tools into the curriculum; (d) new incentive programs are necessary; (e) new funding approaches should be adopted; (f) faculty and university administration need to be encouraged to understand and adopt the new student-centered paradigm; (g) collaboration among universities to speed the deployment of ICT; and (h) the recruitment, tenure and promotion processes must recognize technology’s impact on instruction in the future. Staman (1990) argued that peer success generate more interest on the part of the faculty than any number of papers, reviews, or sales efforts by people external to the university. The dissemination of successful use of ICT to other faculties is the vital factor for the success of the ICT tools integration in teaching and learning.

Ideally, the use of ICT tools should be more prominent in computer science education, and these educators should not only use it in delivering the content (subject matter knowledge), but also in the instructional processes. Goode, with a PhD in Information Systems and has published in a variety of IS journals such as Information and Management, Journal of Computer Information Systems and Information Systems Management, wrote that “IS educators deal with technology every day, yet we are sometimes the first ones to forget how to use it in the classroom (Goode et al., 2007).” ICT tools have been shown use in various disciplines, but investigation of the use of ICT tools in IS is rare. Any successful attempt at integrating technology into existing institutional structures must begin with an evaluation of the current status of the institution and followed with a plan for improvement (Leider, 2003). Similarly, in an attempt to address issues related to the use of ICT among educators, it is suggested by the researcher, conceivably, the most significant and foremost facts that needed to be
identified are the extent of the use of ICT tools among educators, the likely obstacles
and factors that motivate its usage that perceived by educators, and the gaps that left by
existing software in IS instructions.

Rogers (1995) explains the various approaches and positions that individual will take
with regards to new ideas and this may explain the statement concerning educators’
stand on the issues related to the adoption of ICT in teaching and learning. Rogers
categorized adopters of an ICT innovation into five (5) categories namely a) innovators,
b) early adopters, c) early majority, d) late majority, and e) laggards (Figure 1-1). As the
name of categories suggests, innovators are a group of people who would be willing to
try new thing without any hesitation. Early adopters use the data provided by the
innovators’ implementation and confirmation of the innovation to make their own
adoption decisions. If the innovation has been effective for the innovators, then they
will be encouraged to adopt. There would be groups of people (early majority) who
would take the popular approach and wants to stay in step with the rest. Some (late
majority) would adopt something after a wait and see period and then accept it. The last
group would only adopt something if they have absolutely no choice or forced to do so.
IS educators who would prefer to try new approaches or technologies in teaching and
learning fall into the category of innovators or early adopters. IS educators who feel that
the traditional technologies (textbooks and audiovisual material) is sufficient may be
classified as the laggards, as they are uncomfortable of adopting new ways as they are
very comfortable with their current teaching methods.

This research aims to examine the use of ICT tools in teaching and learning of IS,
benefits of using ICT, obstacles and success factors that promote it use after it was first
introduced in Malaysian higher education programme in 1974. It identifies the gap left
by existing ICT tools that support IS instructions and develop a tool to tackle the related issue and problem. This study is designed to provide the answers to the research questions on page 9.

![Rogers Adoption / Innovation Curve](image)

**Figure 1-1**
Rogers Innovation Adoption Curve
(Adopted from www.valuebasedmanagement.net)

1.5. **Purpose and Objectives**

This research is concerned with investigating the usage of ICT in the undergraduate teaching and learning of IS in the Malaysian context, understanding the obstacles and success factors involved in the use of the ICT tools, and deriving at tool that can be used for effective management of the IS instructional processes.

The objectives of this study are to:

i. Determine the extent of ICT usage and the factors affecting the use of ICT tools in teaching and learning of IS in Malaysian higher education;

ii. Identify area(s) where current ICT tools used are inadequate to support IS instructional processes, as perceived by the IS educators;

iii. Design and develop a tool to support the area(s), revealed in (ii) and;

iv. Evaluate the feasibility of the tool to support IS instructional processes.
1.6. Research Questions

In order to meet the purpose and objectives of the study, the following research questions are posed:

i. What are the ICT tools used in teaching and learning of IS in Malaysian higher education?

ii. What are the areas of concern perceived by the IS educators in using these tools in teaching and learning of IS?

iii. What are the factors perceived by the IS educators that contribute towards the successful use of ICT tools in teaching and learning of IS?

iv. What are the areas that the current ICT tools used lack of in IS instructional processes?

v. What are the IS educators’ perceived requirements to address the areas in (iv)?

vi. How well does the tool perform in terms of usability, functionality and accuracy to address the requirements identified in (v)?

1.7. Nature of the study

This research adopts the case study approach which limits the IS educators in Malaysian higher education institutions as the boundary, and it involves the following data-gathering techniques:

i. A literature review to develop an understanding of different computer based applications and its characteristics, as well as the application of ICT scenario at the higher education level for science and technology disciplines;

ii. A survey to examine the usage of ICT tools among the IS educators, and their perceived benefits of using ICT tools, and to identify the factors affecting the use of ICT tools in teaching and learning of IS;
iii. Series of interviews to understand further the use of ICT tools in IS instructions and the problems encountered by the IS educators;

iv. Document analysis of assignment questions performed to further understand the requirements in IS instructions;

v. A second survey in the form of an electronic questionnaire, designed to examine the educators’ perceived requirements for a tool to support IS instructions;

vi. User testing and evaluation of a tool developed.

It has been determined from the literature that the use of multiple methods to gather data is an emerging area of research methodology for the design, implementation and evaluation of a system to fill in the gap that left by existing ICT in supporting instructional processes (Hong et al., 2007; Sakinah et al., 2007). A prototype system is developed to produce implementation steps for the IS educators to improve the management process. The research method is detailed in Chapter Three.

1.8. Delimiters

Boundaries or delimiters are necessary in a study to provide “directions for the terms used, for the scope of the study and for the potential audience” (Creswell, 2003, p.105) and “parameters for a research that establish the boundaries, exceptions, reservations and the qualifications inherent in every study” (Creswell, 2003, p.110). Several decisions were made in the preparation of this study in order to focus this study (delimit) and reflect the assumptions of the researcher. In order to maximize the understanding of this study and its results, the delimiters are made explicit. The researcher has identified four (4) factors that delimit this study.
Firstly, ICT tools are defined as the tools used to access, retrieve, store, organize, manipulate, produce, present and exchange information by electronic that support IS instructional processes. Teaching ICT with ICT is not the focus of this thesis. Among the ICT tools that can be used in teaching and learning of IS are generic software applications (such as word processing, database, spreadsheet), presentation technologies (such as Microsoft PowerPoint, digital projector), the World Wide Web, search tool, file transfer protocol, calendar tool, computer mediated conferencing (such as e-mail, discussion board, bulletin board, chat tools), courseware, multimedia (graphic, animation, sound), voice message, scanner, digital libraries, the Internet, HTML generator, computer assisted assessment, computer assisted learning, audio conferencing and videoconferencing, streaming audio and video, simulations and models, microworlds and games, visualisation tools (such as Macromedia Flash) and learning management system. These ICT tools can be classified into one of these categories: Computer assisted instruction (CAI), Computer managed instruction (CMI) or Computer enriched instruction (CEI).

Secondly, the research work focuses on the design and development of Information Systems as it is a focal point of professional training within IS studies (Tétard and Patokorpi, 2005). Within the IS development lifecycle there are four major interrelated activities, namely (a) requirement definition; (b) design; (c) implementation and testing; and (d) operation and maintenance. Each of these activities produces a well defined output.

Third, the population sample for the two surveys is delimited to full time educators including lecturers, senior lecturers, associate professors and professors who have taught IS in Malaysian universities. The educators teaching IS in computing schools are
selected to participate in this study as it is assumed that the ICT tools in computing schools is well equipped as compared to business and management schools where IS programmes are also administratively positioned. This study is limited to eliciting responses from educators about their use of the various ICT tools in teaching and learning of IS, as well as the obstacles and the success factors. Some of the IS educators have just been newly tenured at their present universities and hence might not have in depth information about factors affecting the ICT utilization, however might be able to give views from other angles. The accuracy of the data collected is dependent on the precise interpretation of the questions in the questionnaire by the respondents and their sincerity in answering them. Different findings may have been resulted if other academic fields or disciplines are chosen. Therefore some of the results may not be applicable to other disciplines.

Finally, for the interview, the study involved only a small number (6) of IS educators. It would not be prudent to generalize the interview findings rather the study itself is crucial to provide ideas and ways for the researcher to gain some insights from which some wider implications may be supposed.

1.9. Operational Definition of Terms

Some of the terms used in this study are very broad and lack standardization both as concepts and application. Therefore, the terms are defined below in the context in which they were used in the case study.

IS Instructional processes is interchangeably used as teaching and learning of IS throughout the thesis. Instructional processes refers to activities involved in (a)
preparation of lessons; (b) delivery of lessons includes lectures, tutorials, laboratory
sessions and consultation sessions; (c) student assessment.

Information Systems (IS) as a field of academic study encompasses the concepts,
principles, and processes for two broad areas of activity within organizations namely: (a)
acquisition, deployment, and management of information technology resources and
services (the information systems function); and (b) development, operation, and
evolution of infrastructure and systems for use in organizational processes (system
development, system operation, and system maintenance). The systems that deliver
information and communications services in an organization combine both technical
components and human operators or users. They capture, store, process, and
communicate data, information, and knowledge. The academic content of an IS degree
programme therefore includes information technology, information systems
management, information systems development and implementation, organizational
functions, and concepts and processes of organizational management (Gorgone et al.,
2002).

Computer Managed Instruction (CMI) is a computer program designed in open source
language to store, retrieve, process and report instructionally related information which
is used by IS educators to organize, schedule, and monitor instructional related activities.
Instructional related activities are such as tests, assignments and students’ discussion in
Internet forums. The instructional related information comprises the results of testing
instrument, students’ participation and assignments and enable educators to (a) examine
students’ attainment for tests, students’ participation in Internet forums, and assignment
results; (b) diagnose students’ performance; and (c) prescribe or advise students to
materials or course of action. CMI assists educators with routine management tasks (Baker, 1978).

1.10. Thesis Organization
This dissertation comprises eight (8) chapters. Chapter 1 presents the background of the study, the context in which the research problem is studied, problem statement, the objectives, the research questions, nature of the study, delimiters and operational definition of terms. Chapter 2 provides a review of the literature pertinent to the study. The chapter starts with an introduction on how the computer is integrated in the teaching and learning processes. It then gives the definition and characteristics of Computer Assisted Instruction (CAI), Computer Managed Instruction (CMI), and Computer Enriched Instruction (CEI) and follows with a review on the use of ICT tools in the science and technology academic disciplines in higher education institutions. Chapter 3 describes the methodology of the study. Chapter 4 provides an analysis of the survey findings on the use of ICT, benefits, obstacles and success factor in the teaching and learning of IS. The chapter continues by presenting the findings of data gathered from interviews with six (6) IS educators. It also provides an analysis of the results of a survey that gather information related the functional requirements of the IS educators on the use of ICT in collaboration, and a summary of the data gathered using the various data gathering techniques which justifies why CMI is used in this study. Chapter 5 details the CMI functions, and the CMI implementation in LMS worldwide, and provides an analysis of functional requirements for CMI system. Chapter 6 provides requirement analysis, development and evaluation of a CMI-based LMS to support the instructional processes in IS. Chapter 7 describes requirement analysis, development and evaluation of a CMI-based collaboration tool to support the IS instructional processes. Chapter 8 concludes the study by providing a synthesis of the key findings in
relation to the research questions posed. It puts forward recommendations for further research study and highlights the significance of the findings and their contribution to the educational industry.
Chapter 2

Literature Review

2.1. Introduction

The chapter provides an integrated and logical literature review pertinent to this study to address the extent of the literature available on the usage of ICT in teaching and learning. Specifically, this chapter aims to review (a) the use of ICT tools in higher education; (b) the definition and characteristics of the computer in education, in the form of Computer Assisted Instruction (CAI), Computer Managed Instruction (CMI), and Computer Enriched Instruction (CEI); and (c) the use of CAI, CMI and CEI in science and technology academic disciplines in higher education institutions.

Electronic databases and printed materials were used to find relevant information related to this topic. Among the electronic databases used were: Digital Library for Information Technology and Education, Educational Resources Information Centre (ERIC) database, ProQuest database and Emerald library. From these databases, many journals and magazines like the Journal of Information Technology Education, Journal of Information Systems Education, Malaysian Online Journal of Instructional Technology, Journal of Management Information Systems and the International Journal of Educational Management were obtained. Printed publications available for use were IT Malaysia, Adult Education Quarterly, Quality Assurance in Public Universities of Malaysia: Code of Practice, seminars and conference proceedings. The majority of the Malaysian universities’ websites were also browsed through. The keywords used to search for materials in the Internet included: learning management tool, computer role in teaching and learning, Malaysia education, barriers or obstacles of using ICT in
teaching and learning, motivating factor of ICT use, Information technology, Information system, CMI, CAI, and CEI.

2.2. Use of the Computer in Tertiary Education

ICTs in higher education are being used for (a) developing course material; (b) delivering content and sharing content; (c) communication between learners, teachers and the outside world; (d) creation and delivery of presentations and lectures; (e) academic research; and (f) administrative support and student enrolment. Kulik and Kulik (1987) performed literature review on computer based instruction, where they applied Glass's methodology in four separate meta-analyses (Bangert-Drowns, Kulik and Kulik, 1985; Kulik, Kulik, and Bangert-Drowns, 1985; Kulik and Kulik, 1986; Kulik, Kulik, and Shwalb, 1986), the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings. These analyses covered a total of 199 comparative studies: 32 in elementary schools; 42 in high schools; 101 in universities and colleges; and 24 in adult education settings. The meta-analyses covered the use of the computer in (a) computer-assisted instruction (CAI); (b) computer-managed instruction (CMI); and (c) computer-enriched instruction (CEI). They put forward the clearest view of the purpose of the computer in education: Computer-assisted instruction (CAI) is where a computer provides drill-and-practice exercise and tutorial instruction; Computer-managed instruction (CMI) is an individualized system where the computer evaluates students’ tests performances, guides students to appropriate instructional resources, and keeps records of student progress; Computer-enriched instruction (CEI) includes the use of the computer (a) as a problem-solving tool, (b) to generate data at the student's request to illustrate relationships in models of social or physical reality, or (c) to execute programs developed by the student.
For the meta-analyses involving 101 studies in universities and colleges, the data sources for the study was located from (a) earlier meta-analysis on computer based education (CBE) at college level (Kulik and Kulik, 1985); (b) a computer search of two databases which are Comprehensive Dissertation Abstract and the Educational Resources Information Center (Research in Education and Current Index to Journals in education); (c) bibliographies used in the documents located through reviews and computer researches. The course content was on mathematics, science, social science, reading and language, and vocational training. The student examination achievement at the end of a program instruction was used as the instructional outcome in the 101 studies. Other outcome variables measured include performance in a follow-up examination at a later date, attitudes towards the computer, course completion, and amount of time needed for instruction.

No significant difference in effectiveness for different type of CBE implementation was reported. CAI, CEI and CMI programs all were reported to make small, positive contributions to student learning. Students at college level were recorded as adaptable to the use of various ICT tools in teaching. This research further delves into these three types of computer use in education.

### 2.3. Computer Assisted Instruction (CAI)

CAI is synonymous with computer-assisted learning, computer-based instruction, computer-aided instruction, computer-enhanced instruction and computer-based learning. The Association for Education Communications and Technology cited in Jenks and Springer (2002) has defined CAI as a method of instruction in which the computer is used to instruct the student, and where the computer contains the instruction
which is designed to teach, guide, and test the student until a desired level of proficiency is attained. It is also defined as an interactive instructional technique in which a computer is used to present instructional material, monitor learning, and select additional instructional material in accordance with individual learner needs (Educational Resources Information Center, n.d.).

Larkin and Chabay (1992, p.2) stated that “the aim of CAI programs is to address existing needs of particular groups of students. CAI programs do not follow a single theoretical model of instruction. In many CAI programs, the instruction emulates interactions that might occur between a student and an excellent teacher. Other programs attempt to create an engaging, motivating environment that encourages purposeful exploration in a domain. A rich diversity of environments and problems is often a goal in CAI, and a suite of programs developed for a single course may vary significantly in goals, tasks, and style.” CAI is most often referred to as drill-and-practice, and tutorials (Newhouse, 2002; Committee on Developments in the Science of Learning, 2000; Kulik and Kulik, 1987; Bangert-Drowns et al., 1985; Grimes, 1977). Emphasis herein will be placed on basic level instructional level of CAI as they pertain to this study i.e. drill and practice and tutorials.

i) Drill and practice

Drill and practice is the most prevalently used type of CAI. Drill and practice exercises are designed to increase speed and accuracy of a skill that has already been learned. Factual learning on the knowledge level is reinforced in this type of CAI (Dixon, 1984). Drill and practice works the same way. A computer is programmed to present exercises, check the answer immediately, and give a response based on the specifics of the answer.
The program provides immediate feedback to indicate if the answer is correct. Each incorrect response increases the probability that the exercise will be presented again.

ii) Tutorials
Tutorials are designed to teach new subject matter. It provides the information and instructional activities students need to master a topic. Tutorials usually present information summaries, explanations, practice routines, feedback, and assessment. Vargas (1986) argued that tutorials should make use of the results of the research that shows students do not learn information presented on a screen unless they are asked to respond to it. In other words, based on research that shows that an educator has no idea how the students are doing without student responses or feedback, information could be presented during tutorials and students could be periodically asked to respond to information deployed on the screen, so that the computer may evaluate student progress (Dixon, 1984).

The characteristics of CAI programs thus can be summarized as follows:

a) The educator has a facilitator role; one that manages the interaction between the student and computer (Newhouse, 2002);

b) The computer takes on part of the instructional role of the educator. The computer has the role of a tutor. The computer dominates the interaction between the students and computer although students control the pace of interaction and navigation (Taylor, 1980; Newhouse, 2002);

c) Tutorial applications are designed to present specific content typically using a variety of media, allowing the user some interaction with the information. Some tutorial applications may also provide written text explaining different concepts (Dixon, 1984; Newhouse, 2002);
d) Drill and practice applications are used to consolidate the content that has been previously presented to students. The purpose of the software is to provide practice and reinforcement. Most of the questions are multiple-choice questions. It offers immediate feedback by noting incorrect responses to questions. Gaming environments with graphics and sound are used to provide additional motivation (Newhouse, 2002);

e) Drill-and-practice and tutorials need to be matched to the curriculum and are typically content or skills based (Newhouse, 2002);

f) The focus in the software is upon individualised instruction, revision and evaluation with more interesting environments (Newhouse, 2002).

The following subsections present review of literature related to studies involving CAI in higher education. The criteria used in locating literature are:

a. Studies should involve instructions in the field of science and technology;

b. Studies should be retrievable in full-text from online databases or university libraries;

c. Studies should be retrievable in full-text from online journal or reputable conferences organized by universities.

### 2.3.1. Medical Imaging Education Instruction

Computer and information technology is widely applied in different imaging techniques in clinics and medical research. Dikshit et al. (2005) describes the development of the online tutorial system for commonly used medical imaging modalities (X-ray, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound imaging, and positron emission tomography (PET)). An internet-accessible interface is used to simulate various imaging algorithms with user input parameters. The tutorial is under
the MATLAB Web Server environment. Macromedia Director MX is used to develop interactive animations integrating theory with graphic-oriented simulations. HTML and JavaScript are used to enable a user to explore these modules online in a web browser. This system includes (a) detailed text description of physics, mathematics, and system configurations with associated pictures and graphics; (b) detailed web page links for medical imaging development milestones, and advanced medical imaging hyper-books for students’ review, reference, or further studies; (c) interactive simulation or animation; and (d) online homework (or questions and answers), projects and examinations. The system is used for teaching medical imaging-related courses for biomedical engineering students in the university.

2.3.2. Biomedical Science Instruction

In the teaching of the physiology of the cardiovascular system, Dewhurst and Williams (1998) studied the effectiveness of a computer-based tutorial as a potential replacement for lectures. The system was designed to include features that would allow reinforcement to help students to understand the information and may be used for both primary learning, revision and as a remedial teaching resource. The question and answer sections implemented in the system were used for self-assessment. The tutorial was evaluated using a pilot study and focus session with two (2) different groups of students.

The results of the study suggested that the tutorial program may provide an adequate replacement particularly if it is used selectively and integrated carefully into the curriculum. For instance, if lectures are used to disseminate factual information, the tutorial program then may be as effective by using features which enhance clarity and quality of presentation, reinforce facts, and promote understanding. The benefit of such system is students are able to work at their own pace. However, the disadvantage of
using this system is the system is not able to emulate other features of lectures such as the lecturer's enthusiasm for their subject, the ability of the lecturer to address student learning issue, and rapport between lecturers and students.

### 2.3.3. Science Instruction

Skavaril et al. (1976) described a CAI program named ‘genpbs’ in an introductory genetics course. The program was written in Coursewriter III, Version 3, IBM. The user interface is a command line interface. The program has five modules of preliminary instruction and 19 modules of problems. The five modules of preliminary instruction describe the system features. The instructions given are for (a) registration of students on the course; (b) the signal for student response or sign off; (c) the use of the “go to” command; (d) the use of the ‘calc’ function; and (e) how a student may send comments while working on the course. Each problem module consists of an average of 14 problems arranged in increasing level of difficulty. The program was designed such that the successive wrong answer tolerance rate is six (6).

The program was tested by a group of 135 students in a formal course. The results of the program evaluation by students indicated a highly favorable student reaction and an overwhelming preference for the computer problems as compared to problems and solutions placed in the library books. The mean course numerical grade for students using the computer was found to be slightly higher than the corresponding mean from a previous quarter when the computer was not used, but the difference was not statistically significant.
2.3.4. Mathematics Instruction

Nor Hapiza et al. (2004) developed an e-tutorial management system for mathematics that contains e-tutorial and discussion forums. The objective of the system was to alleviate the difficulty of students (full time and part time students) to meet their educators. Educators can view students’ participation in tutorial exercises and online discussion forums. For each tutorial, a chapter summary was provided with tutorial questions. The tutorial questions were categorized using Bloom’s taxonomy. Answers for each tutorial were given. The e-tutorial management system enables educators to deliver learning content and to manage the teaching and learning activities. In addition, the e-tutorial management system enables information sharing and interaction among students and educators.

Ahmad Fauzi et al. (2007a) described the tutoring process of a multimedia tutorial courseware named Mastering Calculus Computer Courseware (MACCC) for Calculus. It contained reinforcement modules to assist student learning. Two topics in Calculus named limit and derivative were used in the study. Each topic consisted of four (4) modules, which are the diagnosis module, explanation module, exercise module, and exploration module. Users have to answer several questions to test their knowledge of the topics given (diagnosis module). Users scored 70% and above will proceed to the next concept of the topic given or exploration module (is built based on game concept). Otherwise, users have to go through explanation module (includes animation and examples of the related concept) and exercise module (questions related to the concept) until they master the concept given. An evaluation was performed on the effectiveness of MACCC and the achievement of diploma students in Calculus. 51 students were involved in the evaluation quasi-experimental research where students were assigned to control and treatment group. The findings of this study showed that the students who
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were exposed to MACCC did not benefit much as they did not score better than students in the traditional group. Therefore, instructors could use MACCC only as a supplementary tool.

Wan Fatimah et al. (2006) explored the use of a web-based multimedia courseware (via the visualization approach) developed using Macromedia Toolbook. The courseware focused on the application of integration for area and volume. The framework used to develop each module of the multimedia courseware is objectives, concepts, examples, practice tasks and quiz. The courseware consisted of six (6) modules as follows: area of a plane region bounded by a curve and line, area between 2 curves, volumes by method of disk, volumes by Washer method, volumes by Cylindrical Shells method, and assessment. The courseware was evaluated by ten (10) students and the students were interviewed to get their feedback. In general, positive feedback was given by the students on the courseware where the students indicated that they could understand the subject matter easily through the courseware.

2.3.5. Computer Science Instruction

Kung and Tung (2006) developed an interactive e-learning tool using a Java applet with a simple normalization algorithm to improve IS/IT students' learning of database normalization. The interactive e-learning tool contains an easy-to-follow simple algorithm. The e-learning tool can handle small-sized problems, for example a set of ten (10) functional dependencies. It was evaluated using an experimental approach and thirty three (33) students from undergraduate Systems Analysis and Design class and MBA Business Systems Analysis class in a south-eastern public university in the United States were involved in the study. The results show no significant differences of perceptions between different classes. The students indicated that the e-learning tool is
easy to use and noted that the step-by-step feature helped them gain an understanding of the database normalization process. The e-learning tool can be used by students as a drill and practice tool to help them in learning database normalization.

Shahliza et al. (2007) conducted an evaluation on an adaptive hypermedia learning system called SPATH. SPATH provides adaptation of learning content by personalizing the learning material structure based on student learning style adapted from the student’s personality factor, Myers-Briggs Type Indicator, and by the student’s knowledge acquisition level. The system evaluation was carried out on 44 Computer Science students in the Faculty of Computer Science and Information Systems, Universiti Teknologi Malaysia. The learning material was presented in the Malay language based on the topic Sorting Techniques. The learning material was structured into theories, exercises, examples and activities. The theory part consisted of explanation and pictures describing the different sorting techniques. The exercises tested students’ knowledge on the theories presented. Once the students finished the exercises given, hints for each question and the students’ scores were given. Summative evaluation was performed to address the educational impact of the system on students and its practical acceptability in terms of usability. Questionnaires based on the learnability factors, efficiency factors and satisfaction factors were used as a tool to gather feedback from the participants. Preliminary results of the usability study revealed that the system had a high percentage score in learnability and satisfaction factors. SPATH can be used as tutorials for students who are new to Sorting Techniques and as drill and practices for students who have learned about the subject matter.

Christine Lee and Mohd. Sapiyan (2005) described the development of an intelligent web-based tutoring system using the C++ standard template library for students at the
second level of a degree course. The four main modules of the tutoring system are: (a) The graphical user interface (GUI) module; (b) The student modeling module; (c) The teaching strategies module; and (d) The domain knowledge module. The GUI module handles the interaction between the user (tutor or student) and the system. The student modeling module consists of information obtained from three (3) components. The first component is from the pre-test assessment which stores the prerequisite knowledge of the student. The second is the tutorial module which keeps track of the student’s learning path during problem solving sessions and updates the student model accordingly. The third category of information for the model is derived from the posttest evaluation. This information indicates the acquired skills of the student from the tutorials completed. The teaching strategies module also consists of three (3) main components: the pre-test, the tutorials and the post-test. The pre-test involves the setting of questions to test knowledge of the prerequisite concepts and the pre-test evaluation session. Finally, the domain knowledge is divided into three parts: topics and sub-topics, programme specifications, tutorials and sub-tutorials. The Bayesian theorem is applied to model the student’s knowledge and direct the tutoring intelligently. The tutoring system development applies the eXtreme programming methodology and J2EE technologies.

Preliminary testing was conducted for the pre-test with 34 student participants to find out the applicability of the Bayesian theorem to model the student’s understanding. The results showed the tutoring system to be beneficial for the tutoring sessions as the students could be guided intelligently.
2.3.6. Engineering Instruction

Nur Sofurah et al. (2006) developed an e-module in the form of a multimedia interactive compact disc (CD) as a teaching aid to cater for students having difficulties in understanding and visualizing isometric drawing under the traditional teaching approach. The CD contained the explanation of concepts and characteristics, animations and explanation of the correct method in drawing graphics, and drawing tutorials. Macromedia Authorware Attain Version 5.2 was used for the development of the interactive CD. The multimedia interactive CD was evaluated by six (6) educators. Five (5) educators agreed that the CD was suitable for their students in learning Isometric Drawing. In other words, the contents, teaching strategies and presentations in the multimedia interactive CD fulfills the requirements of the educators.

2.4. Computer Managed Instruction (CMI)

A study of the literature finds that there is little agreement on a precise definition for the term CMI. One of the CMI definitions was “The use of a computer to maintain and analyze data on learner performance and instructional progress as an aid to teachers in selecting learning activities.” (Educational Resources Information Center, n.d.). Day and Payne (1987) defined CMI as an instructional strategy whereby the computers are used by university staff to organize student data and make instructional decisions, or for activities in which the computer evaluates students' test performance, guides them to appropriate instructional resources, and keeps records of their progress. The Dutch definition of CMI adopted by Leiblum (1982) stated that in CMI the computer performs various management tasks related to individualized study courses. These management tasks include: “handling entrance level testing and testing related to student progress during a course; the reference of students to instructional material found outside the computer based on students’ performance in a test; and finally the handling of a final
examination. By performing these tasks not only is feedback to the student possible but also information is given to the instructor concerning individual student progress. Instructors can obtain a broad overview of both individual and group performance.” Baker (1978)’s view of CMI is “a total educational approach in which a computer-based management information system is used to support the management functions performed by the teacher. This totality encompasses the educational goals, the curriculum, the instructional model, the teacher, and a management information system.” The difficulty in defining CMI is due to the different implementation orientation of different systems.

CMI systems were developed primarily to help educators cope with the massive information generated by programs of individualized instruction (Baker, 1978). As such, the design of CMI has focused on providing a clerical level of support concerned with test scoring, recording the number of objectives achieved, and possibly the time it takes to complete instructional units. Clerical support at this level is highly situation-specific, and the type of detailed support needed varies widely from curricula to curricula. As a result, it is possible for one system judge to be viable to have little value in another context.

Baker (1978) describes three (3) themes underlying CMI applications that allow an examination of the topic. The first theme is individualization. As a result of what they have mastered, students may be at different points in the curriculum. Individual differences in learners require diverse routes to go through the curriculum as well as different instructional approaches and rates of progress. Many different dimensions of individualization exist, for instance student interest (motivational variables, self-selection of materials), learning styles (heuristic, inductive, deductive), learning
modality (print, lectures, audio/visual combinations), rate of progress (self-paced study) and other learner characteristics (sex, age, IQ, socio-economic factors). Baker claims that the most commonly found dimension in CMI systems is rate of progress.

The second theme underlying CMI is behavioral objectives. A curriculum or course is broken down into a set of specific “behavioral objectives”. The objectives are the basis for instructional segments designed to enable the student to attain the objective, where attainment is usually defined as a test score exceeding some arbitrary value. In other words, students study to meet course or curriculum objectives. The curriculum is divided into small units of measurable objectives in sequential order. Student progress through these units is gauged by performance on tests or examinations. A student with a test score exceeding some pre-defined value is said to have reached the course objective. Students were given enough time to master the objective. In CMI, courses are broken up into parts, and students are direct to the units to complete or may select the units they wish to complete.

The third theme is educational technology. Baker (1978) argued that the real power of CMI lies in its ability to provide the educator with a management information system capability to be used with the concept of a total educational program. Leiblum (1982) put forward the use of technology with the ‘systems approach’ as “an integrated, programmed complex of instructional media, machinery, and personnel whose components are structured as a single unit with a schedule of time and sequential phasing. Its purpose is to ensure that the components of the organic whole will be available with the proper characteristics at the proper time to contribute to the total system, and in doing so to fulfill the goals which have been established.” The CMI assists educators to manage and produce more effective instruction. Educators use the
computer to access data at periodic intervals, track student data, schedule learning activities, provide clerical and management help, and provide evaluation information. CMI exists for the benefit of the educators. Benefits for students are realized only as the educators’ ability to provide instruction is improved.

Baker (1978) presented a conceptual model of CMI as a total educational system based primarily upon practice at that time. He suggested that CMI is an educational system composed of six components: (a) curricular plan; (b) instructional model; (c) diagnosis and prescription; (d) management; (e) reporting; and (f) computer. They play important roles within the CMI concept, and there are interdependencies among them unique to CMI. The first four components are labeled the educational components; and the last two, as the computer components.

a) Curricular Plans

Curricular plans are the end product of a deliberate design process performed by individual educators, educational research and development centers, and textbook authors. The plans state the subject matter or course, content, academic level, fractionalization of content, and structure and interdependencies of the elements of the plan. The behavioral objectives theme underlying CMI is that curricular plans are often the result of a “task analysis” of a given course. Baker named the minimal curricular elements as “units”.

There are five (5) different curricular structures in the curricular plans associated with CMI systems, namely the linear, strand, block, menu and tree structures. The linear structure is one in which units are arranged in sequence. Within a linear curriculum there are no optional sequences for a student to follow. The strand structure is a
variation of the linear arrangement in which the curriculum is divided into major areas. Within each of the areas or strands, several units are arranged in a linear order and a student may work on a unit within one or more strands concurrently. The student should complete the last unit in each strand. The block structure is one in which the curriculum is broken down into major topics, or blocks, and a number of units exist within each block. There is no structure to the unit within a block. A student is free to take the units in any order until the block is completed. The most sophisticated curricular plan is a tree structure. Each unit is considered a node or a vertex in a graph and the lines connecting the nodes are edges. The units appearing at the bottom of the tree are considered to be prerequisites to those above them. This enables a student to work simultaneously on units on several different branches. This structure generates a considerable bookkeeping task for the educator to keep track of whether all the prerequisites have been met for a given unit and where a student is within the curriculum plan. For the menu structure, the whole course is divided into modules or units that are unstructured. The student can select any module to study. This structure is quite common at the college level.

There is a direct link between the curricular plan and the form of individualization of instruction employed. Four of the curricular plans support rate of progress and a degree of individualization in the sequence where a student undertakes the units. In the strand structure, one can be at different places in each strand. For a block structure, no order is imposed within blocks. In a tree structure, a student may skip around with regard to units but must complete prerequisites units before proceeding to a higher level in the tree. A student may be at a very high level in one part of the tree and a low level in another. Most of the curricular plans require students to complete the total curricular plan. The exception is those plans where a student’s course grade depends upon the
number of curricular units completed, or those where there are core units and optional units. The structure of the curricular plan has implications for the designer of CMI systems. There is a greater amount of instructionally related data generated in the classroom if the number of units in the curriculum is increased. A greater amount of record-keeping is required to track the student through the curricular plan if the curricular structure is complex.

b) Instructional Model

The instructional model is the design for the method used to implement a curricular plan in the classroom or other instructional setting. It states the functional flow of the educational program, the roles of educators, assistants, students, and the educational philosophy being implemented. At university level, CMI implementers use the Keller Plan as the basis for their instructional models. The Keller Plan is designed to implement a college course individualized with respect to rate of progress where the students engage primarily in self-directed study. The following presents the contents of the plan:

i. The subject is divided into units of instruction that have a defined sequence. The students study these units on their own.

ii. Students are required to achieve mastery on the posttest for each unit.

iii. Lectures and laboratory demonstrations are available only to those students who have demonstrated mastery on the prerequisite units.

iv. A hierarchy of an instructor, a graduate student classroom assistant, laboratory assistants, and supervisors are used to provide the students with study materials, to administer and score tests, and to provide assistance to individual students upon request.
v. There is a final examination covering the whole course that constitutes 25% of the student grade. The remaining 75% is based upon the number of units and laboratory exercises completed. Each student must complete a minimum number of units to receive a grade.

The relationship of the instructional model to individualization is important to CMI. The majority of CMI systems developed to individualize only refer to rate of progress, since all students pass under the same curricular plan. Baker described that the school-as-a-factory model from Scientific Management is the foundation of the instructional model applied by the majority of the CMI systems. The unit-of-instruction cycle is similar to a production cycle. The product is a completed curricular unit, and the standard of work is set by a criterion-referenced test. This instructional model is designed to allow the unit-of-instruction cycle to function as efficiently as possible, thus maximizing production.

c) Diagnosis and Prescription

The basis of most instruction is diagnosis and prescription. In a classroom setting, the educator depends on information such as the curriculum, the student’s academic performance, and the available resources to perform diagnosis and prescription. The educator’s experience and sensitivity to the information derived from the classroom situation influence the accuracy of the diagnosis and the appropriateness of the prescription. The diagnostic procedures of most CMI systems are based upon the results of criterion-referenced test administered. The posttests are used to determine whether or not objectives have been mastered by students. There are also CMI systems that employ assessment procedures not based upon test scores. Educators can certify that a student has achieved a particular objective.
Two different prescriptions can be made based on diagnosis: forward and remedial. If a student has passed a unit, a forward prescription can be simply to assign the next unit or module. Otherwise, a remedial prescription can be simply to restudy the material, or assign some resource to aid the student to achieve a satisfactory level of performance. Most CMI implementations tend to be remedial. Ideally, a prescription such as educational resources or activities should be linked very closely to the particular diagnosis. However, the range of prescriptions depends on one’s ability to conceptualize it and to create the appropriate educational resources, as well as financial support to develop prescriptive materials. The exceptions are the educators who prescribe attendance at other professors’ lectures, conferences with teaching assistants, and release from certain course requirements.

d) Management
Educators perform management functions at three levels: instructional, course, and program. At the instructional level of management, the educator is responsible to (a) administer pretests, diagnose and prescribe students performance; (b) locate the necessary resources and make them available to the student for remedial prescription; (c) monitor students progress to keep the student on task (engaged in the prescription) and to clarify any ambiguities in the tasks; (d) administer posttests once the student has completed assigned tasks.

The course level of management is focused on the productivity of the CMI system in a specific course in terms of student scheduling, pacing, and expectation. Under the course level management, the educator is responsible for the students to complete units and proceed through the curriculum plan at a reasonable rate. The educator has to be aware of any student who does not complete a sufficient number of units within a given
period of time. If a student fails to complete a sufficient number of units within the time given, the educator has to take appropriate actions to remedy the situation, such as amend the plan, and assign the student to other remedial activities. The pacing function uses data such as the program of studies, the date the unit was assigned, and the number of units completed to identify students who cannot achieve a given objective within a given time period. The educator has to manage the students in the best manner to achieve progress. The final aspect of course level management is resource allocation. In general, only a finite amount of resources such as equipment and human resources are available. The educator has to arrange for the resources and distribute it to students needing them in order to have an effective instructional program. This is an important function in vocational schools and military training programs.

The program level management is concerned with the educational program of a student or group of students. The management covers issues such as curricular improvement, the attainment of higher level educational goals, the balance of time and other resources across the several courses, interaction of the courses, and the quality of the educational program.

e) Computers

The computer component plays a supportive role in the CMI concept. The computer component in CMI systems is to collect, store, and report on instructionally related data. The five (5) functions performed by computer are data collection, data storage, automated diagnosis and prescription, data processing and reporting. Instructional related data such as test scores, objectives mastered, units completed, and resources employed are recorded on or transcribed to a computer. Data can be entered into the computer via a scanner, keyboard, or optical mark reader. The data is stored in a
database, which is the core element of the computer component of all CMI systems. The computer programs are designed to create, maintain and use tables of the database. For each diagnosis, a prescription that is kept in the database can be retrieved and displayed. Educators are relieved from repetitive instructional tasks. Here the computer can be used to organize, summarize and report data collected for use in instructional management. The functions of the computer are further discussed in Chapter 5.

The characteristics of a CMI program thus can be summarized as follows:

   a. The teacher acts as a manager of instruction over an individualised objective based program;

   b. The computer program is designed to locate and manage resources including course objectives, learning resources, and human resources;

   c. The computer program is designed to evaluate students’ understanding;

   d. The computer program is designed to monitor student progress;

   e. The computer program is designed to advise students of their weak points and suggest areas that need improvement;

   f. The computer program is designed to record and generate reports on student performance and progress.

The following subsections present reviews of literature related to studies involving CMI in the science and technology academic discipline in higher education. Similar criteria as indicated in Section 2.3 (page 18) were used to locate the literature. However, literature related to CMI in science and technology is rather rare. This could be due to the reasons that (a) the development of CMI systems (functions that were implemented in LMS) are performed by propriety software developers or large consortiums, where the publication of the LMS is more likely a marketed product; (b) the implementations
of LMS in higher education are reported only at institutional level or by educational researchers. As such, the information on CMI systems in the science and technology academic discipline is limited.

2.4.1. Science and Technology Education

Gerosa et al. (2005) described the implementation of collaboration components into AulaNet. AulaNet is a free web-based LMS. The first version of AulaNet resources were divided into administrative, assessment and didactic services that led educators to teach in the traditional way. The services of AulaNet were then reorganised based on the 3 C collaboration model (communication, cooperation, coordination), which seems to be suitable for a collaborative learning approach. Communication enables group to interpret messages, update their commitments and knowledge. Coordination involves the identification of the objectives and the mapping out of these objectives into tasks, evaluation and analysis of the tasks, and the documentation of the collaborative process. Cooperation is the joint operation within the shared workspace. The system architecture comprises groupware component frameworks, which provides the flexibility needed in projects with changing requirements. AulaNet was developed by doctorate, masters and degree candidates, and undergraduate students at the Catholic University of Rio.

Bensen and Palaskas (2006) presented an evaluation conducted in one institution as WebCT Vista (LMS) was introduced and piloted. The study highlighted the key issues that emerged from the evaluation. These issues are considered in the context of a selected model (the RIPPLES model (Resources, Infrastructure, People, Policies, Learning, Evaluation and Support)) with the evaluation framework (training and professional development, pedagogical issues, staff and student support issues,
administrative issues, technical issues, communication issues, and overall response) for examining the adoption and diffusion of ICTs in higher education.

Evaluation was conducted in two semesters that included analysis of project documentation, staff interviews, students (such as Medicine, Nursing & Health Science, Pharmacy, Information Technology students) and staff surveys. The study highlights issues relating to people, policies, learning and evaluation as the areas in most need of attention for monitoring the innovation. Given the availability of the resources, identifying and implementing institutional policies and procedures to facilitate continual improvement of the effective pedagogical use of the LMS, coupled with strategies to monitor these through ongoing evaluation, could provide a basis for guiding institutional improvement in the quality of online learning and teaching.

Rahmat Sanudin et al. (2007) explored the effectiveness of an LMS named Blackboard as an assessment tool. Multiple-choice, true/false, fill-in-the-blanks, essays and calculations are the examples of the types of questions that can be used in an assessment. 140 first year undergraduate students in electronic engineering were involved in this study. Students were allowed to take the assessment at any time within a given time frame. The researchers concluded that online assessment could be used as an alternative approach to assess the performance of students but it is not intended to replace the conventional approach. The ICT tools were used to (online assessment) reduce the administration workload of educators in marking.

2.5. Computer Enriched Instruction (CEI)

Computer-enriched instruction (CEI) is defined as learning activities in which computers (a) generate data at the students' request to illustrate relationships in models
of social or physical reality; (b) execute programs developed by the students; or (c) provide general enrichment in relatively unstructured exercises designed to stimulate and motivate students. CEI typically refers to the use of the computer as a calculating device, simulator, modelling or programming tool (Kulik and Kulik, 1987; Cotton, 1991; Committee on Developments in the Science of Learning, 2000; Newhouse, 2002).

The computer can be used to test out ideas and hypotheses. This involves the use of specific simulation packages, modelling software, a programming language and application tools. Simulation programs have the ability to reduce time, deal with large sample spaces and duplicate expensive, massive, delicate or dangerous equipment and experience. The computer is able to provide a means of replicating the experiences where the actual experience is difficult to provide. Modelling software differs from simulation packages in that the computer provides the tools to create a model for a real or non-real environment. Programming provides the greatest level of control for the user over the computer. The computer is made to respond to a variety of different responses from the user and the learner is able to control much of the interaction. Control of the teaching and learning situation is in the user’s hand and away from the computer. Application tools may extend the capabilities of the user and allow information to be represented in a variety of ways. This may provide tools to scaffold the learning for student. There are many applications designed for production, analysis and communication of information.

For CEI, the focus is on learning rather than instruction with the student-computer interaction central but the student in control. Students have to develop a strong sense of responsibility for their own learning and develop skills related to time management, self-discipline, attention to task and ability to follow instructions. Students have the
dominant role to play. Educators will need to set broad learning objectives and task descriptions for students, and provide feedback and monitor progress.

The characteristics of CEI programs thus can be summarized as follows:

a) The computer generates data at the students' request to illustrate relationships in models of social or physical reality;

b) The computer executes programs developed by the students;

c) The computer provides general enrichment in relatively unstructured exercises designed to stimulate and motivate students;

d) The computer provides tools that extend the capability of users to complete tasks.

The following subsections present reviews of literature related to studies involving CEI in the science and technology academic discipline at higher education level. Similar criteria applied for CAI and CMI were used to locate the literature.

2.5.1. Mathematics Instruction

Maizam (2007) described the use of three (3) application software to promote active learning in Statistics. The researcher incorporated Microsoft PowerPoint, EXCEL spreadsheet and concept mapping tool in the teaching and learning process. PowerPoint presentation slides were used to present short problems to promote active responses or learning reflection by students. Students were guided to key in data and to construct the scatter diagram using spreadsheet. These activities help students to see the relationship between source of data, data, graphical representation of the data and the coefficient associated with the data. The Institute for Human and Machine Cognition (IHMC) CMap tool was used for concept mapping activities. Students were asked to draw concept maps on a given topic or concept and these concept maps were later discussed
in the class. 38 students were asked to fill in a questionnaire related to learning with technology. The results showed positive students’ perceptions on ICT tools to promote students’ understandings of statistics.

Ahmad Fauzi et al. (2007b) developed an educational mathematics games and studied its effect on students’ motivation. 69 diploma students who enrolled in the mathematics calculus course were involved in the study. All respondents were asked to answer a questionnaire either after they have completed the game or at the stage when they quit from the game. The results showed all students enjoyed themselves, felt competent with the educational mathematics games and believed that playing educational mathematics games is useful in improving their mastery of calculus.

2.5.2. Science Instruction

a) Chemistry

Kennepohl (2001) examined the benefits of computer simulations in a first-year general chemistry course. Computer simulations employing digitized video images were incorporated into a computer program as the laboratory component of the first-year university chemistry course as part of a pilot study. The simulations were divided into four major topics: (a) oxidation and reduction; (b) acids and bases; (c) reaction rates; and (d) equilibrium. Students could navigate freely through these simulated exercises and stop at any time or continue later. The students were surveyed about their experience, and their performance in this distance course was also tracked and compared with students who did not do the simulations. No difference in overall course performance was observed between students who did the simulations and those who did not. Kennepohl (2001) found that the combination of simulations and laboratory offers advantages in time so that the laboratory portion can be reduced in length and students
using the simulations have a slightly better knowledge of the practical aspects directly related to laboratory work.

b) Physics

Diane et al. (2003) reported on the use of the Internet in the teaching and learning of Physics via the constructivism approach in higher education. A total of 50 students were involved in the study. Students were given two web sites on the topic “Impact of Photo Electric and X-ray (Kesan Fotoelektrik dan Sinar-X)” for one hour. The web sites were developed based on the curriculum of Modern Physics offered by the institution of the researchers and followed constructive design principles of the Interpretation Construction Design Model from Black and McClintock (1995). The students were then asked in a questionnaire (related to learning outcome of using the Internet in the teaching and learning of physics), the suitability of the Internet as a medium for study, and the weaknesses and strong points of the approach. The survey findings showed that students felt that the constructivism approach is attractive and is a new learning approach to them. They obtained a lot of information related to the course and the learning environment was suitable. However, students found that it was difficult to understand downloaded material and the chat room is not very effective. The researchers concluded that using the Internet for teaching and learning in Physics via constructivism is rather new and it could serve as an alternative.

In a separate study, Fauziah et al. (2003) researched on the use of the Internet in the teaching and learning of Physics via the problem based learning (PBL) approach. Students were given two web sites on the topic “Sinaran Jasad Hitam dan Hukum Sasaran Wien” for one and a half hour. The web sites were developed based on the curriculum of Modern Physics offered by the institution of the researchers and followed the PBL process model from Harper-Marinick (2001). A total of 67 students were
involved in the study and completed a questionnaire at the end of the study. Questions forwarded to students in the questionnaires were related to the learning outcomes of using the Internet in the teaching and learning of physics, suitability of the Internet as a medium for study, the weaknesses and strong points of the approach. The research findings showed that students’ perceptions on the use of Internet were good, the students believed that they benefited from the collaborative learning, problem solving skills were improved, they are motivated to learn and are more independent. However, students found that the chat room is not very effective and that explanation on the PBL processes was not clear. In the study, the findings showed that the students were able to use the Internet to complete tasks.

2.5.3. Computer Science Instruction

a) Interactive Multimedia

In the teaching of interactive multimedia, 46 students (in their second year of study) were given a multimedia application project to complete (Neo, 2003). The students chose their own project theme and worked in groups of 4 to 6. Each group had to decide on their group members, their team topic and use a multimedia authoring tool, Macromedia Director, to create the final project and deliver it on a compact disc. These students were given lectures and tutorials to provide them with basic skills in multimedia application development. The students have prior experience in design and other multimedia software such as Adobe Photoshop (for graphics), Premier (for digital video), Macromedia Flash (for animations) and SoundForge (for sound), which they can use to develop their projects. Students had to decide on the concept of the presentation, the design of the presentation interface and navigation, and the appropriate digital multimedia elements and interactive features to use to best convey their topic of interest. The role of the teacher was a facilitator and consultant to these students. The students'
projects were assessed over eight criteria and overall, they did well in their projects. A survey was carried out by the researcher to ascertain the reactions of students enrolled in the interactive multimedia course towards project based learning mode. The results indicated that the students reacted positively towards the set study mode and improved their interpersonal and collaborative learning skills. In this study, students have full control over the use of computer application tools in completing their tasks.

Pfahl et al. (2001) presented a computer-based training module for student education in software project management. A simulation model implemented using the system dynamics simulation modeling method simulates the typical behaviour of software development projects. The simulator can be run using a web browser. The simulation model uses a simplified generic waterfall-model with three phases of a typical software development project: design, implementation, and test. The calibration of the model was based on functional relationships between effort, time, and size (functionality) as in the COCOMO model. The SD modeling tool Vensim 3.0 was used to provide a set of instructive graphical analysis functions to the model user. The user interface was developed using Borland Delphi. The simulator was tested using an experimental approach with nine (9) Computer Science students. Five (5) students formed the experimental group, and four (4) students formed the control group. Three (3) hypotheses were set to be tested based on the experimental data. However, the experiment result was too small to use for hypothesis testing.

2.5.4. Information Systems Instruction

Norhashimi and Sathiyavani (2007) studied on the use of online discussion forums to create an interactive environment among students, and among students and instructors for an E-Commerce Technology course in Malaysia. 55 students pursuing Business
Information Systems degree were involved in the study. The researchers used a questionnaire to collect data regarding students’ perception on student-classmate interaction, student-facilitator interaction and the appropriateness of ICT in online problem based learning. The research findings showed that the use of ICT interactivity tools in problem based learning provides learners with a fun, motivational and effective way to solve problems. The research outcome also stressed on the importance of the role of instructors, learners and use of the right medium for collaborative learning through ICT. As an instructor, one needs to know how to use the medium and how the learners are expected to react to it. On the other hand, the learner should be ready to use the ICT medium as part of their course, and the medium selected by the instructor must support the learning task effectively.

Connolly and Stansfield (2006) investigated how the games-based eLearning technologies can be used to enrich the Information Systems (IS) learning experiences of students with different learning styles. The game is based on a marina called Fair Winds Marina and has been developed as a collaborative project between two Scottish higher education institutions. The game allows teams (of 2 and 4) students, acting in the role of IS consultants, to conduct IS requirements analysis of the Marina’s needs and produce an IT specification aimed at improving problems that they identify within the business. The sample used in the research consists of students in a postgraduate Master of Science in Management of eBusiness course. The authors described the development of the games-based eLearning applications and highlighted the contributions that the technologies can make to overcome the difficulties in teaching IS. They include (a) providing a challenging and complex real-world environment within which to apply their theoretical knowledge; (b) overcoming difficulties in dealing with ambiguity and vagueness; (c) developing and applying transferable analytical and problem-solving...
skills; (d) developing self confidence and increased motivation, and (e) allowing students time to reflect upon their practice and develop meta-cognitive strategies capable of adapting to new and evolving situations. Areas of further direction were identified, such as developing a less sophisticated virtual games environment that is easier to adapt to and is less resource intensive, and thus better able to meet the needs and financial constraints found in higher education.

Tétard and Patokorpi (2005) examined how the learning of IS design could be improved by constructivist methods. 26 students enrolled in the course "User-centred design of information systems", an advanced level course targeted mainly at advanced and postgraduate IS students, were involved in the study. The IS students were worked in groups on one of the design assignments. The students had access to several information sources: the course self-study materials, the lecture notes, the lecture readings, and the web sources, which were provided on the course web site. The students used many ICT tools in communicating their design ideas: e-mail, cell phones, peer-to-peer communication software (ICQ), design software, and drawing boards. However, many students admitted that they spent most of the time in face-to-face meetings. Some teams used digital cameras and a video gun to share and discuss design ideas during the meetings. It seems that one way of making course work more effective would be to make these tools more readily available to all teams. A shared group folder was used to facilitate communication between the students and the teacher. It was reported that most students used the tools made available to them but rarely took the initiative to use other new tools which could have enhanced their work practices. The researchers believed that the most significant further improvements will come from intensified peer support and instructor guidance to individual groups. This research presented the use of various ICT tools to extend the capability of students to complete tasks.
Raman et al. (2005) conducted a case study to examine if wikis could be used to implement a knowledge management system for teaching and learning, and if the technology could support knowledge creation and sharing in an academic setting. The sample used was a knowledge management class at a graduate-level information systems and technology school. Twenty students met in class for three hours per week over a sixteen-week period. During that period, students were expected to create, refine, and maintain a knowledge management system, using an instantiation of wiki technology called TikiWiki. The instructor placed questions, comments and assignments on the wiki on a regular basis. The findings suggested that effective implementation and use of a wiki to support knowledge management for effective teaching and learning is contingent upon both students’ and instructors’ familiarity with the technology, level of planning involved prior to system implementation and use in class, class size, and the ability to motivate students to learn from one another based on the principles of discovery learning. As such, wiki is used as a tool to extend the capability of students to complete tasks.

2.5.5. Engineering Instruction

a) Electrical/Electronic

Saifullizam et al. (2005) studied on the use of Electronic Workbench (EW) software (computer simulation) by 72 students pursuing a diploma in Electronic Engineering. The students were separated into control and treatment groups. The findings showed that the students’ level of skill and students’ score are higher for those exposed to Electronic Workbench. The use of computer simulation (Electronic Workbench) had positive impact on the students’ learning process. This indicated that CEI produce positive learning outcome.
b) Mechatronics Engineering

Zol Bahri and Shazmin Aniza (2005) compared the difference in overall achievement on the use of simulation based courseware and a multimedia based (PowerPoint presentation) module by students in a self-study format. For simulation based courseware, students needed to develop the circuit and run it in order to understand the functionality of each component. For the multimedia based module, students play the presentation slides that look like an animation. 60 students from Mechatronics Engineering were involved. The sample was divided into two groups, high internal motivation and low internal motivation based on the survey question “Responsible towards Intellectual Achievement”. The result showed an increase in students’ score after they used the simulation based courseware and multimedia based module. There was a significant difference in student achievement for simulation based courseware as compared to multimedia based module. The research result also indicated that the group of low internal motivation students using simulation based courseware gave a much better score compared to the other.

c) Aerospace Engineering

A fundamental aspect of space technology is the knowledge of orbiting bodies. To enhance the students’ understanding on fundamental orbital mechanics, a visualization program was developed (Muhammad Shamsul and Radzuan, 2006). A simple system is important to provide a basic training and education for students pursuing space technology. The basic elements of Keplerian and satellites constellation using the concepts of Walkers Constellation were displayed conceptually using Matlab to produce visual simulation of satellite orbits. This fundamental knowledge is essential to serve as guidance towards more complex problems. The development of the program using
Matlab is economical as a learning aid as compared to other expensive software. The visualization program could help students to understand the subject matter easier.

2.6. Summary

This chapter has provided an understanding of how ICT is used in the teaching and learning of higher education, definition and characteristics of CAI, CMI and CEI, and follows with review of these tools implemented in the science and technology academic disciplines. The next chapter describes the methodology used in this study.
3.1. Introduction

Chapter 3 describes the research design and the methodology used in this study. It justifies the data gathering approaches employed to examine the key research questions. This chapter consists of the following sections: research methodology literature, research design, sample of the study, research instrument and data collection procedure, validity and reliability of the instruments; and treatment of data and statistical analysis procedures.

The study has the following objectives:

i. Determine the extent of ICT usage and the factors affecting the use of ICT tools in teaching and learning of IS in Malaysian higher education;

ii. Identify area(s) where current ICT tools used are inadequate to support IS instructional processes, as perceived by the IS educators;

iii. Design and develop a tool to support the area(s), revealed in (ii) and;

iv. Evaluate the feasibility of the tool to support IS instructional processes.

To realise the objectives, the researcher employed a mixed qualitative and quantitative research context (Creswell, 2003) which aimed to answer the following research questions:

i. What are the ICT tools used in teaching and learning of IS in Malaysian higher education?

ii. What are the areas of concern perceived by the IS educators in using these tools in teaching and learning of IS?
iii. What are the factors perceived by the IS educators that contribute towards the successful use of ICT tools in teaching and learning of IS?

iv. What are the areas that the current ICT tools used lack of in IS instructional processes?

v. What are the IS educators’ perceived requirements to address the areas in (iv)?

vi. How well does the tool perform in terms of usability, functionality and accuracy to address the requirements identified in (v)?

A preliminary study of literature was carried out by examining scholarly materials from online databases, online resources, refereed journals, conferences papers and research reports on the research methodology related to the ICT in education at higher education level. It was aimed at assisting the researcher in conceptualizing the research design of this study.

3.2. Review of Research Methodology Related To ICT in Education in Higher Learning Institutions

Reviewing recent literature on the research related to the use of ICT in education offers insight into methodologies used among researchers in this area. Research methodology reviewed in the design, integration and evaluation of ICT in education indicated that the use of multiple methods to gather data is a feasible approach. Nor Sakinah et al. (2007) employed collaborative action research and multiple case studies to explore the development and implementation process of web based portfolio for performance improvement purposes. Questionnaire, tests and interviews were used by Hong et al. (2007) to investigate the effectiveness of teaching a mathematical problem solving course via the Web. Other data gathering techniques identified related to the research of ICT in education include observations (Abdul Halim, 2003), user survey (Achmad
User involvement in developing and evaluating information system is generally considered an important mechanism to improve system quality and ensure successful system implementation. Baroudi et al. (1986) indicated that user involvement in the development of information systems will enhance both system usage and the user's satisfaction with the system. As such, user involvement is the key factor to maximize the chance of success for a system. Users can be involved in projects at various phases and can play different roles. Some approaches to software development (Dynamic Systems Development Method) directly involve users in the development team (Bennett et al., 2002). Nevertheless, it is practically impossible to define a complete set of requirements to address its user needs as software systems are usually required to improve upon the status quo and different users have different requirements and priorities (Sommerville, 1996). To develop software system that meets the majority of its user needs, no doubt that user involvements should start at early stages of software development such as requirement acquisition. This is crucial as the results of analyzing users’ requirements can influence design in at least three ways: (a) by discovering which functionalities users regard as priorities; (b) by developing basic analytical
categories that influence the design of system architecture; (c) by generating integrated

design processes that include empirical research and user participation throughout the
design cycle. If a tool is to be achieving their full usage, they need to be usable and used
by the target users. Therefore, it is important to understand when, how and why users
use a tool, in order to provide or improve ways for them to access and use these
resources.

The same applied to the research on ICT in education. How people use ICT have been
the focus of different groups or individual research studies in the past few years, which
contribute to the creation and design of various tools. It is known that data gathered
from end users could serve as valuable input that will produce better systems. Review of
the literature revealed that not only the educators in general are involved in the
integration and evaluation of ICT in education (Neo, 2003; Dianel et al., 2003; Fauziah
et al., 2003; Mohd. Hizam and Mohd. Daud, 2005; Nor Azilah Ngah and Yeoh, 2005;
Saifullizam et al., 2005; Zol Bahri and Shazmin Aniza, 2005; Goh and Rasaya, 2006;
Maizam, 2007; Rahmat Sanudin et al., 2007; Nor Sakinah et al., 2007), but there are
also educators who are involved in the design, integration and evaluation of ICT in
education as demonstrated in studies conducted by Achmad Sopandi (2003), Mohd Arif
et al. (2003), Nor Hapiza et al. (2004), Johnson Lim et al. (2005), Adelina and Rafiza
management systems such as Claroline, ILIAS, OLAT, ATutor, Moodle,
KEWL.NextGen, Sakai, Metacoon, LON-CAPA and dotLRN shows that the
development of such systems involved a broad user base around the projects. The
success of these projects demonstrates the benefits of adopting a design process that
involved user and system developer. As such, the features that were developed were the
most in demand by the majority of the users and they would be developed general
enough so that they could be used by almost every one. To fulfil the needs of a specific
academic discipline, the functionalities of a tool have to be customised according to the
needs of the discipline under study.

3.2.1. ICT in Education Research Framework

In addition to the research methodologies used in ICT in education, a framework on
how to integrate ICT in education have been conceptualized and described in research
of this nature. Kulik and Kulik (1987) and Bangert-Drowns et al. (1985) carried out
meta-analysis on the computer use in education and categorized the computer use in
instructional processes into one of these categories: CAI, CMI, and CEI. This study
adopt Kulik and Kulik’s (1987) categorization of ICT in education since it is generic
and comprehensive, and it has been used in research on computer based education at
different educational level (such as elementary schools, high schools, colleges, and
nontraditional postsecondary institutions). As a result of the findings from the survey
and interviews (Chapter 4) that most of the IS educators in this study are inclined to use
ICT for CMI-related purposes, this work is mainly concerned with the use of computer
as CMI to guide the research, design and development of a tool to support IS
instructional processes.

3.2.2. Computer Managed Instruction

A detailed definition and description of CMI and a review of how it is used in teaching
and learning has been described earlier in Section 2.4. As described in Park and Lee
(2003), CMI systems have functions to diagnose student learning needs and to prescribe
instructional activities appropriate for these needs. Araki et al. (1993) indicated that the
functions of CMI program in the teaching flow are designed to (a) evaluate students’
understanding; (b) monitor student progress; (c) advise students of their weak points and suggesting areas that need improvement; (d) notify teachers of the individual students' weak points areas that need improvement and suggesting areas of importance. Day and Payne (1987) defined CMI as an instructional strategy, whereby the use of computers by university staff to organize student data and make instructional decisions or the use of computers to evaluate students' test performance, guide them to appropriate instructional resources, and keep records of their progress. The four (4) functions that a CMI should have to provide good computer technology to monitor student educational performance as defined by Gorth and Nassif (1984) are: (a) an identification database; (b) performance data; (c) report generation; and (d) utility functions. The functions of CMI presented by Leiblum (1982) were test generation, banking, and assignments. “The banks” comprise objectives, learning resources, test items, and instructional material. Hedges (1981) described the functions of CMI as diagnosis, prescription, data collection, and data reporting capabilities. Baker (1978) identified the functions of CMI as testing, diagnosing, prescribing, and reporting.

In this study, the research is mainly concerned with the use of computer as CMI to support instructional processes. It is a computer program designed to:

a) locate and manage resources include course objectives, learning resources, and human resources;
b) evaluate students’ understanding against the curriculum. Assessment items could be tests, essay type (assignments or projects) and student discussion as indicated in Chapter 4;
c) record student results and progress;
d) advise students of their weak points and suggest areas that need improvement;
e) generate reports on student performance.
3.3. Research Design

Any successful attempt at integrating ICT into existing institutional structures must begin with an evaluation of the current status of the institution and followed by a plan for improvement. The successful integration of technology into the campus is led by faculty initiative (Leider, 2003). Therefore, a case study approach is adopted in this research, which aims to “illuminate the general by looking at the particular.” (Denscombe, 2003, p.30). The purpose is not to over-generalise from what is an isolated investigation, rather to gain some insight from which some wider implications may be supposed. The case study method is routinely used in research related to technology in education (Yin, 1994). In this study, the researcher employed a case study approach to investigate the current use of ICT tools to support the teaching of IS among educators, the factors that affecting its use, and the gaps left by existing ICT tools in supporting the teaching of IS. With the information gathered, the researcher developed a tool as “proof of concept” to address the areas that the current tools used lack of in supporting IS instructions. This research adopts multiple data collection techniques that involve quantitative and qualitative methods, as accuracy and alternative explanations could be done by using multiple sources of data (Yin, 1994). The need for using multiple sources of data or ‘triangulation’ arises from the ethical need to confirm the validity and reliability of the processes. Addressing these needs can be achieved by using multiple data collection techniques as conducted in this study.

3.4. Population and Sample of the Study

The case study is confined to the Information Systems instructions in Malaysian universities as the boundary of the case. As such it involves universities that offer IS courses or program in Malaysia and IS educators as participants who are willing to
participate in the study. Careful sampling (Smith, 1988) is not necessary as (a) the population is homogenous; (b) getting participants who are willing to participate requires purposive sampling. A total of nineteen (19) universities listed in the Study in Malaysia (2002) handbook that offer IS courses or program were chosen for the first survey. Six (6) IS faculty members teaching IS courses or program were willing to participate in the interview. For the second survey, conducted to further prompt for the requirements of ICT in a specific aspect of IS instructions, seventeen (17) public universities listed in the homepage of the Ministry of Higher Education Malaysia (http://www.mohe.gov.my) that offer IS courses to their students were chosen. Prior to the distribution of the questionnaire for the two surveys, an e-mail was sent to the relevant faculties to get approval and at the same time to request for a list of full-time IS educators’ names and their e-mail addresses (Appendices A and D). To ensure the confidentiality of the information, the universities under study were given assurance that the analysis of the survey results would not be done based on individual university; rather, it would be analysed based on public universities as a whole. Nineteen (19) universities were involved in the first survey and thirteen (13) universities agreed to participate in the second survey.

3.5. Research Instruments and Data Collection Procedures

The researcher employed multiple data collection techniques summarised in Table 3-1. These techniques are surveys, interviews, document analysis, systems review, user testing and evaluation of the developed prototype. The following subsections describe each technique, the sample involved, the activities carried out and the instruments used.
Table 3-1
Data Collection Techniques

<table>
<thead>
<tr>
<th>Technique</th>
<th>Primary method</th>
<th>Information Obtained</th>
<th>Forms of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Interviews</td>
<td>Qualitative</td>
<td>How Individual ICT use in teaching and learning IS educators’ perception on the limitation of ICT in supporting IS education</td>
<td>Narrative Text</td>
</tr>
<tr>
<td>3. Survey (A Survey on Requirements for Assessing Students’ Contributions to Internet Forums)</td>
<td>Quantitative</td>
<td>Individual differences IS Educators’ Requirements of collaboration tool for assessment</td>
<td>Numeric data</td>
</tr>
<tr>
<td>4. Document Analysis (Assignment questions)</td>
<td>Qualitative</td>
<td>Assessment on the nature of question being used</td>
<td>Narrative Text</td>
</tr>
<tr>
<td>5. Systems Review</td>
<td>Qualitative</td>
<td>Use of ICT in education, definition and characteristics of CAI, CMI, and CEI, and application of CAI, CMI, and CEI in the science and technology academic disciplines</td>
<td>Narrative Text</td>
</tr>
<tr>
<td>6. User Testing and evaluation of the developed prototype</td>
<td>Quantitative and Qualitative</td>
<td>User evaluation and acceptance of developed prototype</td>
<td>Numeric data Narrative text</td>
</tr>
</tbody>
</table>

3.5.1. Survey on Utilisation of ICT Tools in the Teaching and Learning of Information Systems (IS) in Universities

Data collection through distribution of questionnaires was chosen because it allows a larger sample, as well as a wider geographical distribution of the sample, and the collection of a large amount of data in a relatively short time (Williamson, 2000). It also allows generalization to be made about the demographic of the entire population being studied (Greenfield, 2001). The first survey administered to the educators aims to:

i. What are the ICT tools used in teaching and learning of IS in Malaysian higher education?
ii. What are the areas of concern perceived by the IS educators in using these tools in teaching and learning of IS?

iii. What are the factors perceived by the IS educators that contribute towards the successful use of ICT tools in teaching and learning of IS?

The instrument is a nine-page questionnaire consisting of four (4) sections (Appendix B). The questionnaire used open-ended questions, questions having multiple choice answers and those using Likert scale answers. The first section (Section A) of the questionnaire consists of five (5) questions on respondent’s background. The focus is on the respondents’ demographics such as their age group, gender, their highest educational attainment, teaching experience and IS courses that they have taught. This section is used to confirm that the respondents were indeed involved in teaching and learning of IS. The second section (Section B) has twenty two (22) questions on the respondents’ use of various types of ICT tools in teaching and learning of IS. The third section (Section C) of the questionnaire has fourteen (14) questions which focus on how ICT tools have supported the teaching and learning in IS. The fourth section (Section D) of the questionnaire consists of twenty four (24) questions and was designed to identify the obstacles towards the use of ICT tools in IS instructions. It then followed with a separate table consists of twenty (20) questions which objective is to collect data on the factors contribute towards the successful use of ICT tools in IS instructions. At the end of the section, a question on the respondents’ views on ICT tools in teaching and learning of IS were posed. Table 3-2 provides a summary on the operationalization of the survey constructs. It also maps with other various studies of which the constructs are based on.
### Table 3-2
Survey constructs for first survey

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
<th>Number of Items</th>
<th>Types of responses</th>
<th>Source (Developed based on)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Section A:</strong> Demographic Information</td>
<td>The respondent’s biodata such as age group, gender, Highest educational attainment, years of teaching experience, The information systems taught.</td>
<td>5 (Question 1 - 5)</td>
<td>Nominal and interval data, open ended answer</td>
<td>-</td>
</tr>
<tr>
<td><strong>Section B:</strong> ICT individual usage differences</td>
<td>Data on the use of various types of ICT tools such as word processor, presentation software, the Internet, E-mail, LMS, digital library and other.</td>
<td>22 (Question 1 - 22)</td>
<td>Ordinal data (Likert type five-scale)</td>
<td>Littlejohn and Higgison, (2003)</td>
</tr>
<tr>
<td><strong>Section D:</strong> Obstacles encountered in using the ICT tools</td>
<td>The perception on hardware, software, management factors, peer or personal factor that get in the way of using ICT tools</td>
<td>24 (Question 1 - 24)</td>
<td>Ordinal data (Likert type seven-scale)</td>
<td>Wilson (1994), Johnston and McCormack (1996), Spotts (1999), Thomas et al.(1996), Butler and Sellbom (2002).</td>
</tr>
<tr>
<td>Factors that promote the use of ICT tools</td>
<td>The perception on hardware, software, management factors, peer or personal factor that motivated the use of ICT tools</td>
<td>20 (Question 1 - 20)</td>
<td>Ordinal data (Likert type seven-scale)</td>
<td>Staman(1990), Boettcher (1994), Johnston and McCormack (1996), Spotts (1999), Littlejohn and Higgison, (2003), Osborne and Hennessy (2003).</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Elicit suggestion and comment on using ICT tools in teaching</td>
<td>1 (Question 1)</td>
<td>Open ended answer</td>
<td>-</td>
</tr>
</tbody>
</table>

The questionnaire was submitted for review to the Head, Department of Information Science, Faculty of Computer Science and Information Technology, University of Malaya, (of which the IS programme is administratively positioned) and seven senior educators who taught IS at the higher education level. Based on the feedback, unnecessary questions were discarded, ambiguities and difficult questions were re-
worded, and each question was checked if an adequate range of responses were given. A pilot test was conducted to test the questionnaire for validity and reliability using a small convenient sample of seven (7) IS educators. Peat’s (2002) pilot study procedure was given careful consideration to improve the internal validity of a questionnaire. The questionnaire was then revised to remove various inconsistencies, ambiguities and difficult questions based on the comments given by the IS educators.

Prior to the distribution of the questionnaire, an e-mail was sent to these 19 universities to request for a list of full time staff working in the faculty of IS. Nine (9) of the universities provided the full time IS educators list, while the remaining ten (10) provided the link in the faculty’s website that list their full time staff information. Questionnaires together with self-addressed stamped envelopes were then sent by hand or mail, or e-mailed to the full time educators teaching IS in all the 19 universities. A total of 273 questionnaires were distributed. Two (2) e-mail reminders were sent to the IS educators who did not return the questionnaire three weeks from the distribution date. A total of 151 usable sets were then returned. Thus, the respondents represent about 55.3% of total IS educators from the 19 universities. The returned questionnaires were checked for completeness (i.e. all questions were answered) before the statistical data analysis. The list of participating universities is presented in Appendix C.

3.5.2. Interviews

Interviews were conducted to probe further opinions and gather in-depth information on the use of ICT tools in the teaching and learning of IS. Through interview, a clearer picture of the activities involved in the teaching and learning of IS was obtained. This approach is used to address research question 4 and 5:
i. What are the areas that the current ICT tools used lack of in IS instructional processes?

ii. What are the IS educators’ perceived requirements to address the areas in (i)?

Six (6) IS educators were willing to participate in the interview. The IS educators were interviewed separately in the respective IS educators’ office. During this phase, the IS educators were asked several questions to obtain an in-depth view about their experiences in using ICT tools in teaching and learning of IS. Probing questions were also introduced to draw more information from the IS educators, especially when it was felt that further elaboration was necessary. The questions were geared towards obtaining a better understanding of the IS educators' perception of the following:

i. What are the areas and problems encountered by the IS educators in IS instructional processes. This includes detailed information on problems faced by educators when using ICT tools in the learning activities such as assignments or projects, student discussion, and tests.

ii. What are the users’ requirements that is necessary as perceived by IS educators to alleviate the problems in (i).

Each interview was scheduled to last approximately one and a half hours. The interviews were carried out using a set of open-ended questions. The six (6) IS educators involved answered the following seven (7) questions:

i. What kind of learning activities you arrange for students in IS courses, and how ICT has helped you in this?

ii. How do you manage the learning activities?

iii. How do you use ICT to support IS instructions?

iv. How do you find about the system or tools that you are using?
v. Do you use any specific systems or computer tools such as CAI, CMI or CEI to support IS instructions?

vi. What would you like to see on a system with a CAI, CMI or CEI elements?

vii. How would you like to use a tool that meets your needs to support instructions?

Explanation of terms or interview questions was given whenever necessary throughout the interviews. Interviews were documented on paper and transcribed as extended field notes. The extended field notes were then verified with the IS educators in the process of “member checking” to check on the correct interpretations of the researcher. “Member checking” is viewed as a technique used for establishing the validity of an account. Lincoln and Guba (1985) regarded that this is the most crucial technique for establishing credibility. The process is necessary to ensure that the research has remained true to the ideas of the primary source. All errors, inaccuracies and omissions in the extended field notes were corrected.

3.5.3. Survey on Requirements for Assessing Students’ Contributions to Internet Forums

Based on the findings of first survey and interviews, it leads to the need to further prompt the IS educators for data on the use of ICT in a specific aspect of IS instructions. The IS educators involved in the interviews indicated that they would like to use a collaboration tool, which could generate a performance indicator on students’ participation (Section 4.3.5). The existing collaboration tools do not support the required features. The survey is necessary to collect data on that specific aspect of IS instructions identified in the interviews so that the true functional requirements required for a collaboration tool can be identified from the IS educators’ perspective.
The research instrument was a self-administered five-page questionnaire consisting of four sections. It used a mixture of open-ended questions, single-choice questions as well as multiple-choice type questions. The first section (Section A) of the questionnaire consists of five (5) questions on respondents’ backgrounds. The focus was on the respondents’ demographic such as their age group, gender, their highest educational attainment, teaching experience and IS courses that they had taught. The aim of this section is to confirm that the respondents were indeed involved in teaching and learning of IS. The second section (Section B) of the questionnaire focused on the proposed model and requirements for assessing students’ contributions to Internet forums. This section also examined the IS educators’ perceptions on a computer generated performance indicator and their primary objective of using it. The items of the questionnaire were developed with reference to the work of Dringus and Ellis (2004). The post categories listed in the survey resulted from a slightly modified version of Scale for Forums / Online Discussion Assessment (SCAFFOLD) after considering the result of findings reported in Dringus and Ellis (2005). The items on ‘closure’, “error free”, ‘topical’, ‘solutions’, ‘comprehensive’, ‘originality’, ‘problem’, ‘reflective’ were eliminated from the SCAFFOLD list as these items can be logically grouped and represented by items ‘summarizing’, ‘evaluative’, ‘social’, ‘summarizing’, ‘social’, ‘synthesis’, ‘questioning’, ‘social’ respectively in the SCAFFOLD list. Some features proposed by Dringus and Ellis (2004) that would help in assessing students' contributions to Internet forums were listed to acquire user feedback. This section is necessary to seek IS educators’ perception on the functional requirements of a tool. The results enable the researcher to generalise the IS educators’ requirements of a tool to support their teaching. Lastly, the respondents were asked about their views on Internet forums in the teaching and learning of IS. Table 3-3 presents a summary on the operationalization of survey constructs. The questionnaire is presented in Appendix E.
<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
<th>Number of Items</th>
<th>Types of responses</th>
<th>Source (Developed based on)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Section A: Demographic Information</strong></td>
<td>The respondent’s biodata such as age group, gender, Highest educational attainment, years of teaching experience, The information systems taught.</td>
<td>5 (Question 1 - 5)</td>
<td>Nominal and interval data, Open ended answer</td>
<td>-</td>
</tr>
<tr>
<td><strong>Section B: Educators’ requirements on collaboration tool</strong></td>
<td>The perception of requirement needs for collaboration tool</td>
<td>5 (Question 1 – 5)</td>
<td>Nominal data</td>
<td>Dringus and Ellis (2004), Dringus and Ellis (2005)</td>
</tr>
<tr>
<td><strong>Section C: Other</strong></td>
<td>Elicit views on using collaboration tools in teaching</td>
<td>1</td>
<td>Open ended answer</td>
<td>-</td>
</tr>
</tbody>
</table>

The questionnaire was submitted for review to three senior educators who teach IS at the undergraduate level. Based on the feedback, revisions and amendments were made to the questionnaire to ensure that the questions are relevant and easy to understand and answer. Again, unnecessary questions were discarded; ambiguities and difficult questions were re-worded; each question was check if an adequate range of responses were given.

A total of seventeen (17) public universities listed in the homepage of the Ministry of Higher Education Malaysia (http://www.mohe.gov.my) that offer IS courses to their students were chosen. Prior to the distribution of the questionnaire, an e-mail was sent to the universities to get approval and at the same time request for a list of full time IS educators’ names and their e-mail addresses (Appendix D). Thirteen (13) universities agreed to participate in the survey and the latest list of their full time IS educators were obtained. An electronic questionnaire in Microsoft Word (Form) file format (Appendix E) was attached with an e-mail and sent to the IS educators in all the thirteen (13)
universities. A total of 178 electronic questionnaires were transmitted. One week after the initial sending date, follow-up e-mails were sent to the IS educators who had not returned the electronic questionnaire. A total of 73 usable sets were returned. Thus, the respondents represent about 41% of the total IS educators from the thirteen (13) universities. The returned electronic questionnaires were checked for completeness (i.e. all questions were answered) before statistical data analysis. Vague or missing answers that required clarification were followed up via e-mail with the respondents. The list of participating universities is presented in Appendix F.

3.5.4. Document Analysis

Another method used to collect data is through document analysis of assignment questions which provides information on the requirements set by the IS educators for students to carry out in a specific aspect of the teaching and learning in IS. The researcher examined and analysed 12 samples of assignments questions format collected from the following IS courses: (a) System Analysis and Design; (b) Object-Oriented Analysis and Design; (c) Accounting Management System; (d) Information Systems Development Practices; (e) Analysis and Design of Information Systems; (f) Decision Support Systems; and (g) Information Retrieval. The samples assignments questions provide information on:

a) Course Information;

b) Objectives of the assignment given;

c) Individual or student team work;

d) Number of educators involved;

e) The chronology of deliverables that take place in the IS assignments;

f) Guidelines or advices given to students on how to conduct research, write and produce report;
g) Types of reference resources provided to students;

h) Deadlines for submission;

i) Mode of submission;

j) Evaluation components and procedures.

This information is necessary to provide a better understanding of the requirements and context to use a tool for managing assignments, as findings from the IS educators interview revealed the need for the educators to use this tool as managing students assignment manually especially assessment is a challenging and tedious process (Section 4.3.2).

3.5.5. Systems Review

By reviewing the literature related to CAI, CEI, and CMI concepts, the use of ICT tools in the science and technology education, CMI functions and various open source software, the researcher summarizes, compares, analyses and present a set of CMI functional requirements. As the research findings show that the IS educators are inclined to use ICT to manage instructional processes, this research focuses on examining the users’ perceived requirements to manage IS instructional processes. A total of ten (10) open source LMS are reviewed and carefully analysed with CMI features. Based on the data collected from these open source LMS, a total of five (5) major requirements have been compiled and categorised according to these systems. These functions are presented under the following features:

i. Authoring tools

ii. Prescription tools

iii. Report generation tools

iv. Record keeping tools
Research Methodology

v. Authorization and access management

3.5.6. User Testing and Evaluation

This final data gathering technique is used to address research question 6 that is “how well does the tool perform in terms of usability, functionality and accuracy to address the requirements identified by the IS educators?” The testing and evaluation of the tool are conducted in for these two features: (a) CMI-based collaboration tool and (b) CMI-based learning management tool, in two phases.

The first phase of user evaluation was on the CMI-based collaboration tool. The evaluation of the collaboration tool was conducted in the second semester of an academic year. Two (2) IS educators from the oldest university in Malaysia agreed to participate in the evaluation of the forum software. Two (2) IS courses (Information Retrieval and Knowledge Management) which had a total of 64 students were involved in the evaluation. The collaboration tool was used by the students to share and discuss information throughout the project. At the end of the project duration, an electronic questionnaire on the usability of the forum software was sent to the students via their e-mail accounts, which had been stored in database when the members registered for the collaboration tool. To determine the usability of the collaboration tool, an electronic questionnaire was developed using questions in the Software Usability Measurement Inventory (SUMI) (Human Factors Research Group, 1992). Twenty (20) questions which were relevant to the forum software were adopted from SUMI and put together into an electronic questionnaire (Table 3-4). SUMI is used because its validity and reliability have been established internationally and only a minimum of about twelve (12) respondents is required when administering SUMI on paper. The answered electronic questionnaires were checked for completeness (i.e. all questions were
answered) before conducting the analysis. The sample of the evaluation form is presented in Appendix G. To measure the accuracy of the assessment model, Pearson product-moment correlations between the performance indicator (PI) scores and the actual grades were calculated.

Table 3-4
A summary of the survey items extracted from SUMI

<table>
<thead>
<tr>
<th>No</th>
<th>Survey Item</th>
<th>Extracted from SUMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The instructions and prompts are helpful.</td>
<td>Q3</td>
</tr>
<tr>
<td>2</td>
<td>The speed of this software is fast enough.</td>
<td>Q29</td>
</tr>
<tr>
<td>3</td>
<td>I would recommend this software to my friends.</td>
<td>Q2</td>
</tr>
<tr>
<td>4</td>
<td>It is easy to make the software do exactly what you want.</td>
<td>Q39</td>
</tr>
<tr>
<td>5</td>
<td>Working with this software is satisfying.</td>
<td>Q12</td>
</tr>
<tr>
<td>6</td>
<td>Learning how to use new functions is difficult.</td>
<td>Q35</td>
</tr>
<tr>
<td>7</td>
<td>The way that system information is presented is clear and understandable.</td>
<td>Q13</td>
</tr>
<tr>
<td>8</td>
<td>The software has helped me overcome any problems I have had in using it.</td>
<td>Q28</td>
</tr>
<tr>
<td>9</td>
<td>I feel in command of this software when I am using it.</td>
<td>Q19</td>
</tr>
<tr>
<td>10</td>
<td>Learning to operate this software initially is full of problems.</td>
<td>Q5</td>
</tr>
<tr>
<td>11</td>
<td>The organization of the menus or information lists seems quite logical.</td>
<td>Q33</td>
</tr>
<tr>
<td>12</td>
<td>It is obvious that user needs have been fully taken into consideration.</td>
<td>Q31</td>
</tr>
<tr>
<td>13</td>
<td>It takes too long to learn the software commands.</td>
<td>Q10</td>
</tr>
<tr>
<td>14</td>
<td>Using this software is frustrating.</td>
<td>Q27</td>
</tr>
<tr>
<td>15</td>
<td>I can understand and act on the information provided by this software.</td>
<td>Q23</td>
</tr>
<tr>
<td>16</td>
<td>It is easy to see at a glance what the options are at each stage.</td>
<td>Q48</td>
</tr>
<tr>
<td>17</td>
<td>It is relatively easy to move from one part of a task to another.</td>
<td>Q44</td>
</tr>
<tr>
<td>18</td>
<td>I have to look for assistance most times when I use this software.</td>
<td>Q50</td>
</tr>
<tr>
<td>19</td>
<td>Tasks can be performed in a straightforward manner using this software.</td>
<td>Q26</td>
</tr>
<tr>
<td>20</td>
<td>The software has a very attractive presentation.</td>
<td>Q42</td>
</tr>
</tbody>
</table>

(PDF 4.0 version of sample UK wording SUMI questionnaire accessed from http://sumi.ucc.ie/)

The second phase of evaluation was conducted on twelve (12) IS educators in the respective IS educators’ rooms or in a small discussion room with personal computer installed. A notebook computer with the preinstalled software (the system) was used in the evaluation to avoid the occurrence of the network reliability problem. The evaluation procedure includes a ten (10) minutes’ briefing on the purpose of the prototype, thirty (30) minutes’ demonstration on the functionality of the prototype modules, and twenty (20) minutes for the respondents to have a hands on experience on
the prototype. The hands on exercises given to the respondents was one of the sample collected from IS educators in document analysis. The researcher read out the scenarios to the participants. Participants created a test and an assignment question in the system. The researcher took the role as a student to submit the test answers and assignment answers, whereas the participant was a lecturer to evaluate the monitoring features of the tool. A written questionnaire was completed at the end of the session. The questionnaire was designed in three (3) parts. Part A concerned the ease of use of the system. Twenty (20) questions were adopted from SUMI (Table 3-4) and put together were asked with a Likert scale of “Strongly disagree”, ‘Disagree’, “Somewhat agree”, ‘Agree’, and “Strongly agree”. Part B was designed to evaluate the functionality of the modules with a Likert scale of “Very Poor”, ‘Poor’, ‘Satisfactory’, ‘Good’, and ‘Excellent’. Part C contained three open-ended questions that were appropriate for eliciting comments and recommendations from the participants. The answered questionnaires were checked for completeness (i.e. all questions had been answered) before conducting the analysis. The sample of the evaluation form is presented in Appendix F.

3.6. Validity and Reliability of Instruments

Ensuring validity and reliability in the qualitative and quantitative research involves conducting the investigation in an ethical manner. For instance, survey questions have to be scrutinized and validated before it can be distributed. A reliable and validity test of the instrument used in the research is described as follow.

3.6.1. Validity

Content validity is defined as the attempt made to judge the degree to which a test is consistent with the content, skills, or objectives it is supposed to measure (Popham,
The survey questions were developed based on the constructs in established literature. The two (2) sets of survey instruments are reviewed to determine the appropriateness and relevance of the content. The research supervisor and ten (10) senior IS educators, all of IS education background were involved in reviewing and commenting on the survey instruments used. The researcher used “member checking” as a validity check for the interviews, whereby the researcher had the original participants review the interpretations and descriptions of the experience for accuracy.

3.6.2. Reliability

The survey process and the questionnaire are tested for reliability purpose as reliability merely reflects the consistency of the measuring device (Popham, 2000). A pilot test was conducted to test the first questionnaire design with a Head of Department of Information Science, Faculty of Computer Science and Information Technology, and seven (7) senior educators who taught IS at the higher education level whereas three (3) IS educators were involved in the second questionnaire design. Based on the feedback, revisions and amendments were made to the questionnaire to ensure that the questions are relevant and easy to understand and answer. The amendments involved include the questionnaire layout, type of responses and clarity in the questions.

The system testing and evaluation was carried out in two phases. One is on the management of the collaboration tool and the other is on LMS. The first phase was carried out for the collaboration tool with three (3) students in a computer laboratory. The pilot study was completed in thirty (30) minutes. For the second stage, before user evaluation on the CMI-based LMS, three (3) IS educators were involved in the pilot study to identify unforeseen circumstances that might occurs. The educators were briefed on the objectives of the systems (LMS) and they took 40 minutes to complete the system evaluation. The educators completed a questionnaire at the end of the
evaluation. The pilot study was conducted in a student research room at University of Malaya, Malaysia.

3.7. Treatment of Data and Statistical Analysis Procedure

Each questionnaire was assigned a number for reference purpose before the information is coded and compiled using a statistical software package, Statistical Package for the Social Sciences (SPSS) version 12.0. All data entry is independently and repeatedly verified in order to ensure its accuracy. For data analysis of the first survey, besides open-ended questions, the frequency of the answers and total adoption for each ICT tool were computed. For data collected using a Likert scale, mean and standard deviation were also computed. The frequency of the answers for each question was computed for the second survey as well as CMI-based system evaluation surveys.

Factor analysis is conducted on selected survey items (Section D of the first survey). Factor analysis was conducted to determine if there were any underlying relationships between the items for the obstacles and success factors. Factor analysis is a data reduction technique that examines the underlying relations that exist between a set of observed variables (such as questionnaire items). The underlying assumption of factor analysis is that there exist a small number of unobserved variables, called factors, that responsible for the correlation among a large number of observed variables. In other words, the factors determine the values of the observed variables. The factor analysis was conducted using the principle component method of extraction and varimax rotation. It was decided that for an item to load on a factor, it must have a minimum absolute value of 0.45 and must not have loaded on another factor at an absolute value of 0.45 or greater.
The interviews were carried out using a set of open-ended questions that were organized into a semi-structured questionnaire. Interview notes were taken and transcribed. The transcripts were then verified with the IS educators via “member checking” process. All errors, inaccuracies and omissions in the transcript were corrected.

The Pearson product moment correlation measures the strength of a linear relationship between two quantitative variables. The values of the coefficient range from -1 to 1. To measure the accuracy of the assessment formula of the CMI-based collaboration tool, Pearson product moment correlations between the performance indicator and the actual grades assigned by the IS assessor were calculated.

3.8. Summary

The purpose of Chapter Three is to present the methodology of this study. Specifically it presents a review of the research employed related to study of this nature and the research design. Since the researcher needs to examine the individual educator’s ICT use, the factors that affecting its use, and the requirements of IS educators related to ICT functionality to support IS education, the researcher employed multiple data gathering techniques to capture all possible breadth and depth of issues. The chapters also reports on the extent of data collection, including the participants and activities involved. The next chapter presents the data analysis and findings for this study.
Chapter 4

ICT Usage, Practice, Perception, and Requirements of IS Educators to Support IS Instructions

4.1. Introduction

This chapter aims to present the findings of this study on the first and second research objectives: (a) to determine the extent of ICT usage and the factors affecting the use of ICT tools in teaching and learning of IS in Malaysian higher education; (b) to identify area(s) where current ICT tools used are inadequate to support IS instructional processes, as perceived by the IS educators. The main focus is to understand the type of ICT tools used in teaching and learning of IS, obstacles encountered, the perceived benefits of using ICT tools, factors that contribute towards the successful use of ICT, as well as to identify the area(s) where the current tools used lack of in teaching and learning of IS and the IS educators’ perceived requirements to address it. This chapter describes and discusses findings from two surveys and series of interviews conducted on IS educators in Malaysian universities. The first survey aims to understand the type of ICT tools used in teaching and learning of IS, obstacles encountered, the perceived benefits of using ICT tools, and factors that contribute towards the successful use of ICT. This is followed with a series of interview to further understand the use of ICT in teaching and learning of IS and the IS educators needs in using a tool to assist them in managing learning activities. The second survey is conducted based on the findings of the interviews. It aims to further prompt the IS educators for data on their perceived requirements in a specific aspect of the teaching and learning of IS.
4.2. Findings of the First Survey

The first survey aims to understand the type of ICT tools used in teaching and learning of IS, obstacles encountered, the perceive benefits of using ICT tools, factors that contribute towards the successful use of ICT. A total of 273 questionnaires were distributed and 151 usable sets were returned. Thus, the respondents represent about 55.3% of the total IS educators from the 19 universities.

4.2.1. Demographics of the Respondents

The first section of the questionnaire gathered the respondents’ background. The focus was on the respondents’ demographics such as their age group, gender, their highest educational attainment, teaching experience and IS courses that they had taught. The findings (n=151) are as depicted in Table 4-1. A total of 43% (65) of the respondents were in age group of 30 and below. The majority of the respondents were Masters Degree holders. The respondents were relatively new in the teaching profession as almost 64% (96) of the respondents have less than five (5) years of teaching experience. The list of IS courses taught by the respondents in the respective universities is presented in Appendix I. The list of IS courses gathered confirmed that the participants are educators teaching IS courses in their respective universities.

4.2.2. Various Types of ICT Tools Used in Teaching and Learning of IS

The respondents were asked how frequently they use the various types of ICT tools in IS instructions. A rating scale ranging from ‘Never’, ‘Seldom’ (using the ICT tools in less than 25% of the courses or semesters taught), ‘Sometimes’ (in 25% to 50% of the courses or semesters taught), ‘Often’ (in more than 50% to 75% of the courses or semesters taught) and ‘Always’ (in more than 75% of the courses or semester taught) was used. In calculating the mean and standard deviation, the following scores were
used: ‘Never’ = 1, ‘Seldom’ = 2, ‘Sometimes’ = 3, ‘Often’ = 4 and ‘Always’ = 5. The value for total adoption shows the percentage of respondents who use the ICT tools in IS instructions (Jacobsen, 2000). In order to estimate the diffusion of ICT tools, the proportion of respondents who rated their ICT tools usage as "Seldom" to "Always" have been combined to calculate a Total Adoption percentage. Rogers (1995) defines innovativeness as the degree to which an individual is relatively earlier in adopting new ideas than other members of a social system. The assumption being made here is that for
one who rates their usage as "Seldom" or “Sometimes” or “Often” or “Always”, they have been relatively earlier to adopt than one who rates their usage as "Never". The data gathered is presented in Table 4-2.

The total adoption of the ICT tools such as word processing software (Item 1), presentation software (Item 2), spreadsheets (Item 3), search tools (Item 4), the Internet (Item 5) and Liquid Crystal Display (LCD) projectors (Item 6) were very high (98% and above) and the mean value for each of the tools is 4.6 and above. The figures reflect that these ICT tools were used extensively for preparation and delivery of lessons. This may indicate that the tools are the standard facilities required for teaching among the IS educators sampled.

ICT tools such as the web (Item 7), e-mail (Item 8), and electronic file sharing facilities (Item 9) were also often used by respondents (mean value ranges from 3.6 to 4.59). The total adoption of these ICT tools is high (90.7% and 98%). The results show that a high percentage of the respondents had engaged in the Internet Technology to disseminate teaching material. Electronic file sharing among peers is common nowadays as the class size is getting bigger and more than one IS educator is required to teach one course which is consistent with the descriptions given by IS educators involved in the interviews. Electronic file sharing would be easier than manually exchanging files. E-mail is easily adopted as the communication tool since every staff and student in institutions of higher education is provided with an e-mail account.
Table 4-2
Extent of ICT Tools Used in IS Instructions (n=151)

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Mean*</th>
<th>Standard Deviation</th>
<th>Total Adoption (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I use <strong>word processing software</strong> (such as Microsoft Word, WordPerfect) to key in my lecture notes, tutorial questions, and lab exercises.</td>
<td>4.85</td>
<td>0.526</td>
<td>99.3</td>
</tr>
<tr>
<td>2.</td>
<td>I use <strong>presentation software</strong> (such as Microsoft PowerPoint) to prepare my presentation slides.</td>
<td>4.76</td>
<td>0.650</td>
<td>99.3</td>
</tr>
<tr>
<td>3.</td>
<td>I use <strong>spreadsheet</strong> (such as Microsoft Excel) to help me to calculate my students results.</td>
<td>4.74</td>
<td>0.728</td>
<td>98.0</td>
</tr>
<tr>
<td>4.</td>
<td>I use <strong>search tools</strong> (such as Google, Yahoo) to search for teaching material available I the Internet.</td>
<td>4.64</td>
<td>0.753</td>
<td>99.3</td>
</tr>
<tr>
<td>5.</td>
<td>I surf the <strong>Internet</strong> to look for teaching materials.</td>
<td>4.60</td>
<td>0.722</td>
<td>100</td>
</tr>
<tr>
<td>6.</td>
<td>I use <strong>LCD projector</strong> in my lecture.</td>
<td>4.59</td>
<td>0.889</td>
<td>98.7</td>
</tr>
<tr>
<td>7.</td>
<td>My teaching materials are available on the <strong>web</strong>.</td>
<td>4.17</td>
<td>1.315</td>
<td>90.7</td>
</tr>
<tr>
<td>8.</td>
<td>I communicate with my students using <strong>e-mail</strong>.</td>
<td>4.04</td>
<td>1.019</td>
<td>98.0</td>
</tr>
<tr>
<td>9.</td>
<td>I share my teaching materials with my peers by making the <strong>files sharable</strong>.</td>
<td>3.62</td>
<td>1.310</td>
<td>90.7</td>
</tr>
<tr>
<td>10.</td>
<td>I use <strong>digital library</strong> to look for materials related to my teaching and research.</td>
<td>3.56</td>
<td>1.320</td>
<td>89.4</td>
</tr>
<tr>
<td>11.</td>
<td>I post notices on <strong>online notice board</strong> for students to refer.</td>
<td>3.48</td>
<td>1.540</td>
<td>81.5</td>
</tr>
<tr>
<td>12.</td>
<td>I use <strong>HTML generator</strong> (such as Microsoft FrontPage, Macromedia Dreamweaver) to develop my web pages for students reference.</td>
<td>3.14</td>
<td>1.583</td>
<td>74.8</td>
</tr>
<tr>
<td>13.</td>
<td>I use <strong>Learning Management System</strong> (such as WebCT, Blackboard etc) to support my teaching.</td>
<td>2.89</td>
<td>1.717</td>
<td>62.9</td>
</tr>
<tr>
<td>14.</td>
<td>My students submitted their assignment to me through <strong>e-mail, ftp or e-assignment</strong>.</td>
<td>2.85</td>
<td>1.355</td>
<td>76.2</td>
</tr>
<tr>
<td>15.</td>
<td>I use <strong>scanner</strong> to scan in photos and documents to put into my teaching materials.</td>
<td>2.72</td>
<td>1.357</td>
<td>78.8</td>
</tr>
<tr>
<td>16.</td>
<td>I use <strong>courseware</strong> in my teaching.</td>
<td>2.54</td>
<td>1.478</td>
<td>62.9</td>
</tr>
<tr>
<td>17.</td>
<td>I use <strong>database application</strong> (such as Microsoft Access) to store my students personal information and results.</td>
<td>2.52</td>
<td>1.612</td>
<td>55.0</td>
</tr>
<tr>
<td>18.</td>
<td>I use <strong>online discussion forum</strong> for interaction between students and tutors.</td>
<td>2.35</td>
<td>1.511</td>
<td>53.6</td>
</tr>
<tr>
<td>19.</td>
<td>I use <strong>calendar tools</strong> (such as Microsoft Outlook) to plan my teaching activities.</td>
<td>2.17</td>
<td>1.478</td>
<td>47.7</td>
</tr>
<tr>
<td>20.</td>
<td>I use <strong>computer assisted assessment</strong> (such as Questionmark) for formative or summative assessment.</td>
<td>1.95</td>
<td>1.224</td>
<td>46.4</td>
</tr>
<tr>
<td>21.</td>
<td>I use <strong>online chat rooms</strong> to chat with my students.</td>
<td>1.84</td>
<td>1.223</td>
<td>40.4</td>
</tr>
<tr>
<td>22.</td>
<td>I use <strong>authoring tools</strong> (such as Macromedia Flash) to animate some of my teaching materials.</td>
<td>1.84</td>
<td>1.120</td>
<td>45.0</td>
</tr>
<tr>
<td>23.</td>
<td>My students use <strong>voice messages</strong> or voicemail to leave message to me.</td>
<td>1.58</td>
<td>1.086</td>
<td>28.5</td>
</tr>
<tr>
<td>24.</td>
<td>I deliver my lectures using <strong>streaming audio</strong> (such as digital audio delivered via the Web).</td>
<td>1.44</td>
<td>1.004</td>
<td>21.2</td>
</tr>
<tr>
<td>25.</td>
<td>I have meeting with my students using <strong>video conferencing</strong>.</td>
<td>1.26</td>
<td>0.761</td>
<td>13.2</td>
</tr>
</tbody>
</table>
The ICT tools which were considered sometimes used by respondents (mean value from 2.60 to 3.59) were digital libraries (Item 10), online notice boards (Item 11), Hyper Text Markup Language (HTML) generators (Item 12), LMS (Item 13), FTPs (Item 14), and scanners (Item 15). The total adoption of these tools varies from 63% to 89%.

Courseware (Item 16), database applications (Item 17), online discussion forums (Item 18), calendar tools (Item 19), computer assisted assessments (Item 20), online chat rooms (Item 21), and authoring tools (Item 22) were seldom used by respondents as indicated by the mean value 1.60 to 2.59. The total adoption of these tools varies from 40.4% to 63%. Authoring tools such as Macromedia Flash (Item 22) were seldom used by the respondents to animate their teaching materials. This indicates that most of the teaching materials had static, unanimated file content. The low level of usage of communication tools such as online chat rooms and online discussion boards could be the result of the common practice among the IS educators to discuss learning issues face to face with students during consultation hours. These ICT tools were categorised as not popularly used in teaching and learning among the respondents.

Voice messages (Item 23), streaming audio (Item 24), video conferencing (Item 25) and streaming video (Item 26) (distance learning solutions) were not used by the majority of the respondents. The mean values for the use of these ICT tools were less than 1.59 (minimum value is 1 = never). The total adoption of these tools varies from 13% to 29%. The low mean value could be the result of the common perception among IS educators...
that the ICT tools such as streaming video, video conferencing and streaming audio, were supposed to be used in distance learning education. Most of the students in the institutions sampled were full time and on-campus students. There is virtually no need for establishing a video conferencing session to conduct a lesson or for recording a lecture on streaming video or audio clip. Feedback from some of the respondents showed that video conferencing facilities available in the institution were to be used for administration purposes only. The use of these ICT tools in teaching and learning of IS is still relatively new in the Malaysian educational environment.

In general, the results of the survey shown the use of ICT tools among IS educators are normal. The type of ICT tools that are often used by IS educators are more towards gathering and searching information, as well as dissemination of learning content. The use of learning management tool, synchronous or asynchronous communication tool such as online discussion forum to support IS teaching is still lacking. It reflects that the ‘theme’ of ICT in IS instructions as ICT-enabled instructional methods in traditional settings. Table 4-3 also presents the diffusion results for the twenty six (26) software/tools. The diffusion results show that (a) ten (10) software/tools (word processing software, presentation software, spreadsheet, search tools, Internet, LCD projector, web, e-mail, files sharable, and digital libraries) have been adopted by Laggards (as indicated by more than 84% total adoption using Rogers’ adopter categories and innovation curve) in the IS instruction; (b) eight (8) software/tools (i.e. online notice board, HTML generator, LMS, ftp, scanner, courseware, database application, online discussion forum) have been adopted by the Late Majority in IS instructions (as indicated by 50% to 84% total adoption using Rogers’ adopter categories and innovation curve); (c) six (6) software/tools (i.e. streaming audio, voice messages, authoring tools, online chat rooms, computer assisted assessment, calendar
tools) that have been adopted by the Early Majority (as indicated by 16% to 50% total adoption using Rogers’ adopter categories and innovation curve); and (d) two (2) software/tools (i.e. video conferencing and streaming video) that have only diffused into the Early Adopters categories.

Table 4-3
Summary of ICT Tools Usage and its Rogers Innovation Adoption

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Usage</th>
<th>Rogers Innovation Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Word processing software</td>
<td>Always</td>
<td>Laggards</td>
</tr>
<tr>
<td>2.</td>
<td>Presentation software</td>
<td>Always</td>
<td>Laggards</td>
</tr>
<tr>
<td>3.</td>
<td>Spreadsheet</td>
<td>Always</td>
<td>Laggards</td>
</tr>
<tr>
<td>4.</td>
<td>Search tools</td>
<td>Always</td>
<td>Laggards</td>
</tr>
<tr>
<td>5.</td>
<td>The Internet</td>
<td>Always</td>
<td>Laggards</td>
</tr>
<tr>
<td>6.</td>
<td>LCD projector</td>
<td>Always</td>
<td>Laggards</td>
</tr>
<tr>
<td>7.</td>
<td>The web</td>
<td>Always</td>
<td>Laggards</td>
</tr>
<tr>
<td>8.</td>
<td>E-mail</td>
<td>Always</td>
<td>Laggards</td>
</tr>
<tr>
<td>9.</td>
<td>Files sharable</td>
<td>Always</td>
<td>Laggards</td>
</tr>
<tr>
<td>10.</td>
<td>Digital libraries</td>
<td>Sometimes</td>
<td>Laggards</td>
</tr>
<tr>
<td>11.</td>
<td>Online notice board</td>
<td>Sometimes</td>
<td>Late Majority</td>
</tr>
<tr>
<td>12.</td>
<td>HTML generator</td>
<td>Sometimes</td>
<td>Late Majority</td>
</tr>
<tr>
<td>13.</td>
<td>Learning Management System</td>
<td>Sometimes</td>
<td>Late Majority</td>
</tr>
<tr>
<td>14.</td>
<td>FTP</td>
<td>Sometimes</td>
<td>Late Majority</td>
</tr>
<tr>
<td>15.</td>
<td>Scanner</td>
<td>Sometimes</td>
<td>Late Majority</td>
</tr>
<tr>
<td>16.</td>
<td>Courseware</td>
<td>Seldom</td>
<td>Late Majority</td>
</tr>
<tr>
<td>17.</td>
<td>Database application</td>
<td>Seldom</td>
<td>Late Majority</td>
</tr>
<tr>
<td>18.</td>
<td>Online discussion forums</td>
<td>Seldom</td>
<td>Late Majority</td>
</tr>
<tr>
<td>19.</td>
<td>Calendar tools</td>
<td>Seldom</td>
<td>Early Majority</td>
</tr>
<tr>
<td>20.</td>
<td>Computer assisted assessment</td>
<td>Seldom</td>
<td>Early Majority</td>
</tr>
<tr>
<td>21.</td>
<td>Online chat rooms</td>
<td>Seldom</td>
<td>Early Majority</td>
</tr>
<tr>
<td>22.</td>
<td>Authoring tools</td>
<td>Seldom</td>
<td>Early Majority</td>
</tr>
<tr>
<td>23.</td>
<td>Voice messages</td>
<td>Rare</td>
<td>Early Majority</td>
</tr>
<tr>
<td>24.</td>
<td>Streaming audio</td>
<td>Rare</td>
<td>Early Majority</td>
</tr>
<tr>
<td>25.</td>
<td>Video conferencing</td>
<td>Rare</td>
<td>Early Adopters</td>
</tr>
<tr>
<td>26.</td>
<td>Streaming video</td>
<td>Rare</td>
<td>Early Adopters</td>
</tr>
</tbody>
</table>

(Icons accessed from http://twiki.org/cgi-bin/view/TWiki04x02/TWikiDocGraphics)
4.2.3. Other ICT Tools Used

Two open-ended questions were asked in order to gain an understanding of other ICT tools that were used by the respondents but were not listed in the questionnaire. The responses obtained are summarised in Table 4-4.

Table 4-4
Extent of other ICT tools Used in Teaching and Learning of IS

<table>
<thead>
<tr>
<th>ICT Tools</th>
<th>Mean*</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saba Centra: an online learning environment that combines a highly interactive virtual classroom learning, e-meeting, and web seminar platform with a learning content management system to deliver optimal blended learning. (<a href="http://www.saba.com/products/centra/">http://www.saba.com/products/centra/</a>)</td>
<td>4.7</td>
<td>5</td>
</tr>
<tr>
<td>Computer-Aided Software Engineering (CASE) tools: a computer-based product aimed at supporting one or more software engineering activities within a software development process. (<a href="http://www.sei.cmu.edu/legacy/case/case_whatis.html">http://www.sei.cmu.edu/legacy/case/case_whatis.html</a>)</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Yahoo! Group: offers free mailing lists, photo &amp; file sharing, group calendars and more. (<a href="http://groups.yahoo.com/">http://groups.yahoo.com/</a>)</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Short message service: a form of text messaging on mobile phones. (<a href="http://en.wikipedia.org/wiki/Short_message_service">http://en.wikipedia.org/wiki/Short_message_service</a>)</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

*‘Never’ = 1, ‘Seldom’ = 2, ‘Sometimes’ = 3, ‘Often’ = 4 and ‘Always’ = 5

4.2.4. CMI

CMI often refers to as a set of functionalities implemented in LMS (Costagliola et al., 2006). Based on findings in Table 4-2, LMS (Item 13) was sometimes used by the survey respondents with a mean of 2.89, and total adoption of 62.9% of the total respondents (the Late Majority using Rogers’ adopter categories). This reflects that 37.1% of the total respondents have never used an LMS. The percentage of IS respondents who rated their LMS usage as ‘Seldom’ is 8.6%, 14.6% of the IS respondents selected ‘Sometimes’ to reflect their LMS usage, 7.3% of the IS respondents rated their LMS usage as ‘Often’, and 32.5% of the IS respondents indicated their usage as ‘Always’ for LMS. The findings show that the LMS usage among the survey respondents is diverse, that ranges from ‘Never’ to ‘Always’. 
4.2.5. CAI

The characteristics of CAI can often be found in coursewares. Based on findings in Table 4-2, courseware (Item 16) was seldom used by the respondents with a mean of 2.54, and total adoption of 62.9% of the total respondents (the Late Majority using Rogers’ adopter categories). This reflects that 37.1% of the total respondents have never used courseware. The percentage of IS respondents who indicated their courseware usage as ‘Seldom’ is 15.2%, 19.2% of the IS respondents selected ‘Sometimes’ to reflect their courseware usage, 13.2% of the IS respondents rated their courseware usage as ‘Often’, and 15.2% of the IS respondents rated their courseware usage as ‘Always’.

4.2.6. CEI

CEI generally referred to simulation, modelling or programming. Authoring tools such as Macromedia Flash (Item 22) enable IS educators to create teaching materials with simulation. As shown in Table 4-2, authoring tools were seldom used by the respondents with a mean of 1.84, and total adoption of 45% of the total respondents (the Early Majority using Rogers’ adopter categories). This reflects that 55% of the total respondents have never used authoring tools for development of animated learning materials. The percentage of IS respondents who rated their authoring tools usage as ‘Seldom’ is 18.5%, 17.9% of the IS respondents selected ‘Sometimes’ to reflect their authoring tools usage, 4.6% of the IS respondents indicated their authoring tools usage as ‘Often’, and 4% of the IS respondents rated their usage as ‘Always’ for authoring tools.

4.2.7. Perceived Benefits of Using ICT Tools in IS Instructions

The respondents were asked to indicate their level of agreement on how ICT tools facilitated the IS instructional processes. The degree of agreement on the fourteen (14)
questionnaire items as a benefit in teaching and learning of IS were rated in terms of a Likert scale, starting from ‘no comment’ (if the respondent has never encountered the situation mentioned), to ‘Strongly disagree’, ‘Disagree’, ‘Slightly disagree’, ‘Slightly agree’, ‘Agree’ and ‘Strongly agree’. To get a clearer picture of the respondents’ agreement on an item as a benefit, those who responded with ‘Slightly agree’, ‘Agree’ or ‘Strongly agree’ for an item were put together to form a single ‘Agree’ category. Similarly, the responses ‘Slightly disagree’, ‘Disagree’ or ‘Strongly disagree’ for an item were grouped together to form a ‘Disagree’ category. The percentage for each category against the total number of responses was calculated. In calculating the mean and standard deviation, the following scores were used: ‘Strongly disagree’ = 1, ‘Disagree’ = 2, ‘Slightly disagree’ = 3, ‘Slightly agree’ = 4, ‘Agree’ = 5 and ‘Strongly agree’ = 6. The findings are detailed in Table 4-5.

<table>
<thead>
<tr>
<th>No</th>
<th>Items</th>
<th>Disagree Category (%)</th>
<th>No Comment (%)</th>
<th>Agree Category (%)</th>
<th>Mean*</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I refer to a wider range of resources to prepare teaching materials</td>
<td>5.3</td>
<td>0.0</td>
<td>94.7</td>
<td>5.29</td>
<td>0.837</td>
</tr>
<tr>
<td>2.</td>
<td>I amended and updated my teaching material easily</td>
<td>5.3</td>
<td>0.7</td>
<td>94.0</td>
<td>5.36</td>
<td>0.963</td>
</tr>
<tr>
<td>3.</td>
<td>My job satisfaction was increased using ICT tools</td>
<td>3.3</td>
<td>3.3</td>
<td>93.4</td>
<td>5.06</td>
<td>0.849</td>
</tr>
<tr>
<td>4.</td>
<td>I communicated with peers or students faster and more efficiently</td>
<td>5.9</td>
<td>2.0</td>
<td>92.1</td>
<td>5.06</td>
<td>0.927</td>
</tr>
<tr>
<td>5.</td>
<td>I tabulated and analysed my students’ results faster</td>
<td>3.9</td>
<td>5.3</td>
<td>90.8</td>
<td>5.22</td>
<td>0.883</td>
</tr>
<tr>
<td>6.</td>
<td>My students visualised and understood teaching material better using ICT supported illustration</td>
<td>6.0</td>
<td>6.0</td>
<td>88.0</td>
<td>4.86</td>
<td>0.935</td>
</tr>
<tr>
<td>7.</td>
<td>My students had shown their satisfaction with ICT supported teaching</td>
<td>4.7</td>
<td>10.6</td>
<td>84.7</td>
<td>4.76</td>
<td>0.851</td>
</tr>
<tr>
<td>8.</td>
<td>My time spent on administrative tasks is reduced by making routine information available online</td>
<td>14.5</td>
<td>4.0</td>
<td>81.5</td>
<td>4.50</td>
<td>1.442</td>
</tr>
<tr>
<td>9.</td>
<td>With multimedia features, my teaching materials have stimulated students’ interest in learning</td>
<td>5.3</td>
<td>13.2</td>
<td>81.5</td>
<td>4.66</td>
<td>0.951</td>
</tr>
<tr>
<td>10.</td>
<td>My students learned more independently using ICT tools</td>
<td>12.6</td>
<td>7.9</td>
<td>79.5</td>
<td>4.53</td>
<td>1.052</td>
</tr>
</tbody>
</table>
Table 4-5, continued

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11.</td>
<td>I took less time to search for teaching resources</td>
<td>23.9</td>
<td>0.0</td>
<td>76.1</td>
<td>4.43</td>
</tr>
<tr>
<td>12.</td>
<td>I monitored my students’ learning progress effectively</td>
<td>9.3</td>
<td>14.6</td>
<td>76.1</td>
<td>4.69</td>
</tr>
<tr>
<td>13.</td>
<td>Computer assisted assessment saved my time on marking</td>
<td>15.3</td>
<td>30.5</td>
<td>54.2</td>
<td>4.45</td>
</tr>
<tr>
<td>14.</td>
<td>My students learned to share learning issues effectively using online discussion board</td>
<td>15.8</td>
<td>31.1</td>
<td>53.1</td>
<td>4.11</td>
</tr>
</tbody>
</table>


In general, the respondents have positive perception towards ICT tools and agreed that the use of ICT tools in IS instructions has benefited themselves and their students. This is shown by the results of the survey where all the survey items have an ‘Agree’ score of more than 53% (mean = 4.11). Twelve (12) survey items has more than 70% of the respondents agreed on the statements.

4.2.8. Obstacles Towards the Use of ICT Tools in IS Instructional Processes

The IS educators sampled were asked about the obstacles they encountered in using ICT tools in IS instructional processes. In this regard, a total of twenty three (23) items were posed. The degree of agreement on the twenty three (23) items were rated in terms of a Likert scale, starting from ‘no comment’ (if the respondent has never encountered the situation mentioned), to “Strongly disagree”, ‘Disagree’, “Slightly disagree”, “Slightly agree”, ‘Agree’ and “Strongly agree”. To get a clearer picture of the respondents’ agreement on an item as a benefit, those who responded with “Slightly agree”, ‘Agree’ or “Strongly agree” for an item were put together to form a single ‘Agree’ category. Similarly, the responses “Slightly disagree”, ‘Disagree’ or “Strongly disagree” for an item were grouped together to form a ‘Disagree’ category. The percentage for each category against the total number of responses was calculated. In calculating the mean and standard deviation, the following scores were used: “Strongly disagree” = 1, ‘Disagree’ = 2, “Slightly disagree” = 3, “Slightly agree” = 4, ‘Agree’ = 5 and “Strongly
agree” = 6. The calculated percentage value for each item is ordered by the highest value of ‘Agree’ category as shown in Table 4-6. The five uppermost obstacles have ‘Agree’ values which range from 37% to 57%. They are:

i. ICT tools are changing too fast to keep current (57%, mean = 3.74);

ii. I had to spend extra time and effort in teaching after integrating ICT tools in teaching (41.7%, mean = 3.20);

iii. The management did not provide any incentive for lecturers to integrate ICT tools in their teaching (38.5%, mean = 3.20);

iv. The network connectivity was poor (38.4%, mean = 3.17);

v. The management did not have any evaluation on integration of ICT tools in teaching (37%, mean = 3.14).

As such, the obstacles perceived by the IS educators in this study are as follows:

i. ICT tools are changing too fast to keep current: It is well known that ICT is one of the fastest changing fields. Every year, new models of hardware with higher processing power and with new and enhanced features are unveiled. The same applies to software, where new versions of operating systems or application software are released with enhanced features. To be knowledgeable and sustainable in this field, IS educators have to keep abreast with the latest developments in the hardware and software available in the market. This poses a great challenge to IS educators in managing their time for teaching, administration, research and acquiring new knowledge.

ii. Extra time and effort is needed after integrating ICT tools in teaching: With the ever changing ICT environment, IS educators need extra time and effort to manage the use of ICT for instructions. For instance, using w-portfolio among students required time and good ICT infrastructure. A good computer network at high speed access of
uploading and downloading the project is vital. Educators have to tackle the problems that arise such as downloading student report files from student’s portfolio with low bandwidth and/or unstable network, and manage the downloaded files. Morgan (2003) also reported that time expenditure is a factor that frequently contributed to some faculty’s reducing their ICT tools usage.

iii. Management did not provide any incentive for lecturers to integrate ICT tools in their teaching: For the institutions of higher education involved in the study, it was found that rarely any recognition and incentive was given to IS educators who successfully integrated ICT tools in teaching. The same finding was shared by Spotts (1999). Teaching has been viewed as educators’ responsibility. The guidelines on the use of ICT tools in teaching are shallow. Not many educators would spare their time on exploring the use of new ICT tools in teaching in higher education except for research purpose. Personal job satisfaction is the only driving force for IS educators who practice ICT tools in teaching. These IS educators value the benefits of using ICT tools in teaching. They are persistent in using ICT tools in teaching even if the institutions do not support these tools.

iv. Network connectivity was poor: The respondents selected “Network connectivity was poor” as the network connectivity was not reliable and it could be disconnected anytime without prior notice. The network response time is not constant and could have large variances. The reasons for a network being disconnected could be due to web server maintenance, virus or hacker attacks, or cabling problems. Frequent disconnections were rather frustrating and de-motivating to the users. The results from the second section of the same questionnaire revealed that the ICT tools used frequently by IS educators are e-mail, search engines, and Internet browsers. These tools require consistent network connectivity to ensure its usage.
<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Disagree Category (%)</th>
<th>No Comment (%)</th>
<th>Agree Category (%)</th>
<th>Mean*</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ICT tools are changing too fast to keep current</td>
<td>38.4</td>
<td>4.6</td>
<td>57.0</td>
<td>3.74</td>
<td>1.476</td>
</tr>
<tr>
<td>2.</td>
<td>I had to spend extra time and effort in teaching after integrating ICT tools in teaching</td>
<td>56.3</td>
<td>2.0</td>
<td>41.7</td>
<td>3.20</td>
<td>1.528</td>
</tr>
<tr>
<td>3.</td>
<td>The management did not provide any incentive for lecturers to integrate ICT tools in their teaching</td>
<td>48.9</td>
<td>12.6</td>
<td>38.5</td>
<td>3.20</td>
<td>1.571</td>
</tr>
<tr>
<td>4.</td>
<td>The network connectivity was poor</td>
<td>59.0</td>
<td>2.6</td>
<td>38.4</td>
<td>3.17</td>
<td>1.435</td>
</tr>
<tr>
<td>5.</td>
<td>The management did not have any evaluation on integration of ICT tools in teaching</td>
<td>52.4</td>
<td>10.6</td>
<td>37.0</td>
<td>3.14</td>
<td>1.589</td>
</tr>
<tr>
<td>6.</td>
<td>The ICT tools were not always reliable</td>
<td>58.9</td>
<td>4.6</td>
<td>36.5</td>
<td>3.00</td>
<td>1.364</td>
</tr>
<tr>
<td>7.</td>
<td>I have had problems getting quality training program</td>
<td>56.9</td>
<td>11.9</td>
<td>31.2</td>
<td>2.92</td>
<td>1.341</td>
</tr>
<tr>
<td>8.</td>
<td>There is no long term staff development to support the integration of technology into instruction</td>
<td>58.3</td>
<td>11.9</td>
<td>29.8</td>
<td>2.96</td>
<td>1.339</td>
</tr>
<tr>
<td>9.</td>
<td>Some of my peers have failed to integrate ICT tools in their teaching</td>
<td>55.7</td>
<td>16.6</td>
<td>27.7</td>
<td>2.81</td>
<td>1.367</td>
</tr>
<tr>
<td>10.</td>
<td>I have had difficulty getting support from technical staff.</td>
<td>67.5</td>
<td>5.3</td>
<td>27.2</td>
<td>2.69</td>
<td>1.258</td>
</tr>
<tr>
<td>11.</td>
<td>The hardware available was not sufficient to accommodate ICT supported teaching.</td>
<td>66.8</td>
<td>6.0</td>
<td>27.2</td>
<td>2.69</td>
<td>1.354</td>
</tr>
<tr>
<td>12.</td>
<td>The software available was not sufficient to accommodate ICT supported teaching.</td>
<td>64.2</td>
<td>9.3</td>
<td>26.5</td>
<td>2.82</td>
<td>1.389</td>
</tr>
<tr>
<td>13.</td>
<td>Certain software was difficult to learn and use</td>
<td>53.7</td>
<td>21.2</td>
<td>25.1</td>
<td>2.88</td>
<td>1.354</td>
</tr>
<tr>
<td>14.</td>
<td>The management did not provide any clear instruction on how to integrate ICT tools in my teaching.</td>
<td>64.0</td>
<td>11.3</td>
<td>24.7</td>
<td>2.69</td>
<td>1.368</td>
</tr>
<tr>
<td>15.</td>
<td>The hardware available was too outdated to accommodate ICT supported teaching.</td>
<td>73.4</td>
<td>5.3</td>
<td>21.3</td>
<td>2.57</td>
<td>1.257</td>
</tr>
<tr>
<td>16.</td>
<td>The management did not initiate any program (such as seminars and workshops) to encourage ICT supported teaching.</td>
<td>72.1</td>
<td>7.3</td>
<td>20.6</td>
<td>2.46</td>
<td>1.316</td>
</tr>
<tr>
<td>17.</td>
<td>Students lacked ICT skills.</td>
<td>78.8</td>
<td>0.7</td>
<td>20.5</td>
<td>2.48</td>
<td>1.235</td>
</tr>
<tr>
<td>18.</td>
<td>The software available was too outdated to accommodate ICT supported teaching.</td>
<td>72.2</td>
<td>10.6</td>
<td>17.2</td>
<td>2.55</td>
<td>1.164</td>
</tr>
<tr>
<td>19.</td>
<td>The management did not have any vision on integration of ICT tools in teaching.</td>
<td>73.5</td>
<td>11.3</td>
<td>15.2</td>
<td>2.16</td>
<td>1.276</td>
</tr>
<tr>
<td>20.</td>
<td>My peers have been giving negative comments about using ICT tools.</td>
<td>74.2</td>
<td>11.9</td>
<td>13.9</td>
<td>2.25</td>
<td>1.264</td>
</tr>
<tr>
<td>21.</td>
<td>Students had negative attitude towards ICT supported teaching.</td>
<td>83.5</td>
<td>4.6</td>
<td>11.9</td>
<td>2.22</td>
<td>1.093</td>
</tr>
<tr>
<td>22.</td>
<td>Students gave negative feedback on ICT supported teaching.</td>
<td>84.1</td>
<td>4.6</td>
<td>11.3</td>
<td>2.21</td>
<td>1.188</td>
</tr>
<tr>
<td>23.</td>
<td>I found myself difficult to change from my current teaching practice to integrate ICT tools in teaching.</td>
<td>83.4</td>
<td>6</td>
<td>10.6</td>
<td>2.15</td>
<td>1.232</td>
</tr>
</tbody>
</table>
v. Management did not have any evaluation on integration of ICT tools in teaching:

Evaluation of educators plays an important role in assessing and providing feedback on job performance. It is also often one of the important criteria for promotion. From the result, there is no detailed evaluation done on the educator’s use of ICT tools in teaching and learning of IS. Lack of this evaluation activity indicates that the institution does not value the effort put into using ICT tools in teaching.

Factor analysis on the twenty-three (23) ‘obstacles’ statements was conducted to determine if there were any underlying factors within the data (Table 4-7). The factor analysis was conducted using the principle component method of extraction and varimax rotation. It was decided that for an item to load on a factor, it must have a minimum absolute value of 0.45 and must not have loaded on another factor at an absolute value of 0.45 or greater. The 23 items were reduced to six (6) factors, which accounted for 67.9% of the variance. The factors detailed in Table 4-7 are namely (a) change management; (b) equipment readiness; (c) peer and students influence; (d) reliability of support; (e) ease of learning; and (f) personal enthusiasm.

Another main finding of this study is that six factors emerged from factor analysis. Four of the factors had multiple loadings. Item such as “there is no long term staff development to support the integration of technology into instruction” (statement 8), “some of my peers have failed to integrate ICT tools in their teaching” (statement 9), and “the software available was not sufficient to accommodate ICT supported teaching” (statement 12) – with loaded above 0.45 on two factors and therefore was not considered to load significantly on any factor. These results indicate that there is an underlying relationship between the items. Each of the factors is described in Table 4-8.
<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
<th>Factor 5</th>
<th>Factor 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>I had to spend extra time and effort in teaching after integrating ICT tools in teaching.</td>
<td>0.063</td>
<td>-0.054</td>
<td>0.077</td>
<td>0.094</td>
<td>0.092</td>
<td>0.832</td>
</tr>
<tr>
<td>I found myself difficult to change from my current teaching practice to integrate ICT tools in teaching.</td>
<td>0.063</td>
<td>0.294</td>
<td>0.249</td>
<td>-0.173</td>
<td>0.188</td>
<td>0.667</td>
</tr>
<tr>
<td>Certain software (such as Macromedia Flash) was difficult to learn and use.</td>
<td>0.284</td>
<td>0.080</td>
<td>0.084</td>
<td>0.127</td>
<td>0.731</td>
<td>0.196</td>
</tr>
<tr>
<td>ICT tools are changing too fast to keep current.</td>
<td>-0.050</td>
<td>0.329</td>
<td>0.136</td>
<td>0.075</td>
<td>0.654</td>
<td>0.080</td>
</tr>
<tr>
<td>My peers have been giving negative comments about using ICT tools.</td>
<td>0.226</td>
<td>0.099</td>
<td>0.552</td>
<td>-0.022</td>
<td>0.371</td>
<td>0.073</td>
</tr>
<tr>
<td>Some of my peers have failed to integrate ICT tools in their teaching.</td>
<td>0.181</td>
<td>-0.028</td>
<td>0.508</td>
<td>0.103</td>
<td>0.540</td>
<td>-0.090</td>
</tr>
<tr>
<td>The management did not have any vision on integration of ICT tools in teaching.</td>
<td>0.742</td>
<td>0.290</td>
<td>0.287</td>
<td>-0.161</td>
<td>0.115</td>
<td>0.070</td>
</tr>
<tr>
<td>The management did not provide any clear instruction on how to integrate ICT tools in my teaching.</td>
<td>0.723</td>
<td>0.194</td>
<td>0.275</td>
<td>0.077</td>
<td>0.256</td>
<td>-0.195</td>
</tr>
<tr>
<td>The management did not provide any incentive for lecturers to integrate ICT tools in their teaching.</td>
<td>0.781</td>
<td>0.012</td>
<td>0.221</td>
<td>0.247</td>
<td>0.083</td>
<td>0.086</td>
</tr>
<tr>
<td>The management did not initiate any program (such as seminars and workshops) to encourage ICT supported teaching.</td>
<td>0.791</td>
<td>0.165</td>
<td>0.166</td>
<td>0.080</td>
<td>0.153</td>
<td>0.092</td>
</tr>
<tr>
<td>The management did not have any evaluation on integration of ICT tools in teaching.</td>
<td>0.750</td>
<td>0.048</td>
<td>0.041</td>
<td>0.305</td>
<td>0.003</td>
<td>0.109</td>
</tr>
<tr>
<td>Students had negative attitude towards ICT supported teaching.</td>
<td>0.234</td>
<td>0.113</td>
<td>0.819</td>
<td>0.016</td>
<td>0.098</td>
<td>0.059</td>
</tr>
<tr>
<td>Students lacked ICT skills.</td>
<td>0.113</td>
<td>0.153</td>
<td>0.699</td>
<td>0.128</td>
<td>0.170</td>
<td>0.179</td>
</tr>
<tr>
<td>Students gave negative feedback on ICT supported teaching.</td>
<td>0.161</td>
<td>0.101</td>
<td>0.780</td>
<td>0.254</td>
<td>-0.122</td>
<td>0.109</td>
</tr>
<tr>
<td>I have had problems getting quality training program.</td>
<td>0.191</td>
<td>0.050</td>
<td>0.019</td>
<td>0.464</td>
<td>0.534</td>
<td>0.173</td>
</tr>
<tr>
<td>I have had difficulty getting support from technical staff.</td>
<td>0.340</td>
<td>0.091</td>
<td>0.214</td>
<td>0.528</td>
<td>0.113</td>
<td>0.342</td>
</tr>
<tr>
<td>There is no long term staff development to support the integration of technology into instruction.</td>
<td>0.471</td>
<td>0.335</td>
<td>0.038</td>
<td>0.489</td>
<td>0.162</td>
<td>0.110</td>
</tr>
<tr>
<td>The software available was not sufficient to accommodate ICT supported teaching.</td>
<td>0.322</td>
<td>0.515</td>
<td>0.073</td>
<td>0.489</td>
<td>0.375</td>
<td>0.125</td>
</tr>
<tr>
<td>The software available was too outdated to accommodate ICT supported teaching.</td>
<td>0.182</td>
<td>0.696</td>
<td>0.120</td>
<td>0.246</td>
<td>0.290</td>
<td>0.194</td>
</tr>
<tr>
<td>The hardware available was not sufficient to accommodate ICT supported teaching.</td>
<td>0.117</td>
<td>0.880</td>
<td>0.098</td>
<td>0.188</td>
<td>0.049</td>
<td>0.056</td>
</tr>
<tr>
<td>The hardware available was too outdated to accommodate ICT supported teaching.</td>
<td>0.199</td>
<td>0.819</td>
<td>0.164</td>
<td>0.203</td>
<td>0.064</td>
<td>-0.040</td>
</tr>
<tr>
<td>The network connectivity was poor.</td>
<td>0.017</td>
<td>0.337</td>
<td>0.133</td>
<td>0.725</td>
<td>0.041</td>
<td>-0.145</td>
</tr>
<tr>
<td>The ICT tools were not always reliable.</td>
<td>0.194</td>
<td>0.348</td>
<td>0.175</td>
<td>0.589</td>
<td>0.244</td>
<td>-0.121</td>
</tr>
</tbody>
</table>
Table 4-8
Summary of Factor Analysis for Obstacles Towards the Use of ICT tools in IS Instructional Processes

<table>
<thead>
<tr>
<th>Factors</th>
<th>Items loaded on the factor</th>
<th>Description</th>
</tr>
</thead>
</table>
| Factor #1: Change management | • The management did not have any vision on integration of ICT tools in teaching (0.742)  
• The management did not provide any clear instruction on how to integrate ICT tools in my teaching (0.723)  
• The management did not provide any incentive for lecturers to integrate ICT tools in their teaching (0.781)  
• The management did not have any evaluation on integration of ICT tools in teaching (0.750)  
• The management did not initiate any program (such as seminar and workshop) to encourage ICT supported teaching. (0.791) | This factor accounted for 16.3% of the explained variance. Individuals who score high on this factor want the deans and heads to play an active role in the change process. They want the deans in the institution to provide direction, clear instruction, proper evaluation and incentives during implementation. |
| Factor #2: Equipment readiness | • The software available was too outdated to accommodate ICT supported teaching (0.696)  
• The hardware available was not sufficient to accommodate ICT supported teaching (0.88)  
• The hardware available was too outdated to accommodate ICT supported teaching (0.819) | This factor explained 12.9% of the total variance. Individuals scoring high on this factor view equipment as an important variable in the implementation process. Before integrating ICT tools in teaching, lecturers want to know if the equipments are in place. |
| Factor #3: Peer and students influence | • My peers have been giving negative comments about using ICT tools (0.552)  
• Students had negative attitude towards ICT supported teaching (0.819)  
• Students lacked ICT skills (0.699)  
• Students gave negative feedback on ICT supported teaching (0.780) | This factor contributed 12.2% of the total variance explained. Individuals who score high on this factor are concerned about peer comments, students’ ICT skills, feedback and attitude on ICT tools support teaching. Lecturers will be more likely to integrate ICT tools in teaching if their students give good feedback on ICT tools used in teaching, and have the ICT skills and willing to learn using ICT tools. They would like to hear positive comments on ICT tools integration from peers as well. |
| Factor #4: Reliability of support | • I have had difficulty getting support from technical staff (0.528)  
• The network connectivity was poor (0.725)  
• The ICT tools were not always reliable (0.589) | This factor explained 10.1% of the total variance of the combined factors. Individuals who score high on this factor would like to know if there are technical staff support, reliable network connection as well as reliable ICT tools if they use ICT tools in teaching. |
| Factor #5: Ease of learning | • Certain software (such as Macromedia Flash) was difficult to learn and use (0.731)  
• ICT tools are changing too fast to keep current (0.654) | This factor explained 9.6% of the total variance. Individuals scoring high on this factor are concerned about the difficulty of learning and the rate of change of ICT tools. They will be more likely to use those ICT tools which are user friendly and where the rate of change is low. |
4.2.9. Factors That Contribute to the Successful Use of ICT tools in IS Instructional Processes

The IS educators sampled were asked to indicate their level of agreement on twenty (20) statements that describe the factors contributing to the successful use of ICT tools in IS instructional processes. Similarly the level of agreement ranges from “Strongly disagree” (1) to “Strongly agree” (6). To get a clearer picture of the respondents’ agreement on an item as a contributing factor, those who responded with ‘Slightly agree’, ‘Agree’ or ‘Strongly agree’ for an item were put together to form a single ‘Agree’ category. Likewise, the responses ‘Slightly disagree’, ‘Disagree’ or ‘Strongly disagree’ for an item were grouped together to form a ‘Disagree’ category. The percentage for each category against the total number of responses was calculated. The calculated percentage value for each item is arranged in descending value of ‘Agree’ category as shown in Table 4-9. The five uppermost contributing factors have ‘Agree’ values that range from 76.2% to 94%. They are:

i. My enthusiasm towards ICT supported teaching was high (94%, mean = 5.02);

ii. Some of my peers have successfully integrated ICT tools into their teaching (86%, mean = 4.93);

iii. Students had positive attitude towards ICT supported teaching (86%, mean = 4.55);

iv. My peers have been encouraging me to use ICT tools (78.2%, mean = 4.53);

v. The management had clear vision on integration of ICT tools in teaching (76.2%, mean = 4.56).
Table 4-9
Factors that Contribute to the Successful Use of ICT Tools in IS Instructional Processes (n=151)

<table>
<thead>
<tr>
<th>No</th>
<th>Items</th>
<th>Disagree Category (%)</th>
<th>No Comment (%)</th>
<th>Agree Category (%)</th>
<th>Mean*</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>My enthusiasm towards ICT supported teaching was high</td>
<td>6.0</td>
<td>0.0</td>
<td>94.0</td>
<td>5.02</td>
<td>0.844</td>
</tr>
<tr>
<td>2.</td>
<td>Some of my peers have successfully integrated ICT tools into their teaching</td>
<td>8.0</td>
<td>6.0</td>
<td>86.0</td>
<td>4.93</td>
<td>0.943</td>
</tr>
<tr>
<td>3.</td>
<td>Students had positive attitude towards ICT supported teaching</td>
<td>10.7</td>
<td>3.3</td>
<td>86.0</td>
<td>4.55</td>
<td>0.969</td>
</tr>
<tr>
<td>4.</td>
<td>My peers have been encouraging me to use ICT tools</td>
<td>13.8</td>
<td>8.0</td>
<td>78.2</td>
<td>4.53</td>
<td>1.169</td>
</tr>
<tr>
<td>5.</td>
<td>The management had clear vision on integration of ICT tools in teaching</td>
<td>15.2</td>
<td>8.6</td>
<td>76.2</td>
<td>4.56</td>
<td>1.153</td>
</tr>
<tr>
<td>6.</td>
<td>I spent less time and effort to prepare my teaching</td>
<td>23.8</td>
<td>0.7</td>
<td>75.5</td>
<td>4.37</td>
<td>1.359</td>
</tr>
<tr>
<td>7.</td>
<td>Students have given positive feedback on ICT supported teaching</td>
<td>15.9</td>
<td>9.3</td>
<td>74.8</td>
<td>4.38</td>
<td>1.058</td>
</tr>
<tr>
<td>8.</td>
<td>The software was up to date to accommodate ICT supported teaching</td>
<td>19.9</td>
<td>7.2</td>
<td>72.9</td>
<td>4.24</td>
<td>1.110</td>
</tr>
<tr>
<td>9.</td>
<td>The software was sufficient to accommodate ICT supported teaching</td>
<td>21.1</td>
<td>6.0</td>
<td>72.9</td>
<td>4.18</td>
<td>1.163</td>
</tr>
<tr>
<td>10.</td>
<td>I was getting good support from technical staff</td>
<td>23.1</td>
<td>4.6</td>
<td>72.3</td>
<td>4.17</td>
<td>1.165</td>
</tr>
<tr>
<td>11.</td>
<td>The hardware was up to date to accommodate ICT supported teaching</td>
<td>22.5</td>
<td>6.0</td>
<td>71.5</td>
<td>4.25</td>
<td>1.112</td>
</tr>
<tr>
<td>12.</td>
<td>The hardware was sufficient to accommodate ICT supported teaching</td>
<td>23.2</td>
<td>6.0</td>
<td>70.8</td>
<td>4.20</td>
<td>1.150</td>
</tr>
<tr>
<td>13.</td>
<td>The management initiated programs to encourage ICT supported teaching</td>
<td>21.8</td>
<td>9.3</td>
<td>68.9</td>
<td>4.20</td>
<td>1.242</td>
</tr>
<tr>
<td>14.</td>
<td>The network connectivity was good</td>
<td>34.4</td>
<td>2.6</td>
<td>63.0</td>
<td>3.82</td>
<td>1.453</td>
</tr>
<tr>
<td>15.</td>
<td>Students had received training on ICT tools</td>
<td>24.5</td>
<td>13.9</td>
<td>61.6</td>
<td>4.03</td>
<td>1.161</td>
</tr>
<tr>
<td>16.</td>
<td>The management provided clear instruction on how to integrate ICT tools in teaching</td>
<td>29.7</td>
<td>9.3</td>
<td>61.0</td>
<td>4.09</td>
<td>1.333</td>
</tr>
<tr>
<td>17.</td>
<td>There is a long term staff development to support the integration of technology into instruction</td>
<td>29.1</td>
<td>11.3</td>
<td>59.6</td>
<td>4.02</td>
<td>1.253</td>
</tr>
<tr>
<td>18.</td>
<td>A committee was set up to plan, coordinate, and evaluate ICT tools integration in teaching</td>
<td>25.2</td>
<td>19.2</td>
<td>55.6</td>
<td>4.02</td>
<td>1.345</td>
</tr>
<tr>
<td>19.</td>
<td>I was given quality training program</td>
<td>39.1</td>
<td>10.6</td>
<td>50.3</td>
<td>3.67</td>
<td>1.298</td>
</tr>
<tr>
<td>20.</td>
<td>The management provided incentives for lecturers to integrate ICT tools in their teaching.</td>
<td>46.4</td>
<td>9.9</td>
<td>43.7</td>
<td>3.56</td>
<td>1.408</td>
</tr>
</tbody>
</table>

As such, the factors that contribute to the successful use of ICT tools to support IS instructional processes are as follows:

i. Personal enthusiasm: In the Malaysian higher education scene, new technology innovations to improve teaching are implemented on a “voluntary” basis. Different IS educators could use different methods to convey the knowledge, and might choose to use certain ICT tools that they prefer for preparation and delivery of lessons. There are no rules and regulations on using ICT tools in teaching. Personal enthusiasm is the only powerful driving force for IS educators to embark on and to continue using ICT tools in teaching. This is true since there is rarely a reward for successfully use of ICT tools in teaching. The common features of ICT tools that promote their enthusiasm to use them are that the ICT tools must be user friendly, meet their requirements to support instructions and benefit educators in terms of increasing teaching efficiency.

ii. Peer success stories: It is rather common that IS educators would not use a new ICT tool unless it has been proven workable in the faculty. Peer success in using ICT tools is crucial to attract more IS educators to use the ICT tools in teaching. The success proves that the ICT tool works well in their faculty setting. The success also indicates that there exist mentors in the faculty that they know and are comfortable with discussing issues on using the ICT tool to support instructions. The mentors could inform peers about the benefits and limitations of the ICT tools in teaching and learning of IS. The same finding was shared by Staman (1990). Livingston (2003) found that peer mentoring is the most effective means of generating real enthusiasm for new teaching methods and tools.

iii. Student attitudes: In the teaching and learning process, the involvement of IS educators alone is not enough to ensure the ICT tools integration. Students also play an important role. Students with positive attitudes towards ICT supported teaching
and learning would take the responsibility of using ICT tools in learning. The demands for ICT supported teaching from students could further boost the use of ICT tools in IS.

iv. Peer encouragement: Livingston (2003) stated that faculty members accept new information most easily from each other. Encouragement from peers could significantly raise the interest of IS educators in using ICT tools in teaching because they know each other. They share their knowledge whenever they discover the benefits of an ICT tool in supporting teaching. They are willing to demonstrate how to use the ICT tool and generally encourage each other to use new technology. The encouragement from peers would have significant positive impact on IS educators to use an ICT tool in teaching and learning.

v. Clear management vision: The vision of an institution was set to lead the institution to achieve excellence in quality of education. This vision could serve as a directive. If there is an ICT vision, it has to be channelled to all educators. A clear vision on integration of ICT tools in teaching and learning would affect how IS educators perceive the value of integrating ICT tools in their teaching, and subsequently affect the amount of effort and time the IS educators are willing to spend on it. This will also affect the willingness of the educators to explore new ICT tools and try to integrate them in teaching (Spotts, 1999). One respondent commented that his institution had set a clear vision on ICT tools integration. The management would take action to improve the ICT tools usage whenever it is found to be low. There is a routine check by management to ensure that the institution always meets the ICT vision. As a result, a majority of the educators in the institution use ICT tools in teaching and learning.
Factor analysis on the twenty (20) ‘contributing factors’ statements was conducted to determine if there were any underlying factors within the data (Table 4-10). The factor analysis was conducted using the principle component method of extraction and varimax rotation. It was decided that for an item to load on a factor, it must have a minimum absolute value of 0.45 and must not have loaded on another factor at an absolute value of 0.45 or greater. The 20 items were reduced to four factors, which accounted for 66.7% of the variance. The four (4) factors are namely (a) change management; (b) equipment readiness; (c) peer influence and personal enthusiasm; and (d) students learning power. A description of each factor is presented in Table 4-11.
Table 4-10
Coefficient Loading of Items for Factors that Contribute to the Successful Use of ICT Tools in IS Instructional Processes

<table>
<thead>
<tr>
<th>Items</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>I spent less time and effort to prepare my teaching after integrating ICT tools in teaching.</td>
<td>0.096</td>
</tr>
<tr>
<td>My enthusiasm towards ICT supported teaching was high.</td>
<td>-0.17</td>
</tr>
<tr>
<td>My peers have been encouraging me to use ICT tools.</td>
<td>0.332</td>
</tr>
<tr>
<td>Some of my peers have successfully integrated ICT tools into their teaching.</td>
<td>0.366</td>
</tr>
<tr>
<td>The management had clear vision on integration of ICT tools in teaching.</td>
<td>0.722</td>
</tr>
<tr>
<td>The management provided clear instruction on how to integrate ICT tools in teaching.</td>
<td>0.778</td>
</tr>
<tr>
<td>The management provided incentives for lecturers to integrate ICT tools in their teaching.</td>
<td>0.691</td>
</tr>
<tr>
<td>The management initiated programs (such as seminar and workshop) to encourage ICT supported teaching.</td>
<td>0.811</td>
</tr>
<tr>
<td>A committee was set up to plan, coordinate, and evaluates ICT tools integration in teaching.</td>
<td>0.842</td>
</tr>
<tr>
<td>Students had positive attitude towards ICT supported teaching.</td>
<td>0.204</td>
</tr>
<tr>
<td>Students had received training on ICT tools.</td>
<td>0.431</td>
</tr>
<tr>
<td>Students have given positive feedback on ICT supported teaching.</td>
<td>0.164</td>
</tr>
<tr>
<td>I was given quality training program.</td>
<td>0.634</td>
</tr>
<tr>
<td>I was getting good support from technical staff.</td>
<td>0.385</td>
</tr>
<tr>
<td>There is a long term staff development to support the integration of technology into instruction.</td>
<td>0.512</td>
</tr>
<tr>
<td>The software was sufficient to accommodate ICT supported teaching.</td>
<td>0.290</td>
</tr>
<tr>
<td>The software was up to date to accommodate ICT supported teaching.</td>
<td>0.337</td>
</tr>
<tr>
<td>The hardware was sufficient to accommodate ICT supported teaching.</td>
<td>0.211</td>
</tr>
<tr>
<td>The hardware was up to date to accommodate ICT supported teaching.</td>
<td>0.227</td>
</tr>
<tr>
<td>The network connectivity was good.</td>
<td>0.033</td>
</tr>
</tbody>
</table>
## Table 4-11
Summary of Factor Analysis for Factors that Contribute to the Successful Use of ICT Tools in IS Instructional Processes

<table>
<thead>
<tr>
<th>Factors</th>
<th>Items that loaded on the factor</th>
<th>Description</th>
</tr>
</thead>
</table>
| Factor #1: Change Management | • The management had clear vision on integration of ICT tools in teaching (0.722)  
• The management provided clear instruction on how to integrate ICT tools in teaching (0.778)  
• The management provided incentives for lecturers to integrate ICT tools in their teaching (0.691)  
• The management initiated programs (such as seminars and workshops) to encourage ICT supported teaching (0.811)  
• A committee was set up to plan, coordinate, and evaluate ICT tools integration in teaching (0.842)  
• I was given quality training program (0.634)  
• There is a long term staff development to support the integration of technology into instruction (0.512) | This factor accounted for 22.9% of the explained variance. Individuals who score high on this factor want the deans and heads to play an active role in the change process. They want the deans in the institution to provide direction, clear instruction, integration master plans and programs for training, evaluation and incentives during implementation. |
| Factor #2: Equipment readiness | • The software was sufficient to accommodate ICT supported teaching (0.851)  
• The software was up to date to accommodate ICT supported teaching (0.850)  
• The hardware was sufficient to accommodate ICT supported teaching (0.911)  
• The hardware was up to date to accommodate ICT supported teaching (0.887)  
• The network connectivity was good (0.552) | This factor explained 20.9% of the total variance. Individuals scoring high on this factor view equipment and infrastructure as important variables in the implementation process. Before integrating ICT tools in teaching, lecturers want to know if the equipment and infrastructure are in place and in good condition. |
| Factor #3: Peer influence and personal enthusiasm | • I spent less time and effort to prepare my teaching after integrating ICT tools in teaching (0.707)  
• My enthusiasm towards ICT supported teaching was high (0.656)  
• My peers have been encouraging me to use ICT tools (0.704),  
• Some of my peers have successfully integrated ICT tools into their teaching (0.601) | This factor contributed 13.2% of the total variance explained. Individuals who score high on this factor are concerned about encouragement and success stories of peers. They have to know the benefits of using ICT tools and their own interest in using such tools in teaching. |
| Factor #4: Students learning power | • Students had positive attitude towards ICT supported teaching (0.777)  
• Students had received training on ICT tools (0.550)  
• Students have given positive feedback on ICT supported teaching (0.813) | This factor explained 9.7% of the total variance of the combined factors. Individuals who score high on this factor are concerned about students’ ICT skills, feedback and attitude on ICT tools-supported teaching. They will be more likely to use ICT tools in teaching if their students give good feedback, have the ICT skills and attitude to learn how to use ICT tools. |
4.3. Findings of the Interviews

This section presents findings derived from the analysis of the data obtained from interviewing six (6) IS educators from two different universities in the Klang Valley, Malaysia. These educators who were earlier sampled in the initial survey expressed their willingness to participate in the interview. Their demographic information is presented in Table 4-12. Each interview took approximately one and a half hour. The interview was carried out in the educator’s respective office. The interviews were carried out using a set of seven (7) open-ended questions, organized into a semi-structured questionnaire. The questions posed were:

i. What kind of learning activities you arrange for students in IS courses and how ICT has helped you in this?

ii. How do you manage the learning activities?

iii. How do you use ICT to support IS instructions?

iv. How do you find about the system or tools that you are using?

v. Do you use any specific systems or computer tools such as CAI, CMI or CEI to support IS instructions?

vi. What would you like to see on a system with a CAI, CMI or CEI elements?

vii. How would you like to use a tool that meets your needs to support instruction?

Interview notes were manually taken and transcribed. The extended field notes were then verified with the IS educators in the process of “member checking” to facilitate credibility of responses. All errors, inaccuracies and omissions in the transcript were corrected.
Table 4-12
Demographic Information of IS Educators Involved

<table>
<thead>
<tr>
<th>Gender &amp; Age</th>
<th>Educator (Pseudonym)</th>
<th>Teaching Experience (years)</th>
<th>Highest education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (28)</td>
<td>Miss Lee</td>
<td>4</td>
<td>Master degree</td>
</tr>
<tr>
<td>Male (39)</td>
<td>Dr Men</td>
<td>8</td>
<td>PhD degree</td>
</tr>
<tr>
<td>Female (45)</td>
<td>Mr Loh</td>
<td>14</td>
<td>Master degree</td>
</tr>
<tr>
<td>Female (40)</td>
<td>Ms Priya</td>
<td>11</td>
<td>Master degree</td>
</tr>
<tr>
<td>Female (30)</td>
<td>Ms Yeap</td>
<td>6</td>
<td>Master degree</td>
</tr>
<tr>
<td>Female (35)</td>
<td>Ms Norlaila</td>
<td>9</td>
<td>Master degree</td>
</tr>
</tbody>
</table>

Although this case study focuses on a very small number of IS educators, some very interesting themes emerged. The following results section is structured according to the findings that are organized around the following themes:

a) IS educators rely on computer applications and the Internet

b) IS assignments or projects are vital to assess students’ understanding and students working in teams

c) IS educators seldom use computer system to manage students assignments

d) IS educators would like to use a system with CMI features to manage students assignment

e) IS educators encouraged students to discuss using collaboration tools

4.3.1. IS Educators Rely on Computer Applications and the Internet

Generally, all IS educators involved in the interview (Miss Lee, Dr Men, Mr Loh, Ms Priya, Ms Yeap, Ms Norlaila) indicated that they depend on ICT tools such as application software to prepare lessons, curriculum plan, exercises, and project assignments. All indicated that ICT tools are essential and useful. This is an anticipated answer since they are well exposed to ICT tools. The researcher asked the IS educators to describe the activities they planned in IS courses and how ICT could help in the IS instructional processes. All participants mentioned that students have to complete
assignments. Lee reported preparing questions for practices only. For first year students, Yeap and Norlaila arranged for tests with multiple-choices questions.

All IS educators involved said that, in order to prepare assignment questions, they surfed the Internet. Four of them (Lee, Dr Men, Loh, Yeap) searched the digital library for materials related to the subject matter in addition to using reference texts. Most of them (Lee, Dr Men, Loh, Priya, Yeap) rely on web browsers (such as Microsoft Internet Explorer) and search tools (such as Google or Yahoo) to get the information and issues related to the subject matter, while Norlaila was concerned about the content reliability of certain web site and preferred to refer to reference books instead. All of them use word processors to prepare the assessment materials (tutorials, tests and examination questions). Digital file sharing is common among peers who teach similar IS courses.

Lee has been exploiting the use of ICT tools in the teaching and learning for many years. She remarked, “For IS courses that I taught more than one time, I reuse the teaching materials. I changed some of the questions for practices. The questions for practice are related to each chapter and my project covers a few chapters. For new IS courses, I refer to references books and online resources to prepare teaching material. I summarise my lecture notes into presentation slides using presentation software, or I may perhaps use the presentation slides available in the CD that comes together with the reference book. Some of the questions for practices were selected from the reference books used.” Lee seems to be a hard working educator. She uploaded all learning materials (lecture notes, video clips (downloaded from the Internet), tutorial questions, and project question) to the faculty web site at the beginning of every new semester. The web site address is given to students. Students are advised to visit the given web site at least once a week. She said, “Any online tutorial or quizzes related to IS courses
that I found will be posted on my website for students’ references.” She preferred to use the faculty web site instead of university’s LMS as she was not sure if the university had decided to adopt a LMS.

Priya has many years of experience in using ICT. She uploads files such as lecture notes, tutorial questions, assignment questions to free web hosting site (yahoo group) on weekly basis. Her tutorial questions (Theoretical based, with discussion) are related to the chapters covered during lectures, while the assignment is research paper on one chosen area from a list of suggested topics. Students were expected to take the responsibility of downloading and reading the files from the web site. Priya sometimes shares the teaching of the course with other educators. This happens when the student enrolment increases. She said, “Coordination of work among peers is important when more than one educator is teaching the same course. A unit leader is selected by the faculty to prepare unit plan, manage and report on the course matter. The educators assigned have to agree on the file formats, any other media use, type of questions and mode of submission for student reports. This is necessary to minimise the problems of students comparing among themselves especially when different instructions were given by different educators.”

Similar to Priya, Dr Men uploads learning materials on a weekly basis to his own web site which resides in the faculty’s web server. He no longer uses handwritten documents in classroom instructions. All teaching materials are in electronic form and mostly saved in Word format. He refers to reference books and online materials to set tests and examinations questions. For Loh, Yeap, Norlaila, they uploaded their material to the propriety LMS provided by the institution. There was no specific pattern of uploading file for them. Loh strongly felt that the learning materials uploaded to the LMS serve as
guidelines, and students are free to refer to reference books or materials that are available online. Loh emphasizes, “Students can find most of the learning materials that I presented online. Surfing the Internet has become one of my habit to gather material online”. On the other hand, Norlaila said, “I depend on the CD or website given by publisher. Those resources have sufficient teaching material with examples and questions. As such, I do not need to create questions.” Yeap depends on the online dictionary and Internet forums to understand certain terms and formula that were presented in references books or online resources used. She said, “I rely on my computer a lot. If the computer is down, I would not be able to work at all. I always backup my teaching resources to prevent data loss that could happen due to hardware failure.”

The institutions of higher learning that the educators are attached to are equipped with appropriate hardware and software to facilitate teaching and learning. The ICT tools used to support teaching and learning include computers, LCD projectors, word processor, presentation software and the Internet. Lee remarked, “Occasionally I encountered network reliability (such as disconnection) problems or web server problem. When this happened, I was not able to access files that were uploaded to the faculty web site. I then save the required files from my personal computer into a portable device and bring it along to the class.”

4.3.2. IS Assignments or Projects are Vital to Assess Students’ Understanding and Students Working in Teams

All six IS educators emphasised the need for students to do assignments or projects as these activities provide an opportunity for students to analyze, synthesize and evaluate the knowledge they gained in their courses. The terms assignments and projects seem to have similar meaning to the educators, and grading of assignments is a method of
student evaluation that is widely used in IS education. Lee said, “My students have to complete an IS project that contributes 30% to the final grade. The project covers most of the chapters taught. Four students work together as a team. Students have to conduct an interview with a selected company. I gave students guidelines such as the key elements on how to approach the problem and the report outline. Students who have doubts on the project requirements would meet me during my consultation hours. Alternatively, they could send enquiries via e-mail.” Lee maintains a list of frequently-asked-questions (FAQs) about the project in her website to avoid repeating the same answers to different students. She would read students draft reports upon request. She had difficulties in monitoring student project progress especially for absentees and shy students. She added that student motivation is very important in encouraging them to carry out their task.

Priya also required students to complete one assignment which also contributes 30% to the final grade. Her students have to submit a research paper on one topic selected from a list of suggested topics she provided, and she emphasised the need for students to work in teams to solve the assignment problem. They go through analysis, evaluation and synthesis processes to answer the assignment. Priya’s students make appointment with her via e-mail. She strongly believes that feedback is important as it serves as guidelines as well as motivation elements for students to carry out the assignment. She said, “I have face to face discussion with students on assignment issues during consultation hours to alleviate problems such as students do not understand or they misunderstand the selected assignment topic. I also answer frequently asked questions during lecture.”
Similar to Priya and Lee, Loh requires his students to work in teams and submit one assignment report before the end of the semester. Loh remarked, “The problem specification is often open to interpretation. Answers for the assignments are very subjective as they depend on the problem domains. The assignment contributes 85% to their practical mark. My students learnt the system development cycle using the same set of user’s requirements. They understand better with this approach.” Loh designed the assignment question that reflects the information system life cycle. Students have to complete the assignment in ten (10) weeks. Loh added, “My students have to submit a short report at different checkpoints so that I can monitor their work progress and support groups which seem to be going astray in their work. It will also instil good practice among the students. Providing timely feedback is important for students to ascertain that they have carried out the assignment correctly, such as whether the correct methodology had been used, or the required scope had been covered. This is an important task and cannot be overlooked as it could subsequently influence students’ understanding and hence their results.” Loh admitted that extra effort have to put into feedback provision as it is done manually. This includes prepare a list containing the student groupings and their assignment titles, and updating the student submission list when the deadline for each stage is over.

Dr Men set two assignments for student to complete. He commented, “Students discuss among themselves and they can come to see me during consultation hours. I select some students to present what they have done at certain stage of the assignment. Normally the group leader will be the presenter. Each assignment contributes 15% to the final grade.”
Yeap said, “Students must submit their assignment before the end of the semester. They will not pass the course if they fail their assignment. It is mandatory for the students to do assignments. As such, I check their work every week. If students did not show their work in one week, they must show their work in the following week. I like to practice weekly checking on students’ work. It is fun and pleasant to see students’ progress in learning.”

Norlaila set two assignments for students to complete; one is to be done individually, while the other is to be done in group. She disclosed that the task of managing student assessment, especially assignments, challenging. The output of the assignments could be a system specification or a framework, the evaluation of which cannot be automated and requires human intervention. Inappropriate assignment management can lead to missing assignments, ungraded or late work. Norlaila said, “Students come to see me during my consultation hours or make appointments with me via e-mail. I encourage peer discussion and expect them to be independent. For students who fail to get the minimum mark for the assignment, I normally give them another small assignment to do. They normally pass after completing it.”

4.3.3. IS Educators Seldom Use Computer Systems to Manage Students’ Assignment

One question that the researcher asked was “Do you use any specific systems or computer tools such as CAI, CMI or CEI to support the instruction?” The six (6) educators understood CAI and CEI, and could spell out some of the characteristics and give some examples of CAI and CEI tools. However, all six (6) IS educators were not that familiar with the term CMI. However, they immediately comprehend the CMI components and features when the researcher explained these to them. Four (4) out of
the six (6) IS educators involved in this study did not know any features available in LMS, but two (2) IS educators (Norlaila and Yeap) used some of the CMI features as described below.

For Loh, Yeap, Norlaila, the propriety LMS that used in their institution support tests and quizzes, assignments submission and feedback, record keeping using electronic gradebooks and gradebooks reports viewed online. Yeap and Norlaila used online tests supported by the LMS for first year IS course. They keyed in the multiple choice questions and answers (provided in CDs format come together with reference books) into the institution’s LMS. Students have to complete tests within a given timeline. The system will automatically mark the answers. Yeap said, “For students in year one, students have to take online test at the dedicated time in the laboratory. Using multiple choice questions can test students knowledge on the subject matter concept, the system significantly reduce my time on marking and at the same time I know if students master the subject matter before giving them assignment. However, I did not provide any prescription at the end of the test.” Norlaila remarked, “Only 15 marks is given to the multiple choice practice; students have to retake the test if they fail.” Loh said, “I focus on students assignments instead of quizzes. Students should be able to search quizzes on their own to practice on. Assignments are given so that students can practices more on analysis, synthesis and evaluation of subject matter. Feedback should be given to students on their achievement in that aspect.” Loh managed his assignments manually. Assignment submission and grading were done in hard copies. Loh remarked, “The existing LMS seems not fit in the way I used to work. For IS courses, I gave them assignments that require some deliverables during it progress. My students work in groups. The LMS does not support submission of students’ group assignments, as gradebooks do not support data entry using the students’ group names. It does not
reduce my administrative work.” Norlaila gave the same reasons. She commented: “The assignments submission supported by the LMS is suitable for individual student projects. It is not for group projects. The features supported for student groupings, such as private discussion boards, are not fully utilised by students.”

Yeap had her own reasons for not using CMI features in LMS. She said, “Firstly, I found that the speed of uploading and downloading files from the server is very slow and there is a file storage limit. Secondly, student assignments are submitted as group work. The assignment submission features in LMS does not allow students to submit using a group name. The system can only record sender’s name and the report name. As a result, it does not reduce my workload. I still have to check the student list manually with or without using the LMS.”

Priya, Dr Men, and Lee did not use any CMI system. These educators receive and acknowledge assignments submitted manually. They grade students’ assignments directly on the hard copies. Lee summarised the way she handle assignments as follows “After the students submit their hard copy reports, I start marking them. I return the projects after recording the marks. I do not use assignment tool provided by the university as it only functions as a drop box. It would be better if the system has functions that allow educators to put down their comments and monitor students in a group.”

4.3.4. IS Educators Would Like to Use a System with CMI Features to Manage Students’ Assignment

In general, all participants express their interest to use a system that fulfils their needs. Lee said “I would like to use a system that can keep records of my students’ learning
progress and that can manipulate the records using team/group name. I will be able to write my project question, guidelines, upload files, create hyperlinks, FAQs and provide my feedback. The system could generate reports of student performance. My students should be able to create their own group as long as the number of member in a group is not more than four. The system must store student’s e-mail address so that I do not need to search for them. Most importantly, the system must be easy to use.” Dr Men shared the same opinion as Lee in that the system must be easy to use for educators.

Loh remarked, “It would be good if there is a system that has features that keep track of all the system development cycle that match my assignment question. You may keep a copy of my assignment as reference. (Handling over the question to researcher) I would definitely try out the system. I need a system that allows me to record all the phases, enable me to give marks and feedback to students, with their group name as an identifier. I would be happy if the system could allow me to view students’ marks online.”

Yeap said, “I think the system should allow educators to put down their comments and monitor students using their team name. My students can then read feedback and get their grade instantly.” On the other hand, Priya said “If the system can reduce my work in handling assignment (as mentioned to you earlier) such as allowing access by other tutors or educators sharing the same courses so that they can assess their own groups of students, I would like to give it a try.”

4.3.5. IS Educators Encouraged Students to Discuss Using Collaboration Tools

Lee, the youngest IS educators involved in this interview, said, “I guess I integrate ICT in teaching most of the time. I encourage students to integrate ICT in learning activities,
for instance, to search online for learning resource for their assignments, join Internet forums to get more information or share information with others. I know that some students follow my advice. They join Yahoo discussion groups. My students did invite me to get involved. However, I do not join the discussion forums as I am afraid I might not have the time needed to follow up on the discussions. Moreover, the discussion forums have limited functions and there is no way for me to get to know more about student involvement.” On the other hand, Yeap asked students to join Internet forums related to IS courses to learn more about the subject matter. She gave a few Internet forum hyperlinks to her students. Yeap remarked, “It is necessary to get students to collaborate and reflect in order to learn from the tasks given in the assignment. An Internet forum accommodates the schedules and preferences of students better. However, some students still not participate in the forums.” Yeap considered giving marks for participation to encourage students to join in online discussions as is being practised in class. She is afraid that this has to be done manually, as Internet forums are not generally designed with those features. Loh said, “I have face to face discussion sessions with my students. I do not use any Internet forum for my course. I motivate students to discuss among peers. Students can join online Internet forums if they want to. There are plenty of forums out there in the Internet. I personally think that it would be good if the forums have statistics on the students’ participation. Management always requests information related to students’ participation and students progress.”

Priya remarked, “I knew that some of my colleagues join Internet forums. There is a discussion forum on my course that set up by my students. I encourage my students to share information in the forum. I think not all students like to participate in the forum based on the discussion thread shown. I am too busy to really look into it.”
Norlaila and Dr Men set up discussion forums for students especially for assignment purpose. Dr Men thinks that Internet forum is an alternative avenue for students to learn. However, he feels that students themselves must be willing to get involved. Norlaila said, "I want to know what the students have discussed about. Occasionally I put down my comments. I found that more students would get involved in the discussion if they know that I am reading their discussion. It is fun. I do not assess their discussion. There is hundred of threads and perhaps thousand. Ask the researcher to find out the solution. I would use it if the forum gave me reports on students’ participation.”

Although some IS educators do not involve themselves in online discussion, they generally encourage students to participate in Internet forums. When the researcher asked, “How can the problem be solved?” Lee suggested, “It would be good if there is a report on students’ participation in discussion forums that would help the educator to know the extent of student involvement.” Priya, Norlaila, Yeap and Dr Men gave the same answers. Priya added, “Perhaps this information can be used to assess and encourage the students’ participation.”

4.4. Findings of the Second Survey

Findings of first survey and interviews lead to the need to further prompt the IS educators for data on the use of ICT in a specific aspect of IS instructions. Findings from the interview indicated respondents’ urgent needs of a collaboration tool to facilitate students’ discussion. The specific requirements of the tool to manage students’ participation in discussion or work group would require further investigation. As such a survey is necessary to collect data on that specific aspect of IS instructions identified in the interviews so that the true functional requirements required for a collaboration tool can be identified. The survey instrument specifically aims to find out further about the
IS educators’ perception on the functional requirements for the collaboration tool to be developed.

A total of 178 electronic questionnaires were transmitted. Three (3) weeks after the initial sending date, 73 usable sets were returned. Thus, the respondents represented about 41% of the total IS educators from the thirteen (13) universities. The results obtained were summarized using a statistical software package - Statistical Package for the Social Sciences (SPSS) version 12.0 except for open-ended questions, the frequencies of the answers were computed.

4.4.1. Demographics of the Respondents

The first section of the electronic questionnaire gathered the respondents’ background. The focus was on the respondents’ demographics such as their age group, gender, their highest educational attainment, teaching experience and IS courses that they had taught. 43.8% of the respondents were in age group of 30 and below. The majority of the respondents (83.5%) were Masters Degree holders. A large portion of the respondents were relatively new in the teaching profession as almost 45.2% of the respondents have less than five (5) years of teaching experience. The findings are as depicted in Table 4-13 and the list of IS courses taught by the respondents in the respective universities are presented in Appendix J. The list of IS courses gathered confirmed that the participants are educators teaching IS courses in their universities.
Table 4-13
Demographics of the Respondents (n=73)

<table>
<thead>
<tr>
<th>Demographic Variables</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age Group (years)</strong></td>
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<td></td>
</tr>
<tr>
<td>30 and below</td>
<td>32</td>
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<td>31-35</td>
<td>18</td>
<td>24.7</td>
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<td>36-40</td>
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<td>41-45</td>
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<tr>
<td>51-55</td>
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<td>4.1</td>
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<tr>
<td>56-70</td>
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<td>0</td>
</tr>
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<td>100</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>26.0</td>
</tr>
<tr>
<td>Female</td>
<td>54</td>
<td>74.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td>100</td>
</tr>
<tr>
<td><strong>Highest Education</strong></td>
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<td></td>
</tr>
<tr>
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<td>15.1</td>
</tr>
<tr>
<td>Master</td>
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</tr>
<tr>
<td>Degree</td>
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<td>1.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>73</td>
<td>100</td>
</tr>
<tr>
<td><strong>Teaching Experience (years)</strong></td>
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<td></td>
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<td>16-20</td>
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<td>9.6</td>
</tr>
<tr>
<td>Above 20</td>
<td>7</td>
<td>9.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>73</td>
<td>100</td>
</tr>
</tbody>
</table>

4.4.2. Requirements for Assessing Students’ Contributions to Internet Forums

The second section of the questionnaire focused on the requirements for assessing students’ contributions to Internet forums. Internet forums are used to support interaction between any numbers of members in an asynchronous, text-based environment. Messages in the Internet forums are displayed as ‘threads’ organised according to subject referents and allow the history of the online conversation to be easily followed (McKenzie and Murphy, 2000). Internet forums are also referred as
online discussion forums, bulletin boards, and online discussion boards. The findings are detailed in the following headings:

i. **Perception on the Usefulness of a Computer Generated Performance Indicator**

Performance indicator scores are data that provide a measure of students’ participation in discussion of Internet forums. As IS educators are the end users of an Internet forum who prefer to manage students’ participation, it is necessary to examine the perception of the IS educators on the usefulness of a computer generated performance indicator before it could be suggested for implementation. A total of 95.9% of the respondents agreed that it would be useful to have an Internet forum that can generate performance indicator scores for students’ online contributions whereas 4.1% did not agree (Figure 4-1).

![Figure 4-1](image)

**Figure 4-1**
Perception on the usefulness of a computer generated performance indicator scores (n=73)
ii. Primary Objective of using a Computer Generated Performance Indicator in an Internet Forum

The IS educators sampled were asked the primary objective or benefit they would obtain from using a performance indicator score in an Internet forum. As shown in Figure 4-2, 32.9% of the respondents indicated that the primary benefit of using a computer generated performance indicator score is that it “Saves time on evaluating students’ contributions”, 37.0% of the respondents believed students’ contributions will have more focus to meet the criteria used in performance indicator, 30.1% of the respondents opted for “Encourages students to participate in Internet forums” as the primary benefit. It seems that the percentages of the respondents for each listed benefit of using the performance indicator scores listed are almost evenly distributed. An open-ended question was asked in order to gain an understanding of other benefits obtained from using a performance indicator in Internet forums but was not listed in the questionnaire. However, no answer was given by the respondents.

Figure 4-2
Primary objective of using a computer generated performance indicator (n=73)
iii. Post Categories Selected for Assessing Students’ Contributions to Internet Forums

Ellis and Dringus’s (2005) findings suggest students’ discussions in Internet forums can be categorized based on content and then grouped into three levels of reflection in learning, i.e. content level, process level, and premise level. The indicators included in content level reflection are (a) broadened (increased the scope of the discussion); (b) evaluative (was evaluative, assessing the meaningfulness or validity of ideas being shared); (c) questioning (raised thoughtful questions about the topic); and (d) synthesis (contained well formed, clear, connected, and synthesized ideas). The indicators included in process level reflection are (a) analysis (provided analysis of the problem being discussed); (b) summarizing (summarized the topic discussion overall); and (c) resolution (promoted cooperation to resolve issues of debate or disagreement). The indicators included in premise level reflection are (a) acknowledging (responded to another contribution); (b) clarification (supplied or sought clarification as needed in responses); (c) resources (exchanged useful resources with others such as links or citations); and (d) social (conversational or social in nature, interjected personal commentary or experiences). These indicators are described and listed as SCAFFOLD instrument, a tool for categorizing and describing discussion forum contributions that would be encountered in a college-level course. As findings from the interview indicated the respondents’ needs to manage students’ participations in discussion for Internet forums, the indicators described could be used as a range of statistical parameters representing “message category”, a measure to manage students’ participations in discussion of a collaboration tool.

The respondents were asked to indicate the post categories that would be used as assessment criteria to assess students’ contributions to Internet forums in the teaching
and learning of IS. The respondents can choose more than one answer for this question. The results are shown in Figure 4-3. ‘Analysis’ is the most popular post category since 76.7% of the respondents selected it. ‘Resources’, ‘Evaluative’ and ‘Questioning’ are popular as 63%, 65.8% and 67.1% respectively of the respondents opted to use it as assessment criteria for assessing students’ contributions. ‘Synthesis’, ‘Summarizing’, ‘Clarification’ and ‘Acknowledging’ categories are accepted by 50% - 60% of the survey respondents for assessment purposes. ‘Social’, ‘Resolution’ and ‘Broadened’ categories are respectively opted by 46.6%, 39.7%, and 35.6% of the respondents. ‘Evaluative’, ‘Synthesis’, ‘Analysis’, considered categories of higher order thinking skills, were selected by more than 50% of the respondents to be used in the assessment criteria. All post categories were selected by the respondents as assessment criteria with various degrees of acceptance.

![Bar chart showing the percentage of respondents selected for each post category as assessment criteria.]

Figure 4-3
Analysis of Responses for Post categories as assessment criteria (n=73)
iv. Features that Facilitate in the Assessment of Students’ Contributions to Internet Forums

Figure 4-4 shows the analysis of responses for features that the respondents would like to include for assessing students’ contributions to Internet forums. “Set up student grouping” had 82.2% of the respondents choosing it as a feature to include in assessing students’ contributions to Internet forums whereas 75.3% of the respondents selected the “Categorize posting” feature. “Approve/deny a student’s participant” feature was requested by 56.2% of the respondents, “Suspend/resume a student’s participation” had 45.2% of the respondents selecting it as a feature to include into Internet forums. “Change a posting’s category” was selected by 45.2% of the respondents. All the features would be included as more than 45% of the respondents had selected these features. An open-ended question was asked in order to gain feedback of other features that the respondents would like to add but was not listed in the questionnaire. No written feedback was provided for the question.

Figure 4-4
Analysis of Responses for Features to add in Internet forums (n=73)

As findings from the interview indicated IS respondents’ needs to manage students’ participations in discussion (Section 4.3.5), performance indicators score for a student’s
participation in Internet forums could include a range of statistical parameters such as “timeliness of posting” which means messages are posted or replied on time or within due date given by the educator, “categories of posting” that is to categorize and describe messages based on SCAFFOLD, “number of discussions posted” is the number of messages posted by a student, and “length of posting” means the amount of words in the student’s messages.

With regard to the analysis of responses for the criteria used in a performance indicator, 67.1% of the respondents would like the “timeliness of posting” to be a criterion in a performance indicator. “Categories of posting” and “Number of discussions posted” were selected by 58.9% and 56.2% respectively of the respondents as criteria used in a performance indicator. “Length of posting” was selected by 24.7% of the respondents. The figures show that all the respondents wanted to assess students’ contributions whereas none of the respondents selected the NONE option. “Number of discussions posted”, “Categories of posting”, and “Timeliness of posting” are popular assessment criteria among respondents since more than 50% of the respondents selected them. These findings show that a criterion in a performance indicator is and will remain as a subjective option of the respondents. An open-ended question was asked in order to gain a suggestion of other assessment criteria that the respondents would like to add but was not listed in the questionnaire. No suggestion was given. Figure 4-5 presents these findings.
As IS educators are the end user of Internet forums who would like to manage students’ participation, it is necessary to examine the IS educators’ requirements on the presentation of students’ performance in discussion before it could be suggested for implementation. “Rank based on predefined criteria used in a performance indicator” means students’ performance in Internet forums can be displayed in descending order for the criteria (such as “categories of posting”, “Number of discussions posted”, and “length of posting”) selected by the IS educator. “Filter to view only a group of students” means IS educators can selectively view students’ performance in discussion for the IS course opted by them. “Plain text or comma delimited format exportable for further processing” means IS educators can export students’ performance in discussion as Comma-Separated Value (CSV) file(s).

Figure 4-6 shows the analysis of responses for presentation of performance indicator scores. According to the analysis, 84.9% of the respondents selected “Rank based on predefined criteria used in a performance indicator”. A total of 42.5% respondents opted for “Filter to view only a group of students”. Only 27.4% of the respondents selected
“Plain text or comma delimited format exportable for further processing”. All the features would be added for software development. An open-ended question was asked in order to gain an opinion of alternative methods to present the performance indicator scores but was not listed in the questionnaire. Again no feedback was obtained for open-ended question.

![Diagram](attachment://image.png)

**Figure 4-6**
Analysis of Responses for presentation of performance indicator scores for IS educators (n=73)

### v. Features that Help to Improve Students’ Contributions to Internet Forums

Figure 4-7 for presents analysis of responses for features that would help to improve students’ contributions to Internet forums in the teaching and learning of IS, 79.5% of the respondents selected “A performance indicator score for each individual student”, 64.4% of the respondents selected “Frequency on the criteria used in a performance indicator” (that is showing individual counts for each criterion), 46.6% of the respondents selected “Self categorize posting”. These figures reflect that the majority of the respondents would like to include these features on the Internet forums to support their students’ learning process. All features will be added in order to increase students’ contributions to Internet forums. An open-ended question was asked in order to gain a
suggestion on features that the respondents would like to add but was not listed in the questionnaire. However, no suggestion was given for the question asked.

![Chart showing the percentage of respondents selected for features helping to improve students' contributions](chart.png)

**Figure 4-7**
Analysis of Responses for features that help to improve students’ contributions to Internet forums (n=73)

### 4.4.3. Other Comments and Suggestions

The respondents were asked to give other comments or suggestions on features that could help in supporting the assessing of students’ contributions to Internet forums. The verbatim comments and suggestions as follows:

i. Technology, such as Internet forums, cannot replace humans. However, it acts as a tool to complement them.

ii. It is good to encourage new students to use this technology in education.

iii. The IT infrastructure must be good, and allows students and teachers to communicate. The costs of Internet access must be lower. Down time must be low such as 0.09%.

iv. I believe if the performance indicator can be implemented, the IS course will be greatly improved in various ways. The course will be more interesting to learn.
v. Length of posting is not significantly related to the quality of a student’s performance.

vi. Someone has to start a topic, and to make summaries as well as conclusions.

vii. Policies and regulations must be set up, especially on discussions posted. All discussion must be filtered before posting (if they will be viewed openly in the Internet) as this may lead to defamation cases - free-speech law!!

viii. I don't think assessing a student according to his timeliness and length of post is appropriate. Also, assessment of the quality of content posted for discussions in any posting may vary from one educator to another as quality is not measurable.

ix. Performance scores should not be provided; students would be aiming to increase marks rather than focusing on actual work to be completed.

From the comments and suggestions collected from the survey, it shows that the respondents have different responses on the criteria to measure students participation in IS instructions. This finding again shows that establishing assessment criteria on student participation in Internet forums is distinctive to educators. The survey findings also show the likelihood that respondents promote the use of the tool and highlight their concern on the IT infrastructure and policies for its successful use.

4.5. Summary

This chapter has presented the research findings from two surveys and interviews conducted on the IS educators for IS instructional processes. The questions related to ICT tools used in IS instructional processes has been answered, especially the first five questions stated in Section 1.6. To answer the first research question, the first survey findings indicated that the survey participants use ICT tools in the teaching and learning. However, the ICT tools usage among IS educators is normal and some ICT tools usage (such as word processing software, presentation software, Internet, LCD projector) have
no significant difference from non-computing courses (Jacobsen, 2000). Eighteen (18) software/tools (word processing software, presentation software, spreadsheet, search tools, Internet, LCD projector, web, e-mail, files sharable, digital library, online notice board, HTML generator, LMS, ftp, scanner, courseware, database application, online discussion forum) have been adopted by the Late Majority and Laggards in IS instructions, six (6) software/tools (calendar tools, computer assisted assessment, online chat rooms, authoring tools, voice messages, streaming audio) have been adopted by the Early Majority, and two (2) tools (video conferencing, streaming video) that have only diffused into Early Adopters categories in the Rogers diffusion of innovations. Among tools used for CMI, CAI, or CEI purposes, it seems that CMI has a higher mean value (2.89) of usage among the respondents and have been adopted by the Late Majority. This indicated that the respondents inclined to use ICT to manage instructional activities.

This result has identified the obstacles and success factors towards the use of ICT tools in IS instructions. Obstacles such as “ICT tools are changing too fast to keep current” will require IS educators to possess self-development skill and to consistently update their knowledge to keep abreast with the inevitable technological changes, while others like “Extra time and effort is needed to integrate ICT tools in teaching” will require IS educators to work intellectually to adopt the new technology. In CAI emphasis is placed upon having students learn new concepts or in reinforcing previously learned concepts. Unfortunately, because it takes many hours to develop even one hour of CAI, the cost of producing CAI programs or acquiring CAI material can be expensive. In CMI, the computer mainly manages a student's instructional activities. This is accomplished by allocating or scheduling learning materials and physical resources for each student; providing the student with access to test questions; grading examinations or assignments; providing diagnoses of learning performance based upon test performance scores;
prescribing different instructional activities according to the student's performance and/or rate of progress; record keeping; and reporting. Due to the fact that provision of instruction via CMI is often much less expensive than through CAI, CMI is often the instructional model of choice. This implies that educators would prefer to use CMI tools that could lead to time saving, and relief educators from doing repetitive management work. The survey item for success factor “My enthusiasm towards ICT supported teaching was high” was agreed by 94% of the survey respondents. This indicates that the level of interest of IS educators on the use of ICT tools is crucial as they are the one who decide on the use of ICT tools in IS instructions. Thus, any research or decision related to the use of ICT in education is recommended to seek the IS educators’ view or consensus. In such, among the CAI, CEI, and CMI, CMI has a higher mean value of usage among the respondents indicated that the respondents are interested to use ICT to support instructional activities.

This study also conducted factor analysis on the data to examine if there is any underlying relationship among the questionnaire items for the obstacles and success factors. For the obstacles, the results from the factor analysis produced six (6) factors. They are change management, equipment readiness, peer and students influence, reliability of support, ease of learning and personal enthusiasm. However, only four (4) factors were emerged for the success items. They are change management, equipment readiness, peer influence and personal enthusiasm, and finally, students learning power.

It is not possible to generalize the interviews findings to all IS educators because of the sample size. However, the interviews produced important picture for all those who care about the use of ICT to support IS instructions. The key findings from the interviews can be summarised as below:
a) Computer application tool and the Internet were widely used in IS instructional processes.

b) Assignments are widely practice as one of the student learning activities. IS educators sampled managed assignment manually. Diagnosis of student work and prescription were done through written comments or discussions between students and IS educators. Some IS educators require students to submit report(s) to show the assignment progress.

c) The data gathered shown that some common requirements that the IS educators sampled would like to use for handling assignments but are not implemented in existing tools. Nevertheless, some educators have their own specific needs that they would like it to be implemented in a tool. In general, IS educators sampled are willing to use a tool with CMI elements that meets their needs.

d) The data also shown that there is a need to further investigate the requirements on a collaboration tool that could assist the IS educators sampled to manage students’ participation. The IS educators sampled isolate themselves from the discussions in Internet forums because of time pressure, work priorities and limited features to manage students participation in Internet forums. Some IS educators sampled suggested to have some indicator on student participation. The actual requirements to manage the students’ participation in a collaboration tool would require further investigation.

The findings of interviews lead to the need to further prompt the IS educators for data on the use of ICT in a specific aspect of IS instructions. The second survey have revealed that the majority of the IS respondents agreed that it would be useful to have a computer generated performance indicator to predict student participation in discussion in Internet forums. The primary objective of using a computer generated performance indicator in an Internet forum by the IS educators sampled are identified as well. The
related requirements for managing students’ participations in Internet forums identified are criteria used in a performance indicator, the presentation of performance indicator scores, features that help to manage students’ contributions to Internet forums, and features that help to motivate students’ contributions to Internet forums. However, the criterion used in the performance indicator is and will remain, in a large way, a subjective option of the respondents.

In general, findings of the three different data collection methods show that the IS educators are inclined to use CMI-based tools to support instructional processes as compared to CAI and CEI. The next chapter presents an analysis of CMI functions and systems.
Chapter 5

Computer Managed Instruction (CMI) Functions and Systems

5.1. Introduction
This chapter aims to (a) present CMI functions and system flow; (b) identify the open source LMS worldwide that implemented CMI functions; and (c) the CMI features obtained from literature with the open sources LMS under study. The chapter described builds upon the key components which constitute the theoretical framework underlying CMI.

5.2. CMI: Its Functions and System flow
Various CMI definitions are presented in Section 2.4. In this section, a review is given on the functionality of CMI. The difficulty in defining CMI is due to the different implementation orientation of different systems. As such, CMI functions which are tied to the clerical support are highly situation-specific, and the type of detailed support required varies widely from curricula to curricula (Baker, 1978). As a result, a CMI system implemented in one context is possible to have little value in another context. As described in Park and Lee (2003), CMI systems have functions to diagnose student learning needs and prescribe instructional activities appropriate for these needs. As such, CMI-based systems may be used to provide management support on four (4) broad areas in the following system flow (Leiblum, 1982). Firstly, it can construct, mark, and analyze tests for diagnostic or assessment purposes. Secondly, it can keep records of the student’s performance and progress through the courses. Thirdly, based on what is known about each student and the structure of the course, it can provide guidance for each student, directing or advising on the option or route through structured course materials. Finally, from its records, it can report on the performance and progress of the
Computer Managed Instruction Functions and Systems

students to the individual students, the educators and the management of the educational institution. It means the use of computer technology to oversee the learning process.

Figure 5-1
General Model of CMI (Leiblum, 1982)
Figure 5-1 presents the general model of CMI from the perspective of the student, the computer, and the educator or instructor. The model starts with a student studies an instructional module which can be executed either through the computer or studied via other means, such as books, programmed instruction texts, audio visual learning packages. The student then takes a test. The computer processes the test and, based on the results and what is already known about the student and course structure, advises the student on the choice of the next module. The cycle is completed as the student begins to study new module. An educator administers and guides the instructional processes using a computer. The computer becomes an information system that records students’ learning, academic history, lists programs of studies, scores tests and examinations, and furnishes this information to the educator. Computers are used in managerial aspects of the educational program.

The four (4) functions that a CMI should have to provide good computer technology to monitor student educational performance as defined by Gorth and Nassif (1984) are: (a) an identification database, (b) performance data, (c) report generation, and (d) utility functions. Araki et al. (1993) listed the functions of CMI program in the teaching flow as to (a) evaluates students’ understanding; (b) monitors student progress; (c) advise students of their weak points and suggesting areas that need improvement; (d) notify teachers of the individual students' weak points areas that need improvement and suggesting areas of importance.

On the other hand, Leiblum (1982) listed twelve CMI “functions” or elements as a) objective banking; b) learning resources banking and library information retrieval; c) learning material banking; d) item banking; e) item generation; f) test generation; g) assessment; h) reporting; i) evaluation; j) assignment; k) counseling; l) scheduling. The
twelve CMI elements are as shown in Table 5-1. The 12 elements all together are seldom found in existing CMI systems. Leiblum (1982) indicated that a perfectionist may argue that a majority of elements must be present and integrated. Leiblum put forward an alternative way of grouping these 12 elements into three (3) categories.

### Table 5-1
CMI Elements (Adopted from Leiblum, 1982)

<table>
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<th>Element</th>
<th>CMI Elements</th>
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| 1.      | Objective Banking.  
          The collection and maintenance of a structured set of objectives related to a lesson, task, a course, a discipline of curriculum. |
| 2.      | Learning Resources Banking and Library Information Retrieval.  
          The collection and maintenance of structured lists of educational facilities/resources/packages and/or a library information retrieval system (just books or printed materials) |
| 3.      | Learning Material Banking.  
          The collection and maintenance of instructional materials (a learning resource center) limited to those types which can be stored in computer hardware/software of peripheral units. |
| 4.      | Item Banking  
          Collection of a structured set of items  
          Online editing of items  
          Maintenance of item statistics  
          Maintenance of bank usage statistics |
| 5.      | Item Generation  
          Generation of items via a framework or macro facility, e.g. random number generation  
          Generation of items through randomly selecting/substituting existing parts of the item (stem of answer choices)  
          Generation of items based on a model/grammar representing the structure of the learning materials |
| 6.      | Test generation  
          Allocating items for individual study quizzes  
          Generating parallel forms of a specific quiz  
          Generating standardized final examinations from an item bank |
| 7.      | Assessment  
          Scoring of individual quizzes  
          Scoring of final examinations |
| 8.      | Reporting of (usually in printed form) individual study results (tests)  
          Reporting of individual and group study progress |
| 9.      | Evaluation  
          Providing test analysis  
          Providing educational product analysis (formative evaluation)  
          Providing educational process analysis, for e.g., information about study time, intervals between attempts, number of attempts, questionnaire processing, etc. |
| 10.     | Assignment  
          Assigning tasks based on objectives or study results. |
| 11.     | Counseling  
          Providing individual advice relating to study goals. |
| 12.     | Scheduling  
          Creating and maintaining schedules of educational facilities. For instance, manpower or physical/instructional resources. |
Group 1 contains banking of items and objectives, learning resource and material banking (element 1,2,3,4); Group 2 has item generation, test generation, assessment, reporting, and evaluation (element 5,6,7,8,9); Group 3 contains assignment, counseling, and scheduling (element 10,11,12.). The grouping is subjective and affected by the intuitive feeling that a CMI system should minimally contain one from each group because they closely relate to the management aspect of systems. As such, a system that integrates at least one from each group can be called a CMI system (Leiblum, 1982).

Van Hees as cited in Leiblum (1982) identifies CAI as a micro level of educational computing, and CMI at a macro level. Van Hees scheme shows a linking of all CMI functions (Figure 5-2). Not all the functions (as presented in Table 5-1) must be present in a CMI system as described earlier.

Hedges (1981) described the functions of CMI as diagnosis, prescription, data collection, and data reporting capabilities. Baker (1978) observed common capabilities of CMI systems as testing, diagnosing, prescribing, and reporting. While the terminology used to describe the functions of CMI is different, further examination of all the above definitions revealed the functions common to all of them. The description found in literature for the CMI functions, described as testing, prescription, record keeping and reporting, is presented as follows.

i) **Testing Function**

CMI-based systems can be used to construct, mark, and analyze tests. Generally, tests are employed to find out if the objective of curriculum is achieved. Educators can use the system for pretesting and post-testing as the student progresses. The tests may cover single objective or a number of objectives. Educators can also use CMI-based systems
to accumulate test items from many sources, store test items to facilitate the construction of tests. A lot of test options are available via CMI programs. Classification of test items can be based on objectives, difficulty level (easy, average, or hard) and behavioral level (knowledge or application). The test items used in the tests can be randomly selected to allow students to take them at various times. The tests items can has different weigh as determined by the educator based on difficulty index. Some CMI provide “scoring-guides” to assist the use in interpreting the results (Leiblum, 1982).

Figure 5-2
Functional Scheme of computer support of education (Leiblum, 1982)
Coburn (1982) presented two examples of testing-based CMI models. The first example described student test responses being machine-scored and the computer generate a prescription based on the results of the test. In the second example, the student took the test on a computer which calculated, analyzed, and recorded the data instantly. The student then received instant feedback and be guided to a tutorial CAI program for remediation. Mizokawa and Hamlin (1984) suggested several guidelines for software design in computer managed testing. They are

a) directions for the test need to be on a single screen, to be viewed in entirety;
b) students should be allowed to move forward or backward from screen to screen to review previously encountered problems, preview ensuing items, or modify a response already given;
c) student should be permitted to study the directions from any point during the test;
d) avoid breaking a large paragraph between two different screen displays, forcing the student to flip back and forth to read;
e) practice items should resemble actual items with a difficulty level low enough for most students to get correct;
f) practice items should require the same physical response as required on the actual test;
g) feedback must be given after each practice item;
h) the program could offer the brief justification for the correct response so the student understands the nature of the error;
i) the student may be offered another try if the response is out of the range of choices;
j) timing shouldn’t be a factor as the tests tend to be criterion reference and not standardized tests;
k) response input should be as simple as possible
l) the student should be in control of the presentation rate;
m) results should be recorded only at logical breaks in the test, not after each response.

n) the student should spend less time in learning to manage the computer than the time needed for testing.

ii) **Prescription Function**

Based on the data about each student, CMI-based systems can provide information in the form of prescriptions or advice as to material or course selection for the completion of set objectives. Baker (1978) and Allen (1980) emphasized the importance of CMI to generate prescription and indicated that any system which does not generate prescriptions is not CMI. Two (2) types of prescription are generally used in most CMI systems are: the forward and the remedial. The forward, based on the student’s mastery of a given unit, will allow that student to select the next module on the menu. The remedial prescription is based on the student’s non-mastery of a given unit and takes two forms that of having the student re-study the material or assigning the student to some educational activity or resource. Most CMI systems rely on academic performance in establishing student profiles and making instructional prescriptions. Leiblum (1982) argued that it should be based on a wide range of criteria such as test results, objectives to be covered, general performance history, personal learning styles, intellectual skills, or student preference. Matching student learning styles with suitable instructional components in the teaching units were recommended by Stewart (1983). The learning style profile employs learner preferences and strengths to determine suitable instructional modalities best suited to the individual or group. Sources for the profile include test information, student interest, needs assessments, questionnaires, conferences, sociometric devices, and educator observations. CMI-based systems can perform certain parts of the management process. However, human decision is still critical to the success of the computer application. According to Martin (1981), proper
planning, programming, data collection, data input, and interpretation of results by educators is still important for the success of any information system or software. The system neither overcomes poor decision-making nor replaces weak administrative actions and procedures. It is useful only if one understands the information needs and goals of the system.

iii) Record Keeping

CMI-based systems can maintain a large amount of data about student progress and performance which can includes information on intellectual ability, age, courses enroll and socioeconomic factors. Gorth and Nassif (1984) presented the nature of the records maintained in a CMI system ranged from student demographic data to a listing of availability of instructional resources. The records comprises (a) an identification database containing student name, identification number, and demographic characteristics; (b) academic history including assignment scores and course performance data, made up a major portion of the student record; and (c) other data such as school, period, and class identification, as well as test, answer, objectives, and prescriptions. The system makes the maintenance of such records easy. According to Gorth and Nassif (1984), utility functions such as copying files and modifying records are essential in this system. Adams and Howland (1983) indicated that the nature of the records depended on the needs of the user. The type or categories of record are unique to particular systems. The systems can store individual test item responses for use in item analysis, or interdisciplinary records can show relationships across course areas where skills in one area may be prerequisite to a skill in another. The process of record keeping would consist of entering data, modifying data, copying data, storing data, and summarizing the information using sorting and statistical routines (Gorth and Nassif, 1984). Accessing data in a CMI-based system requires special consideration such as
security arrangements to protect data from unauthorized personnel. Different users role are required to ensure editing of data could be done by the assigned users.

iv) Reporting Function

CMI-based systems can generate reports on student performance and progress for use by students, parents and educators. Printed reports or online reports on students’ performance help them decide what areas to focus on and assist educators put emphasize on the areas of concern. The system has sorting feature that sort information on learner progress has provided educators with a number of profiles and reports establishing instructional groups. These profiles can provide information on how large numbers of students are progressing in a program. The system process data in a very short time which save educators time to do it manually. Reports are available for individuals and groups. The nature of the reports, as with the types of records kept and tests generated, is dependent on the needs of the system user.

Four (4) types of reports presented by Gorth and Nassif (1984) are individual student performance, class average performance, curriculum performance (such as item analysis of the quality of individual test items), and parent reports. Adams and Howland (1983) put forward six (6) categories of test reports supported by CMI, namely (a) Individualized student report which lists objectives mastered and prescriptions for objectives not yet mastered; (b) The Class Diagnostic report which lists the names of students who did not reach mastery level on each objective, along with the percent mastered and the prescriptions for each; (c) The Group Summary Report that provides information regarding overall student progress and program assessment; (d) The Test Item Matrix Report which provides an item by item analysis, including incorrect choices and permits an examination of developing patterns that may prove useful in
student diagnosis, test revision, or modification of teaching strategies; (e) The Objective Matrix Report which lists the students who have mastered each objective at a given test; and (f) The Student Record Display which provides records of objectives with students’ mastery status over a period of time.

In this study, the research is mainly concerned with the use of computer as CMI for the instructional processes guided by the findings in Chapter 4. The processes are summarized as the computer program is designed to

- a) locate and manage resources include course objectives, learning resources, and human resources;
- b) evaluate students’ understanding against the curriculum;
- c) provide assessment items could be tests, essay type (assignments or projects) and student discussion;
- d) record student results and progress;
- e) advise students of their weak points and suggest areas that need improvement;
- f) generate reports on student performance.

5.3. **Open Source LMS with CMI Concept**

There are many modern computer programs have the functions to manage instructions to cater the needs of users in teaching and learning. Computer programs that are known as learning management system (LMS) or course management system (CMS) support the CMI features. The researcher concentrates on examining only projects that have been successfully deployed, utilizing open source approach and initiated by institution of learning or group of researchers. Recent years have seen Open Source making a major impact in the LMS as Open Source programs have gain a substantial portion of the education market (such as Moodle). Propriety commercial software that provides
similar features is not reviewed, as proprietary software product is not accessible without fee. In addition, many proprietary software product licenses include clauses that forbid public criticism of the product without the vendor's permission (Wheeler, 2007). Ten (10) open source LMS software with CMI concept are selected for the following reasons:

a) The language of instruction is English;

b) These software have organization or consortium to support ongoing development that indicating they are more likely to be sustained;

c) These software have published list of their adopters that indicating they are widely accepted by public;

The ten (10) open source LMS are summarized in subsequent sections.

a. Claroline

Claroline (http://www.claroline.net/) was initiated by the IPM, University pedagogy and multimedia institute from Catholic University of Louvain (UCL), Belgium in 2001. The project was financially supported by the Foundation Louvain. Claroline is a platform allowing teachers to build effective online courses and to manage learning and collaborative activities on the web. It is released under the Open Source license; a free online learning management system developed in PHP and MySQL and uses the current standards like sharable content object reference model (SCORM) and IMS question and test interoperability (IMS/QTI) for the exchange of contents. Claroline has been developed following teachers' pedagogical experience and needs. The Claroline platform is organized around the concept of space associated to a course or a pedagogical activity. Teachers or education organizations are able to create and administrate courses through the web. Each course space provides a list of tools enabling the teacher to do the following tasks: write a course description, publish
documents in any format, administer public and private forums, develop learning paths, create groups of students, prepare online exercises, manage an agenda with tasks and deadlines, publish announcements, propose assignments to be handed in online, see the statistics of the users activity, and use the wiki to write collaborative document. Claroline is translated in 35 languages and used by 86 countries with 1056 organization around the world. The Claroline project is the winner of the 2007 UNESCO-King Hamad Bin Isa Al-Khalifa Prize for the Use of ICT in Education. The Claroline Consortium was set up in May 2007. It is an international non-profit association that aims at organizing the promotion and the development of the Claroline platform at the technical and pedagogical level. It opens its doors to every user (person or organization) who is interested in collaborating to the development and promotion of the Claroline platform. The Consortium coordinates the efforts and strengths of all the people involved in the Claroline project. The Consortium also has the mission to redefine the platform evolution strategy.

b. Integrated Learning, Information and CooperAtion System (ILIAS)

The first prototype of ILIAS (http://www.ilias.de/) was developed in end of 1997 within the VIRTUS project at University of Cologne, Germany. In November 1998 version 1 of the ILIAS was published and offered for eLearning at the Cologne faculties of business administration, economics and social sciences. The aims of VIRTUS project was to (a) enable time independent distance learning; (b) expand the traditional functions of higher education by a web-based learning and working environment; and (c) improve communication between students and teachers (Kunkel, 2005). ILIAS has become open source software developed in Apache, PHP with MySQL in 2000. ILIAS allows efficient creation of courses and course materials as well as managing the learning resources. It offers standardized tools and templates for the learning and
working process including integrated navigation and administration. ILIAS has many features under different topics that including Personal Desktop, Course Management, Group System, Repository, Communication, Test and Assessment, Supported Standards (LOM, SCORM 1.2, SCORM 2004, IMS-QTI, and AICC), ILIAS content modules, Learning Management Features and System Administration. ILIAS is supported by ILIAS open source development team, a group of active developers and maintainers all around the world for developing new features, maintaining language versions and doing bug fixing. The ILIAS open source team at the University of Cologne coordinates contribution from volunteer worldwide. ILIAS offers translations for twenty one languages and has been used by institutions from more than twenty countries.

c. Online Learning And Training (OLAT)

OLAT (http://www.olat.org/website/en/html/index.html) is a web application that supports any kind of online learning, teaching, and tutoring with little didactical restrictions. OLAT is a web-based open source learning management system. The development of OLAT started in 1999 at the University of Zürich, Switzerland and it won the MeDiDa-Prix in the year 2000. OLAT has been developed from the beginning to support campus wide E-learning. It runs on Apache web server, Java SDK, Tomcat Servlet Engine and a database like MySQL or PostgreSQL. The University of Zurich has a team of 12 developers to support OLAT development. OLAT has a lot of features under the topics: Users and Groups, Course Management, Authentication Options, Course Elements OLAT Offers, and Multilingual. OLAT supports eLearning standards such as SCORM and IMS QTI. It offers translations for over 15 languages and uses Asynchronous JavaScript and XML (AJAX)/Web 2.0 technology. There are about 150 OLAT installations running worldwide. The main OLAT installation is located at the University of Zurich (maintained by the Multimedia & E-Learning Services of the University of Zurich) but used by more universities such as the University of Basel, the
University of Bern, the University of Lucerne, the Swiss Federal Institute of Technology in Zurich and in Lausanne.

d. Modular Object-Oriented Dynamic Learning Environment (Moodle)

Moodle (http://moodle.org) was created by Martin Dougiamas, a WebCT administrator at Curtin University Australia. The design and development of Moodle is guided by “social constructionist pedagogy”. Moodle is designed to help educators create online courses with opportunities for rich interaction. It emphasizes that user (students and teachers) can contribute to the educational experience in many ways. Moodle's features reflect this in various design aspects, such as work collaboratively in a wiki or glossaries. Its open source license and modular design enable people develop additional functionality. It can run in any system that supports PHP with MySQL or PostgreSQL. Since 2003, development is undertaken by a globally diffused network of commercial and non-commercial users, spearheaded by the Moodle Company based in Perth, Western Australia. Moodle has many features expected from an e-learning platform including: Forums, Content managing (resources), Quizzes with different kinds of questions, Blogs, Wikis, SCORMs/AICC, Resources, Surveys, Chat, Glossaries, Peer assessment, Multi-language support. Moodle has a significant user base with over 36,000 registered sites with 16 million users in 1.6 million courses and support over 70 languages.

e. Knowledge Environment for Web-based Learning – The next Generation (KEWL.NextGen)

KEWL.NextGen (http://avoir.uwc.ac.za/avoir/index.php?module=cms) is a free/open source e-learning platform. KEWL.NextGen was developed using its predecessor KEWL, has many features expected from a cutting-edge e-learning environment for content, communication, assessment, personalization, and management. KEWL was
developed initially by Derek Keats at the University of the Western Cape (Republic of South Africa) as an ASP application in the 1990s, but was rewritten in PHP with MySQL or PostgreSQL in 2005 as part of the African Virtual Open Initiatives and Resources (AVOIR) project so that it would run on Linux and other platforms. The AVOIR project is a collaborative effort among several African higher education institutions to support capacity building in Free and Open Source software engineering. KEWL's objective is to partner with other African institutions to enable collaboration, open sharing of knowledge, and make possible distance learning. KEWL has been adopted by other institutions such as the University of Ghana Legon and the NetTel Africa project. Examples of KEWL.NextGen modules include, content authoring and organization, quiz, worksheets, assignments, problem based learning, weblog, chatroom, instant messaging, e-mail, buddy lists, calendar, smart web search, file storage and sharing, image gallery, commenting, SCORM, and many others. KEWL.NextGen can play SCORM 1.2 fully compliant SCOs and a process is under way to obtain SCORM compliance certification. KEWL.NextGen is under active development by a team of developers in 11 African higher education institutions. It is used in universities around Africa, as well as in Afghanistan, Iran, and the Philippines (Tectonic, 2006).

f. ATutor

ATutor (http://www.atutor.ca/atutor/) is an Open Source Web-based Learning Content Management System (LCMS) released in late 2002 from the University of Toronto’s (Canada) Adaptive Technology Resource Center. ATutor is written in the PHP language with MySQL. It is designed for accessibility and adaptability. Examples of accessibility features in the system are text alternatives for all visual elements, and keyboard access to all elements of the program. There are four main areas that reflect the adaptability of ATutor design principle: themes, privileges, tool modules, and groups. Themes are used
to give ATutor a new user interface from which users could choose one as a preference setting. The privilege system allows instructors to assign tool management privileges to particular members of a course. Instructors may create assistants or course tutors that had limited control over any of the authoring or management tools. Educators can quickly assemble, package, and redistribute Web-based instructional content, easily retrieve and import prepackaged content, and conduct their courses online. Students learn in an adaptive learning environment. ATutor supports four different user roles: learners, instructors, administrators, and developers. Among the features supported by ATutor are Forums, Glossary, File storage, chat, Frequently Ask questions, Links, tests and surveys, site-map, polls, directory, groups, blogs, reading list, web search, export content, and my tracker. ATutor also includes a SCORM 1.2 Runtime Environment (LMS RTE3) for playing and managing SCORM based Sharable Content Objects (SCOs). ATutor offers translations for twenty five languages. The ATutor Development Site has been created as a place to learn about the ATutor source code, and as a place for volunteers to contribute to ATutor's development. ATutor’s core development team is with The Adaptive Technology Resource Centre, University of Toronto, Canada. ATutor is used internationally and has been translated into over fifteen languages.

g. Learning Online Network with Computer-Assisted Personalized Approach (LON-CAPA)

LON-CAPA (http://lon-capa.org) is an Open Source Freeware Distributed Learning Content Management and Assessment System that runs on a Linux server. LON-CAPA is the product of the joint efforts of the CAPA (a Computer-Assisted Personalized Approach) and LectureOnline groups. LON-CAPA provides a superset of the CAPA and LectureOnline functionalities. The core LON-CAPA development team is based at Michigan State University and the first beta-tested with two
courses at Michigan State University (USA) in 2001. LON-CAPA is a full-featured, web-based course management system. It aims to allow sharing and using online learning and assessment materials across institutions and disciplines. It possesses the features such as homework assignments, assessment analysis, porting content (LON-CAPA supports IMS Package Import from other Course Management Systems), one source/multiple targets, multilingual resources, clicker device support, and integration of Computer Algebra System. LON-CAPA differs from traditional e-learning platforms in that its many web servers (in various parts of the world) can communicate with each other. As such, LON-CAPA is referred as the LON-CAPA network. The LON-CAPA network allows participating universities and schools to create learning resources (test problems, web pages, etc.) and to share them across the network. The majority of LON-CAPA's learning resources are written in English. LON-CAPA domains are operated by individual universities, community colleges and high schools in the United States, Canada, Europe, Asia, South America and Africa.

h. dotLRN

dotLRN (http://dotlrn.org/product/) is originally funded by the Sloan School of Management at The Massachusetts Institute of Technology (USA) and is the most widely adopted enterprise-class open source software for supporting e-learning and digital communities. dotLRN is used worldwide by over half a million users in higher education, government, non-profit, and K-12. dotLRN is backed by the dotLRN Consortium, a non-profit organization committed to advancing innovation in educational technology through open source principles. The Consortium’s goal is to: (a) provide the premier toolkit for innovation in educational technology and research collaboration; (b) support education and research communities with advanced collaboration tools; (c) provide a scalable architecture based on open industry standards;
and (d) create a sustainable and affordable platform adaptable to local languages and cultures. Consortium member institutions work together to support each other's deployments and to accelerate and expand the adoption and development of dotLRN. dotLRN is built using the OpenACS (Open Architecture Community System) object oriented web application framework. OpenACS runs on AOLserver (America Online's open source web server) with either Oracle or PostgreSQL as its database. dotLRN is a full-featured application for rapidly developing web-based learning communities. The system allows users and administrators to define different kind of communities, where each community can be equipped with different tools and resources for shared work, dialogue, and investigation. dotLRN features a lot of applications such as assessment, forums, e-mail, calendar, curriculum, news, homework dropbox, staff list, project manager, survey, gradebook, syllabus, user tracking, FAQs, file storage, weblogger, and slide presentations. DotLRN has been internationalized to support multiple languages, dialects and time zones. An editor that allows easy addition of other languages is provided. It is used in America, Asia, Africa, Australasia, and Europe.

i. Sakai

The Sakai (http://www.sakaiproject.org/) is a free, community source, educational software platform distributed under the Educational Community License. Sakai is a Java-based, service-oriented application suite. The objective of the project is to develop a common collaboration and learning environment for education. The early versions of the software were based on existing tools created by the founding institutions, the University of Michigan's (USA) ‘CHEF’ course management system. Sakai provides around twenty six software tools designed to help instructors, researchers and students to create websites on the web for teaching and learning purpose. The software tools includes including document distribution, a gradebook, discussion, live chat, assignment uploads, and online testing. The Sakai community is made up of volunteer resources
drawn from many different organizations around the world. The Sakai Foundation is a member-based, non-profit organization that is dedicated in the collaborative design, development and distribution of open-source software for education, research and related scholarly activities. The foundation is supported by voluntary partner contributions. Sakai is in production at over 150 institutions and being piloted by over 100 institutions.

j. Metacoon

Metacoon (http://www.metacoon.net/) is an online platform for learning, cooperative work and for producing learning material (authoring tools). The development started in 2001 at the Bauhaus University of Weimar, Germany. The Metacoon project is part of a support programme for new media in education. The platform is open source (Linux, Apache, MySQL, and PHP) and the authoring tools (Tomcat and Cocoon are required in order to render XML to HTML and PDF) are freeware. Metacoon uses the “room metaphor” in which the platform can be imagined as a virtual house with as many virtual rooms as there are courses or projects managed using the platform. A metacoon platform consists of a website with entrance room (for all platform users) and any number of learning or working rooms. The system is adaptable as it bases on a modular design principle. Each learning/working room can individually equip with tools for learning, communication, cooperation and authoring. Therefore the system is used as an LMS and also as a virtual office, a platform for distributed research and development projects or a community portal. On the learning platform any learning material can be found. For instance PDF-files, slide shows (Power Points), HTML course material, SCORM course material. Besides, authors can produce learning material with the following metacoon authoring tools: (a) Hypertexts: XML learning material pages can be produced with OpenOffice (having a metacoon plug in), animations, figures, videos
and entries of the reference book of the platform (like glossary or the bibliography) can be included; (b) Video slide presentations and audio slide presentations are produced with an authoring tool on the platform; and (c) Question and tests are produced with an authoring tool from the university of Chemnitz "ELQues". This open source project is mainly financed by the service provider metacoon services. Several universities and companies in Germany are cooperating for further development of the system. The system is used by all universities in the German federal state of Thuringia with a state contract, schools / vocational schools, professional training that is in administration or business.

5.4. An Analysis of the Functional Requirements of CMI in Open Source LMS

This section summarizes, compares and analyses the functional requirements for CMI described in previous section. The examples of features relevant are listed below:

a) Authoring tool which enables educators to create test questions, assignment questions;

b) Function to write instructional prescriptions;

c) Functions to keep track students’ performance and record;

d) Functions to generate reports of students’ performance;

e) Authorization and access management, which is related to the authorization of users and the verification of their access rights for the use of tests, submission of assignment and projects reports;

f) Functions to maintain and organize user data such as users’ personal data, and course data;

g) Functions to enable educators to make available their instructional resources including learning objectives, learning resources, assessment of students
performance, view and keep records of students’ progress for the courses under their responsibility.

The ten (10) open source LMS selected for this analysis have been described earlier and the CMI features that supported by these open source LMS are highlighted, summarised and tabulated (Table 5-2 to Table 5-11).

Table 5-2
Features support by Claroline

<table>
<thead>
<tr>
<th>CMI Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manage documents and links</strong></td>
</tr>
<tr>
<td>-Publishing documents and files accessible to the users</td>
</tr>
<tr>
<td>-Creating directories and sub-directories to gather files</td>
</tr>
<tr>
<td>-Creating hyperlinks and building HTML pages</td>
</tr>
<tr>
<td><strong>Create online exercises</strong></td>
</tr>
<tr>
<td>-Creating exercises with a list of questions</td>
</tr>
<tr>
<td>-Elaborating different types of questions</td>
</tr>
<tr>
<td>-Tracking the results of the users</td>
</tr>
<tr>
<td><strong>Coordinate group work</strong></td>
</tr>
<tr>
<td>-Creating several groups of users enrolled in this course</td>
</tr>
<tr>
<td>-Defining the registration settings</td>
</tr>
<tr>
<td>-Providing own tools for each group</td>
</tr>
<tr>
<td>-Facilitating the collaboration between users during group work</td>
</tr>
<tr>
<td><strong>Produce : assignments and wiki</strong></td>
</tr>
<tr>
<td>-Posting files that can interest other course members</td>
</tr>
<tr>
<td>-Submitting an assignment to the course manager</td>
</tr>
<tr>
<td>-Elaborating or filling out an assignment from home on a unique document</td>
</tr>
<tr>
<td>-Gaining time and efficiency in group work</td>
</tr>
<tr>
<td><strong>Organize : agenda and announcements</strong></td>
</tr>
<tr>
<td>-Adding events in the course calendar</td>
</tr>
<tr>
<td>-Showing the complete calendar displaying the events from all courses</td>
</tr>
<tr>
<td>-Attaching to an event a link to other tools of the course or to an existing resource</td>
</tr>
<tr>
<td>-Writing an announcement which will be displayed on the course homepage</td>
</tr>
<tr>
<td>-Sending an announcement by e-mail to a user or a group of users</td>
</tr>
<tr>
<td><strong>Supervise : users and statistics</strong></td>
</tr>
<tr>
<td>-Following the access to the platform</td>
</tr>
<tr>
<td>-Tracking the tools use</td>
</tr>
<tr>
<td>-Supervising the progression of the users</td>
</tr>
<tr>
<td><strong>Develop learning path</strong></td>
</tr>
<tr>
<td>-Creating complete sequences of learning activities</td>
</tr>
<tr>
<td>-Putting together modules that consist of documents, exercises or imported SCORM contents</td>
</tr>
<tr>
<td>-Stimulating the students to read documents</td>
</tr>
<tr>
<td>-Filling exercises and following a learning activity</td>
</tr>
<tr>
<td><strong>Discuss : chat and forum</strong></td>
</tr>
<tr>
<td>-Public discussion space divisible into topics (asynchronous conversation)</td>
</tr>
<tr>
<td>-Online discussion tool (synchronous conversation)</td>
</tr>
</tbody>
</table>
### Table 5-3
Features support by ILIAS

<table>
<thead>
<tr>
<th>Integrated Learning, Information and CooperAtion System (ILIAS) (<a href="http://www.ilias.de/">http://www.ilias.de/</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CMI Features</strong></td>
</tr>
<tr>
<td>1. <strong>Learning Management Features</strong>: a user can compare his/her process time with the recommended expenditure of time for a specific learning module.</td>
</tr>
<tr>
<td>2. <strong>Repository</strong>: users can find all available resources for learning and working such as ILIAS learning modules, digital books, or SCORM modules, learning objects, courses, discussions forums, files or working groups.</td>
</tr>
<tr>
<td>3. <strong>ILIAS Content Modules</strong>: support ILIAS Learning Modules, Glossaries, Digital Books</td>
</tr>
<tr>
<td>4. <strong>Test and Assessment</strong>: The test &amp; assessment supports the following types of questions: multiple choice, Single choice, Allocation questions, Cloze questions (free text, select box), arrangements duties, Hot spot (search images to click on), Unsettled questions.</td>
</tr>
<tr>
<td>5. <strong>Course Management</strong>: ILIAS offers a comprehensive and flexible course management to create a choice of eLearning courses. Arbitrary learning modules of the repository can be arranged to courses with forums, chats, groups and other objects.</td>
</tr>
<tr>
<td><strong>Other features</strong></td>
</tr>
<tr>
<td>6. <strong>Personal Desktop</strong>: personal work space for each user.</td>
</tr>
<tr>
<td>- Subscribed courses and content modules (include last visited page)</td>
</tr>
<tr>
<td>- Subscribed new and unread mails</td>
</tr>
<tr>
<td>- Subscribed own forums and groups</td>
</tr>
<tr>
<td>- Administration of the personal profile, for instance the language setting or vCard</td>
</tr>
<tr>
<td>- Administration of the personal bookmarks for internal and external links</td>
</tr>
<tr>
<td>- Calendar and time scheduler</td>
</tr>
<tr>
<td>- Memo feature</td>
</tr>
<tr>
<td>- Overview for monitoring of the personal learning progress</td>
</tr>
<tr>
<td>- Push-feature for the contents</td>
</tr>
<tr>
<td>7. <strong>Group System</strong>: Users can create groups that are open for everyone or have specially defined access restrictions. Other users can be invited or get access with a password.</td>
</tr>
<tr>
<td>8. <strong>Communication</strong>: ILIAS offers an internal news system, discussion forums and a combined PHP/Java chat. Tutors can moderate forums and chats.</td>
</tr>
<tr>
<td>9. <strong>Supported Standards</strong>: SCORM 1.2 (LMS-RTE3 compliant), AICC, LOM metadata, IMS QTI.</td>
</tr>
</tbody>
</table>
Table 5-4
Features support by OLAT


CMI Features:
1. Course Management
   - Flexible course system
   - Based on IMS Learning design concepts
   - Create a personalized course structure according to one needs
   - Course editor: create course using OLAT course elements
   - Group management: manage learners
   - Rights management: grant specific users access to course tools
   - Assessment tool: assess learners
   - Archive tool: download log files or runtime data and import/export courses
   - Create your own course layout using cascading style sheets (CSS)

2. Course Elements
   - Folders for download material
   - Tasks with drop box, sample solution and scores
   - Tests (with scores) and self-tests (anonymous, no scores) based on QTI standard
   - Questionnaire for course evaluations
   - Enrolment for groups (by student or tutor or both) with wait lists
   - Wiki
   - Single pages with integrated WYSIWYG HTML editor
   - Include external pages or sites
   - Forums and “file dialog” element to discuss papers

3. Users and Groups
   - Different roles
   - Various authentication methods
   - Administrators can add, modify or delete users
   - Personalized authoring and learning environment
   - Manage files via HTTP or WebDAV
   - Configure personal home portal
   - Calendar (per course, per group and combined personal calendar)
   - Be up-to-date as regards news and changes via e-mail or RSS feed
   - Full-text search
   - Share resources with other authors (learning resource repository)
   - Form own project groups and invite buddies
   - Use discussion forums, file share space, contact forms etc.
   - Instant Messenger

Other features
4. Authentication Options
   - Users can create their own accounts (with/without approval by administrators)
   - Direct login into OLAT with OLAT user name and password
   - Access file system via WebDAV login
   - Full Shibboleth integration
   - Single sign-on
   - Control access to courses

5. Online Help and Documentation
6. Multilingual: 15 languages
Table 5-5
Features support by Moodle

<table>
<thead>
<tr>
<th>Feature Support by Moodle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modular Object-Oriented Dynamic Learning Environment (Moodle) (<a href="http://moodle.org">http://moodle.org</a>)</td>
</tr>
</tbody>
</table>

CMI Features:
1. Assignments: enable educators to grade and provide comments for uploaded files and assignments created on and off line.
3. Quizzes: allows educators to design and set quiz tests, consisting of multiple choice, true-false, and short answer questions and more. Each attempt is automatically marked, and the teacher can choose whether to give feedback or to show correct answers.
4. Resources: can be prepared files uploaded to the course server; pages edited directly in Moodle; or external web pages made to appear part of this course.
5. Lessons: delivers content related multiple choice questions in pages.
6. Wiki

Other features:
7. Glossaries
8. Chats
9. Choices (Poll)
10. Forums
11. SCORM package (SCORMs/AICCs)
12. Workshops: peer assessment activity with a huge array of options. It allows participants to assess each other's projects, as well as exemplar projects, in a number of ways.
13. Survey

Table 5-6
Features support by KEWL.NextGen

<table>
<thead>
<tr>
<th>Feature Support by KEWL.NextGen</th>
</tr>
</thead>
</table>

CMI Features:
1. Content: Content management, Glossaries with parsing in content pages, Instructional Design, File uploads, Multimedia parsing, including audio, video, mindmaps, timelines (in v. 3.0), Google Maps (in v. 3.0), Wiki.
2. Assessment (including formative assessment): Quizzes with a variety of question types, Rubrics with links to assessment activities that can be assessed including forums, podcasts, blogs, and essays. Essays and written assignments, Configurable assignment types

Other features:
3. Communication: Forums, Weblog (Blog), Podcast, Chat, Instant messaging, Homepage and buddy lists.
4. A full online survey capability, Multi-language support, Easily skinnable interface, GUI management tools, Flexible configuration options at the level of site and course.
### Table 5-7
Features support by ATutor

<table>
<thead>
<tr>
<th>CMI Features</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Content Usage:</strong> Individual usage statistics can be reviewed to identify gaps in content coverage and the learning tendencies of each learner.</td>
<td></td>
</tr>
<tr>
<td><strong>2. Work groups:</strong> Instructors can manually create, or automatically generate work groups for a variety of purposes.</td>
<td></td>
</tr>
<tr>
<td><strong>3. Assignment drop box:</strong> Instructors can create file folders for collecting assignment submissions, collected from all course members, from group members, or from individuals.</td>
<td></td>
</tr>
<tr>
<td><strong>4. Reading List:</strong> Instructors can gather a list of resources (books, papers, urls etc.) related to topics in a course, and create a Reading List based on those resources.</td>
<td></td>
</tr>
<tr>
<td><strong>5. File Manager:</strong> Instructors can upload and manage course related files. Directories can be created to sort files, zip archives can be uploaded and unpacked.</td>
<td></td>
</tr>
<tr>
<td><strong>6. Test manager:</strong> Instructors can create tests with multiple choice, true/false, Likert, ordering, matching, drag and drop, and a number of open ended question types. M/C, multi-select M/C, ordering, matching, and T/F questions are marked automatically.</td>
<td></td>
</tr>
<tr>
<td><strong>7. Course Property:</strong> Instructors can view course log in statistics, edit course properties, and send course-wide email messages.</td>
<td></td>
</tr>
</tbody>
</table>

**Other features**
- News and Announcement
- Enrollment Manager
- IMS QTI Test Export
- Content editor
- Visual editor
- Manager file storage
- Guest Access
- Backup Manager
- Learning tools
- Polls
- Forums
- E-mail
- Privileges

### Table 5-8
Features support by LON-CAPA

<table>
<thead>
<tr>
<th>CMI Features</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Homework Assignments:</strong> create and/or assemble individualized assignments, quizzes, and examinations</td>
<td></td>
</tr>
<tr>
<td><strong>2. Assessment Analysis:</strong> give an overview of how the students are performing on all assignments</td>
<td></td>
</tr>
<tr>
<td><strong>3. Multilingual Resources:</strong> resources (text pages, homework problems, …) can have multiple languages embedded into them. According to the course preferences, when the resources is rendered server-side, different sections are rendered</td>
<td></td>
</tr>
<tr>
<td><strong>4. Resource Assembly Tool:</strong> Faculty can assemble resources from the shared resource pool</td>
<td></td>
</tr>
<tr>
<td>Authorization in LON-CAPA is roles based. A user can have roles across domain boundaries.</td>
<td></td>
</tr>
</tbody>
</table>

**Other features**
- Clicker Device Support: Users (both faculty and students) can register their clicker devices within LON-CAPA
- Porting Content: supports IMS Package Import from other Course Management Systems, such as BlackBoard, WebCT, or ANGEL
- One Source/Multiple Targets: LON-CAPA resources can render themselves in online mode, print mode, online exam mode, bubble-sheet mode, PDA, and different accessibility modes, as well as edit mode for online problem creation
- Integration of Computer Algebra System: works with the MAXIMA CAS system
- Real time chat
- Cross-Institutional Network: is a geographically distributed network of persistently connected servers at schools, colleges, and universities
Table 5-9
Features support by dotLRN

<table>
<thead>
<tr>
<th>CMI Features</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assessment: provides capabilities to conduct surveys, tests and dynamic</td>
<td>provides</td>
</tr>
<tr>
<td>information gathering in general.</td>
<td>capabilities</td>
</tr>
<tr>
<td>2. Curriculum: create, publish and add elements to curriculum</td>
<td></td>
</tr>
<tr>
<td>3. Homework Dropbox: enables students to submit homework assignments</td>
<td></td>
</tr>
<tr>
<td>4. Gradebook/Evaluation: post assignments, create assignments, create</td>
<td></td>
</tr>
<tr>
<td>assignment groups, submit answers, evaluate the assignments, post reports</td>
<td></td>
</tr>
<tr>
<td>for the student, give each user different privileges.</td>
<td></td>
</tr>
<tr>
<td>5. Syllabus: add a file or URL for the class syllabus</td>
<td></td>
</tr>
<tr>
<td>6. File Storage: Users have access to their own private files or public files</td>
<td></td>
</tr>
<tr>
<td>that are shared with other users.</td>
<td></td>
</tr>
<tr>
<td>7. WimpyPoint: alternative for Microsoft’s PowerPoint Slide presentations</td>
<td></td>
</tr>
<tr>
<td>8. FAQs</td>
<td></td>
</tr>
<tr>
<td>9. User Tracking: view community statistics, registration history, and</td>
<td></td>
</tr>
<tr>
<td>contributions history.</td>
<td></td>
</tr>
<tr>
<td>10. Staff List</td>
<td></td>
</tr>
<tr>
<td>Other features</td>
<td></td>
</tr>
<tr>
<td>11. Weblogger</td>
<td></td>
</tr>
<tr>
<td>12. News</td>
<td></td>
</tr>
<tr>
<td>13. Forums</td>
<td></td>
</tr>
<tr>
<td>14. E-Mail/Bulk mail</td>
<td></td>
</tr>
<tr>
<td>15. LORS Central (Learning Object Repository)</td>
<td></td>
</tr>
<tr>
<td>16. Calendar</td>
<td></td>
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<tr>
<td>17. LORS Management</td>
<td></td>
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<tr>
<td>18. Photo Album</td>
<td></td>
</tr>
<tr>
<td>19. Project Manager: manage tasks, assignees and working hours of projects</td>
<td></td>
</tr>
<tr>
<td>20. survey</td>
<td></td>
</tr>
</tbody>
</table>

Table 5-10
Features support by Sakai

<table>
<thead>
<tr>
<th>Sakai (<a href="http://www.sakaiproject.org/">http://www.sakaiproject.org/</a>)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CMI Features:</td>
<td></td>
</tr>
<tr>
<td>1. Announcements Tool: is an online bulletin board, allowing instructors to</td>
<td></td>
</tr>
<tr>
<td>post upcoming events and due dates on a site’s homepage</td>
<td></td>
</tr>
<tr>
<td>2. Assignments Tool: enables an instructor to post, grade, and return</td>
<td></td>
</tr>
<tr>
<td>assignments to students</td>
<td></td>
</tr>
<tr>
<td>3. Gradebook: allows a user to view grades for a course.</td>
<td></td>
</tr>
<tr>
<td>4. Syllabus Tool: create a course syllabus with Sakai’s text editor</td>
<td></td>
</tr>
<tr>
<td>5. Tests and Quizzes: students can take graded and ungraded exams</td>
<td></td>
</tr>
<tr>
<td>6. Wiki Tool Website Information Tool</td>
<td></td>
</tr>
<tr>
<td>7. Resources Tool</td>
<td></td>
</tr>
<tr>
<td>Other features</td>
<td></td>
</tr>
<tr>
<td>8. Chat Room Tool</td>
<td></td>
</tr>
<tr>
<td>9. Help Tool</td>
<td></td>
</tr>
<tr>
<td>10. Discussion Tool</td>
<td></td>
</tr>
<tr>
<td>11. Email Archive Tool</td>
<td></td>
</tr>
<tr>
<td>12. Website Setup Tool</td>
<td></td>
</tr>
<tr>
<td>13. Site Info Tool</td>
<td></td>
</tr>
<tr>
<td>14. Membership Tool</td>
<td></td>
</tr>
<tr>
<td>15. Message Center</td>
<td></td>
</tr>
<tr>
<td>16. My Workspace</td>
<td></td>
</tr>
<tr>
<td>17. News Tool</td>
<td></td>
</tr>
<tr>
<td>18. Permissions and Roles</td>
<td></td>
</tr>
<tr>
<td>19. Preferences</td>
<td></td>
</tr>
</tbody>
</table>
Table 5-11
Features support by Metacoon

<table>
<thead>
<tr>
<th>CMI Features:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. learning material:</td>
</tr>
<tr>
<td>- learning material pool with a search function and a describing page for each item</td>
</tr>
<tr>
<td>- all learning materials displayable in a web browser can be managed by metacoon includes:</td>
</tr>
<tr>
<td>PDF, power point documents, Word documents, videos, animations, hypertext learning material,</td>
</tr>
<tr>
<td>SCORM courses can be imported</td>
</tr>
<tr>
<td>- metacoon Hypertext-learning materials feature a search functionality and related links to other chapters within a course, a PDF/print functionality, they can contain all media types mentioned above. In addition you can add reference books and bibliographies.</td>
</tr>
<tr>
<td>- Central List of required/recommended literature – entries can be subscribed for each course</td>
</tr>
<tr>
<td>- Reference books (can be included in learning materials): glossary, products and standards, persons, institutions, (adaptable)</td>
</tr>
<tr>
<td>- Turn in assignments (privacy is guaranteed; visability can be set up by the room owner)</td>
</tr>
<tr>
<td>- Feedback on assignments (privacy is guaranteed)</td>
</tr>
<tr>
<td>2. cooperative authoring / wiki</td>
</tr>
<tr>
<td>- flexible rights management for groups of authors</td>
</tr>
<tr>
<td>- books of reference</td>
</tr>
<tr>
<td>- central literature management</td>
</tr>
<tr>
<td>- course weblinks and private link management</td>
</tr>
<tr>
<td>- use the information/research system of your library/division</td>
</tr>
<tr>
<td>- produce audio and video presentations</td>
</tr>
<tr>
<td>- produce hypermedia learning material using OpenOffice and our transformer plugin - books of reference, literature lists and all common types of media can be integrated (freeware)</td>
</tr>
<tr>
<td>- quizzes and test according to the QTI standard can be created using the ELQues software developed by the University of Chemnitz (Freeware)</td>
</tr>
<tr>
<td>- use the course builder to compile courses from existing hypertext learning material (the index data structure of a course complies with the standards of the SCORM Manifest)</td>
</tr>
<tr>
<td>- render appealing HTML or PDF learning material from your XML data (appearance of the courses can be adapted to your corporate design)</td>
</tr>
</tbody>
</table>

Other features

3. desk:
- my rooms |
- enrolment for rooms (rooms represent lectures, courses or seminars) |
- news on the platform (new courses/rooms, tasks, learning materials, bulletins, users…) |
- personal and group calendar |
- task management including assignment distribution and status display |
- project management, links on entries |
- file manager (home directory for each user, group directories) |
- visual directory structure, check/uncheck or lock files and folders, version management |
- picture gallery (use it to store any kind of photos (e.g. shots of your whiteboard during presence teachings) link those images to any kind of entry on the platform (e.g. course descriptions, personal profiles…) |
- take notes |

4. communication and individual settings |
- Global communication tools (for the whole platform): address book with e-mail functionality, instant messages / Messenger (global) |
- the following communication tools can be set for each course/room: list of all online users for each room with a messenger functionality, business cards, pin boards (for definable topics), forums, chat rooms, mailing lists for groups, group presentations with list of members |
- settings: nickname und icon, User name, password, system settings |
This research focuses on the use of CMI concept to support the IS instructional processes, as such, only the CMI-related functions are presented in the analysis. Based on the data collected from the ten (10) open source LMS, a total of five (5) major requirements or tools have been compiled and categorised as follows:

a) Authoring tools

b) Prescription tools
c) Report generation tools
d) Record keeping tools
e) Authorization and access management
f) Other typical services

a) Authoring tools for tests features

Authoring tools provide a platform to support tests. The most typical authoring tools an LMS provides is that it enables the educators to create true or false, matching and fill in the blank questions. This section presents features that are desirable for authoring tools in LMS and further analyses and compares the authoring features in the ten LMS initiatives under study. All the ten (10) open source LMS under this study provide tests features under different titles such as online exercises, quizzes, test manager, assessment tool, test and assessment. Claroline, Moodle, ATutor, KEWL.NextGen, and Sakai support different types of questions include multiple choice-single answer, fill in the blanks, true/false, multiple choice-multiple answer, matching and ordering. ATutor supports drag and drop, and a number of open ended question types as well. ILIAS supports the following types of questions: multiple choice, multiple answers, allocation questions, cloze questions (free text, select box), arrangements duties, hot spot (search images to click on), unsettled questions. dotLRN supports different types of questions: short answer, open question, file-
upload questions and multiple choice questions. Metacoon ELQues (E-Learning-Questionnaire) supports a range of common question types such as multiple choice, multiple response, short answer, ordered-object, drag and drop, fill-in-the-blank, and image hotspot. LON-CAPA supports questions including true/false, matching, ordering, fill in the blanks, multiple-choice, multi-component formula response, click-on-image. OLAT only supports questions with multiple choice-multiple answers and multiple choice-single answer, and fill in the blank. A summary of the authoring features available at each open source LMS is presented in Table 5-12.

Claroline, ILIAS, ATutor, Moodle, LON-CAPA and Sakai support question/test banks feature. With this feature, educators can deposit questions in a question bank and the questions are re-usable. Students of Claroline, KEWL.NextGen and ATutor have to complete tests within the “Start date” and “end date” that set by the educators. Other LMS do not support deadline for quizzes. All open source LMS support equal weighting for answers except Claroline and ILIAS. Claroline and ILIAS enable educators to set different marks for each question asked. Claroline, OLAT, Moodle, LON-CAPA and dotLRN required the students to complete the exercises within certain time limit and the instructors can set the number of attempts allowed that range from one (1) to unlimited. ATutor supports number of attempts allowed. Claroline, dotLRN and ATutor support anonymous attempts for the exercises given. Claroline and LON-CAPA can randomize the questions and answers.

Open source LMS has common quizzes features that similar to one another but some of the LMS support features that other do not. ATutor supports additional features such as assign tests to groups of students, and allow guests to take tests.
ILIAS supports the determination of the schemes for evaluation and the margin of error for announced answers. The examination performance of a participant can be used to activate self-controlled new, previously arranged contents. All results of tests and questions are exportable in formats of excel or Comma Separate Value (CSV), for data analysis in specific evaluation tools. In addition to quizzes, Moodle support Hot Potatoes quizzes. The Hot Potatoes suite enables educators to create interactive multiple-choice, short-answer, jumbled-sentence, crossword, matching/ordering and gap-fill exercises. Hot Potatoes is not freeware, but it is free of charge for those working for publicly-funded non-profit-making educational institutions, which make their pages available on the web (Hot Potatoes, n.d.).

dotLRN assessment tool supports a lot of features that are not available in other LMS such as set the number of questions displayed on each page, display questions by: order of entry, randomly or alphabetical, set up an action in order to execute a transaction into the system, called triggers (such as set up a registration form in order to use it on the registration process). Users can export user responses to CSV file format. dotLRN assessment tool acknowledges users who already complete the assessment via an e-mail. Educators can import a Question & Test Interoperability (QTI) zip file to create an assessment or export an assessment into a QTI zip file. Sakai provides Quiz and Test Tool which offers a variety of options such as randomizing answers, importing questions, and organizing the assessment into sections. The Tests and Quizzes support file upload and audio recording as types of question types.
### Summary of authoring tool for tests features

<table>
<thead>
<tr>
<th>Open source LMS</th>
<th>Tests element</th>
</tr>
</thead>
</table>
| 1. Claroline (http://www.claroline.net/) | Online Exercises  
- Creating exercises with a list of questions  
- Elaborating different types of questions (multiple choice-single answer, fill in blanks, true/false, multiple choice-multiple answer, matching)  
- Instructor can create personal test banks  
- Different weighting of the answers  
- Start date and end date  
- Number of Attempts allowed  
- Anonymous attempts (for each exercise)  
- Maximum allowed time  
- Randomize the questions and answers.  
- View Results  
- Tracking the results of the users |
| 2. Integrated Learning, Information and CooperAtion System (ILIAS) (http://www.ilias.de/) | Test and Assessment  
- Supports the following types of questions: multiple choice, single choice, Allocation questions, Cloze questions (free text, select box), arrangements duties, Hot spot (search images to click on), Unsettled questions.  
- Questions are deposited in a question pool and arbitrarily re-usable. All kinds of types of questions can be combined in setting the tests.  
- Supports different weighting of the answers, the determination of the schemes to evaluate and the margin of error in announced answers.  
- All results of tests and questions are exportable in formats of excel or CSV and so enable deeper evaluable in specific evaluation tools |
- Supports multiple choice and Single choice questions, and fill in the blank  
- Number of Attempts allowed (for each question)  
- Maximum allowed time  
- View Results |
| 4. Modular Object-Oriented Dynamic Learning Environment (Moodle) (http://moodle.org) | Quizzes  
- Consisting of multiple choice, true/false, and short answer questions, numerical, matching.  
- The teacher can choose whether to give feedback or to show correct answers  
- Teachers can assemble quizzes from the questions in the question bank  
- Teachers can set a variety of options determining how the student interacts with the quiz (time limit, repeated attempts, level of feedback)  
- Support Hot Potatoes quizzes |
- Creating exercises with a list of questions  
- Elaborating different types of questions (multiple choice-single answer, fill in blanks, true/false, multiple choice-multiple answer, matching)  
- Start date and end date |
### 6. ATutor (http://www.atutor.ca/atutor/)
- Test Manager
  - Different types of questions (multiple choice-single answer, true/false, multiple choice-multiple answer, Likert, ordering, matching, drag and drop, and a number of open ended question types)
  - Start date and end date
  - Number of Attempts allowed
  - Anonymous attempts (for each exercise)
  - Select from a pool of questions to generate random question quizzes.
  - Assign tests to groups of students.
  - A test property can be set to allow guests to take tests.

### 7. Learning Online Network with Computer-Assisted Personalized Approach (LON-CAPA) (http://lon-cap.org/)
- Quizzes
  - Support different types of questions (true/false, matching, ordering, fill in blanks, multiple-choice, multi-component formula response, click-on-image)
  - Test banks
  - Number of Attempts allowed
  - Maximum allowed time
  - Randomize the questions and answers

### 8. dotLRN (http://dotlrn.org/product/)
- Assessment
  - Create assessment that allows anonymous responses.
  - Set the time required to complete an assessment and the number of tries allowed.
  - Reuse sections and questions.
  - Create different types of questions: short answer, open question, file-upload questions and multiple choice questions.
  - Set the number of questions displayed on each page.
  - Reuse set of multiple choices.
  - Display questions by: order of entry, randomly or alphabetical.
  - Set up an action in order to execute a transaction into the system, called triggers (e.g. set up a registration form in order to use it on the registration process).
  - Export user responses to CSV file format.
  - Send e-mail to people who already complete the assessment.
  - Import a QTI zip file to create an assessment or export an assessment into a QTI zip file.

### 9. Sakai (http://www.sakaiproject.org/)
- Quiz and Test Tool
  - Support multiple choice, multiple answer, true/false, short answer, matching, or fill in the blank questions.
  - Provides a variety of options such as randomizing answers, importing questions, creating a question pool, and organizing the assessment into sections.
  - Allows for file upload and audio recording as types of question types.

### 10. Metacoon (http://www.metacoon.net/)
- “ELQues”
  - Support a range of common question types such as multiple choice, multiple response, short answer, drag and drop, ordered-object, fill-in-the-blank, and image hotspot.
b) Prescription tools

Based on the data about each student, the system can provide information in the form of prescriptions or advice as to material or course selection for the completion of set objectives. Claroline (http://www.claroline.net/) supports remedial prescription in which students have to re-study the material and pass the online exercise before starting the next learning material in the learning path module. Claroline also supports prescription for student assignment. Educator can type individual assignment feedback, private feedback and set the grades of the assignment as a feedback. ILIAS has the test and assessment tool that offers (a) an authoring tool for creating tests; (b) administration of existing questions in pools; (c) evaluation and grading routines and the possibility to give access to other modules depending on the test results (CampusSource, n.d.). Preconditions for the access of selected course items can be set and tested. The close functional linkage of the course management with test and assessment in ILIAS allows the individual check-up of previous knowledge and accomplished learning target of the course members. OLAT (http://demo.olat.org/demo/dmz/) supports tests with features such as feedback for answer, feedback for all correct answers and feedback for wrong answers. Whereas ATuTor has a feature that enable educators to set feedback for pass and fail score. LON-CAPA (http://lon-capa.org) supports remedial prescription where student can answer the homework assignment multiple times (99 times) until the correct answer is given. Tests and quizzes of Sakai (https://collab.sakaiproject.org/portal/help/main) supports (a) immediate feedback; (b) no feedback will be displayed to the student; (c) feedback will be displayed to the student at a specific date. Educators can choose any combination of the following options to include in the feedback: question text, student response, correct response, student's score, question-level feedback, selection-level feedback, grader's
comments, statistics and histogram. Assignments module in Moodle, dotLRN’s Homework Dropbox, Metacoon’s assignments, KEWL.NextGen’s assignments and essay allows instructors to comment, evaluate and return assignments.

c) Report generation
The computer can generate reports on student performance and progress for use by students, parents and educators. Claroline support statistics on the course access, tools use, and student learning progress. Instructors can view the statistics online and save the statistics in a CSV (Comma-Separated Values) file so that one can open it in a text editor or a spreadsheet (Abenoja, n.d.). In ILIAS, the report is based on the time a student has spent with the learning modules, courses, tests and exercises during all of his visits. ILIAS also supports educators to view all results of tests and exercises online. All results of tests and questions are exportable in formats of excel or CSV. OLAT has functions to generate reports, showing the time, date and frequency students as an aggregated group accessed the course content. Instructors can export the scores in the grade book to an external spreadsheet as well. Moodle supports feature where instructors can view students’ scores for assignments and can export the scores in the gradebook to an external spreadsheet. KEWL.NextGen enables instructors to view the results of students’ assignments and worksheet (University of Western Cape and Ryan Sain, n.d.). ATutor supports two statistics which are (a) Question Statistics which shows each question of the test and the number/percentage of students who chose each of the answers; (b) Submission Statistics shows each submission's overall mark and marks given for each test question. The overall test average is also calculated (ATutor, 2006). Instructors can view statistics online or export test marks in CSV format. LON-CAPA supports assessment analysis that gives an overview of how the students are performing on
all assignments. The educators can view the assessment analysis online. Sakai supports Gradebook tool that allows instructors view students’ grades online for assignments. dotLRN support an application named Gradebook/ Evaluation. With the evaluation system, students submit completed tasks online and they can see their grades at any time. The instructor can post reports to the students. dotLRN has another application named Assessment that support tests where the user responses can be export to CSV file. Assignments module of Metacoon enables instructors to view grade online.

d) Record keeping tools

Generally, the records maintained in a CMI system comprise an identification database, academic history and other data such as school, period, and class identification. An identification database contains student name, identification number, and demographic characteristics. Academic history includes assignment scores and course performance data, which made up a major portion of the student record. Claroline, ILIAS, OLAT, ATutor, Moodle, KEWL.NextGen, LON-CAPA, Sakai, Metacoon and dotLRN support monitoring and tracking of students learning progress from different aspects. Claroline supports (a) following the access to the platform; (b) tracking the tools use; and (c) supervising the progression of the users. Claroline supports learning path tracking list where the progression of users on all learning paths is kept. Instructors can look at the individual statistics by clicking the name of learner. In the exercises listing, instructors can click the statistics/tracking link requested by an orange line graph icon. Instructors can see every student’s statistics. Instructors can view details of the exercise for instance the average time it was taken and the score details. Instructors can save the statistics in a CSV file so that one can open it in a text editor or a spread sheet (Abenoja, n.d.).
ILIAS has a tool named "tracking of learning progress" which supports the course tutor in aiding the course members. A course tutor can know the course member who have not accessed certain contents (learning modules or tests or whole courses), and those who had attended successfully certain parts of the courses. In case the Course administrator / Learning Module author has selected a certain setting for the status control of the Learning Progress, learner can also decide on his own whether the course has been "completed". The test and assessment module support evaluation and grading routines that can be used for the monitoring of learning progress by the users as well as the tutors and examiners. The tutors and examiners can perform deeper evaluation on all results of tests and questions since tests and questions are exportable in formats of excel or CSV.

OLAT supports online grade book to monitor student learning progress. When instructors add an assignment to the course, the software automatically adds it to the grade book. Instructors can add grades for offline assignments and add details to the grade book in custom columns. Instructors can export the scores in the grade book to an external spreadsheet as well. Other than that, instructors can get reports showing the time, and date, and frequency students as an aggregated group accessed course content. (Edutools, 2008).

Moodle supports a feature where instructors can add detailed comments to manually graded items in the Assignment module, Lesson module, and Quiz module. When an instructor adds an assignment to the course, the software automatically adds it to the gradebook. Instructors can add grades for offline assignments and can export the scores in the gradebook to an external spreadsheet. Instructors can create a course
grading scale that can employ either percents, letter grades, or pass/fail metrics. KEWL.NextGen enables instructors to view or mark students assignment, essay and worksheet (University of Western Cape and Ryan Sain, n.d.). Instructors can view student’s online tests results. The assignments module for Metacoon shows the course member who have not submitted their reports. Instructors can comment and grade assignments under the assignments features of Metacoon.

ATutor support tests and surveys manager. There are two sets of statistics available for tests. Question Statistics shows each question of the test and the number/percentage of students who chose each of the answers. Submission Statistics shows each submission's overall mark and marks given for each test question. The overall test average is also calculated. Instructors can export test marks in CSV format (ATutor, 2006).

LON-CAPA supports an assessment analysis that gives an overview of how students perform on all assignments. The overall problem statistics page displays the following data about the problems currently in the course: the total number of students attempting the problem, the total number of attempts to solve the problem, the largest number of attempts to solve the problem by a student, the average number of attempts, the standard deviation of the tries, the skewness of the students' tries, the number of students who solved the problem correctly, the number of students who solved the problem by override, the percentage of students who tried to solve the problem but were unable to, and the degree of difficulty of the problem. For the sequence statistics, it shows the compiled statistics on problems based on their containing sequence. The following data are shown: the number of problem parts in the sequence, the mean, standard deviation, maximum, and minimum of the
scores of the selected students on the given sequence, the number of the selected students who submitted answers to problem parts in the sequence, the mean, standard deviation, maximum, and the minimum count of correct problem parts of the selected students on the given sequence, the number of the selected students who submitted answers to problem parts in the sequence, the reliability statistic (KR-21) measures the internal reliability of a test or exam. Submission time analysis gives a display and analysis of submission times on assessments. Instructors can see how the number of submissions varies while the problem is open. Instructors can also see how the number of students with the problem correct increases over time.

Sakai supports Gradebook that allows instructors to list course assignments and corresponding student scores, and calculate, store, and distribute grade information to students. Assignments are private and student submissions are not visible to other users of the site. Instructor can also have grades from the Assignments tool.

dotLRN supports an application named Gradebook/ Evaluation. With the evaluation system, students submit completed tasks online and they can see their grades at any given time. Instructors can create tasks, assign ratios to the tasks and post grades. The basic functionality of dotLRN package are: post assignments, create assignments categories, edit the ratios of the categories and assignments, create assignments groups, evaluate the assignments, submit and view grade reports, submit answers, post reports for the student, track changes/audit, and give each user different privileges. dotLRN has another application named Assessment that support tests where the user responses can be export to CSV file. A summary of the records maintained for students learning progress at each open source LMS is presented in Table 5-13.
Table 5-13
Summary of Records Maintained

<table>
<thead>
<tr>
<th>Open source LMS</th>
<th>Record keeping</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Claroline (<a href="http://www.claroline.net/">http://www.claroline.net/</a>)</td>
<td>Records of - following the access to the platform; - tracking the tools use; - supervising the progression of the users.</td>
</tr>
<tr>
<td>2. Integrated Learning, Information and CooperAtion System (ILIAS) (<a href="http://www.ilias.de/">http://www.ilias.de/</a>)</td>
<td>Records related to students access learning contents or tests or questions or whole course</td>
</tr>
<tr>
<td>6. ATutor (<a href="http://www.atutor.ca/atutor/">http://www.atutor.ca/atutor/</a>)</td>
<td>Records related to - each question of the test and the number/percentage of students who chose each of the answers - each submission's overall mark and marks given for each test question</td>
</tr>
<tr>
<td>7. Learning Online Network with Computer-Assisted Personalized Approach (LON-CAPA) (<a href="http://lon-cap.org/">http://lon-cap.org/</a>)</td>
<td>Records of - the total number of students attempting the problem - the total number of attempts to solve the problem - the largest number of attempts to solve the problem by a student - the average number of attempts, the standard deviation of the tries - the skewness of the students' tries - the number of students who solved the problem correctly - the number of students who solved the problem by override - the percentage of students who tried to solve the problem but were unable to - the degree of difficulty of the problem - the number of problem parts in the sequence - the mean, standard deviation, maximum, and minimum of the scores of the selected students on the given sequence - the number of the selected students who submitted answers to problem parts in the sequence - the mean, standard deviation, maximum, and the minimum count of correct problem parts of the selected students on the given sequence - the number of the selected students who submitted answers to problem parts in the sequence - the reliability statistic (KR-21) measures the internal reliability of a test or exam</td>
</tr>
<tr>
<td>10. Metacoon (<a href="http://www.metacoon.net/">http://www.metacoon.net/</a>)</td>
<td>Records related to submission of course assignments and student grades</td>
</tr>
</tbody>
</table>
e) Authorization and access management

All open source LMS under this analysis support authorization and access management. Users must register themselves before using the system. The majority of the LMS has user registration forms online that require the new users to fill in their personal information, user name and password to use the system. The most common authentication method is user name and password. Access management is normally based on user roles such as administrators, instructors, student assistant and students. The set of tools that available to users are based on the roles of users.

Claroline’s home page has a link (“create user account”) that directs a new user to a page that enables one to create an account to use the system. Users are required to enter their personal information, user name and password before using the system. Users have to select radio button on whether they wanted to follow courses or create course in Claroline during the registration. Once registration is completed, the user can use Claroline instantly. New users of ILIAS system have to click on ‘register’ link for registration. New users have to agree on the registration agreement terms before the online registration form is displayed. The registration is completed after users have filled in the online registration form. An e-mail is sent to the user to acknowledge the registration. Users have to wait for another e-mail from ILIAS system administrator to inform on if the user account is activated. To register as users of Online Learning And Training (OLAT), users are required to fill in their e-mail address on a page displayed after clicking on ‘Registration’ hyperlink available in OLAT home page. An e-mail is sent with a hyperlink as its content to the user for online registration purpose. Users have to surf the designated site to fill in their personal particular, user name, password, and agree on the terms of use before the registration is completed. New users of Moodle, Sakai, ATutor and Metacoon are
required to fill in the online registration form available in the respective home page (click on hyperlink “Create new account” or “Register” or “New account” or ‘Join’) before they can access to the system. To register as users of KEWL.NextGen, users are required to fill in an online registration form with their personal information and user name. Password is generated by the system upon successful registration. Users can log in the system after registration. Users can browse or join other courses or create their own course. An e-mail with the registration detail is sent to the user upon the first login to the system. For registration of using LON-CAPA, there may be a 24-hour delay for newly registered students between registration in the course and enrollment in LON-CAPA. To use the services provided by dotLRN, users are required to fill in their personal information and the registration detail is sent to users via e-mail.

f) Other typical services

Other services present in the open source LMS described earlier are:

**Communication tools:** All the open source LMS analysed support communication tools. Communicative tools are systems that mediate communication between the educator and students, or among students beyond the physical barrier (either by space, time, or both) of the classroom. They are increasingly used in traditional face to face classes for supporting class communication. The communication tools supported by the open source LMS could be either synchronous (such as chat) or asynchronous (such as forum, discussion board, mailing list) or both. Communication tool such as forums allow assimilation, collaboration and reflection among students in their study.
**Personalised desktop/tool:** Personalised desktop or tool in open source LMS include personal workspace for each user, administration of the personal profile, for instance the language setting, calendar and time scheduler, overview for monitoring of the personal learning progress, subscribed courses and content modules, administration of the personal bookmarks for internal and external links and others, subscribed new and unread mails, subscribed own forums and groups. ILIAS, Sakai, and Metacoon have a better support on this feature where a user could find the personalised desktop features under single title: “personal desktop”, “my workspace”, and “my room”. ILIAS supports all the above mentioned features under “personal desktop”. Sakai provides each user with his or her own individual online worksite which functions as a private workspace. “My workspace” includes several features, including resources, schedule, worksite setup, announcements, news, web content, preferences, help and membership. Metacoon which provides each user with “my room” features, includes several features such as (a) enrolment for rooms; (b) news on the platform (new courses/rooms, tasks, learning materials, bulletins, user); (c) personal and group calendar; (d) task management including assignment distribution and status display; (e) project management; (f) links on entries; (g) file manager; (h) visual directory structure; (i) check/uncheck or lock files and folders; (j) version management, (k) picture gallery (e.g. course descriptions, personal profiles), and (l) take notes.

**User documentation and information pages:** This feature is essential and available in all the open source LMS analysed, and it takes in various forms such as Help, Contact/Support, About Us, Disclaimer, Privacy, Sitemap, User handbooks, Search, System and Features, Download, Development, and Community. The
information provided would help new users to learn about the open source LMS and allows users to browse the system and download the latest release version with ease.

5.5. Summary

This chapter has presented a review of the CMI functions and an analysis of different open source systems that support CMI functions. The next chapter describes the user requirements culled from the findings in Chapter 4, and the development and evaluation of the CMI-based learning management tool using open source approach.
Chapter 6

Requirement Analysis, Development and Evaluation of A Computer Managed Instruction (CMI)-based Learning Management System

6.1. Introduction

The findings of interviews described in Chapter 4 (page 100-112) have presented a set of IS educators’ needs to use ICT tools manage IS instructional processes. This chapter aims to (a) determine the user requirements from the data gathered in interviews and perform document analysis on the assignment questions collected from the IS educators; (b) present the system development of the requirements identified; and (c) report on the usability and functionality of the tool developed. Research questions 5 and 6 are addressed in this chapter.

6.2. Determine User Requirements

The users’ requirements for the system were extracted from two data sources: extended field notes and document analysis of 12 assignment questions. The following subsection summarised the findings.

6.2.1. Analysing Interviews Transcript to Determine User Requirements for a CMI-based Tool

As shown in Figure 5-1 of Chapter 5, the general CMI model consists of testing, record keeping, prescription and reporting. Findings from the interviews with six (6) IS educators lead to the CMI functions delineated in Baker (1978) and Leiblum (1982) and the proposed user requirements detailed in Table 6-1. As such, a CMI-based tool can be illustrated in Figure 6-1. An instructional module can be executed either through the computer or studied via other means, such as books. The computer processes the test and, based on the students’ results, advise the students on their next action. For instance,
advise students to retake the test if the test result is below the passing mark. The cycle is completed as the student begins to take a new test. Figure 6-1 presents the cycle from the perspective of the student, the computer, and the instructor. An educator administers and guides the instructional processes using a computer. The computer becomes an information system that marks test, records test results, provide feedback and reports this information to the educator and the student.

Figure 6-1
A Model of CMI-based Tool
### Table 6-1
User Requirements Extracted from Interviews

<table>
<thead>
<tr>
<th>No</th>
<th>Extracted from Interviews Transcript</th>
<th>CMI functions</th>
<th>Proposed Users’ requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Educators set assignments for student learning (see Section 4.3.1 and Section 4.3.2)</td>
<td>Assessment</td>
<td>The system should allow educators to create, modify and delete assignment questions.</td>
</tr>
<tr>
<td>2.</td>
<td>Educators wanted to give Individual and group assignment (verbal statement such as “one is to be done individually, while the other is to be done in group”) (see page 107 paragraph 2 under Section 4.3.2)</td>
<td>Record keeping</td>
<td>The system should have features where educators can specify the number of students allowed working on an assignment. These functions selected act as input function for record keeping purpose.</td>
</tr>
<tr>
<td>3.</td>
<td>Educators wanted to keep track of students report submission. (Verbal statement such as “I need a system that allows me to record all the phases, enable me to give marks and feedback to students, with their group name as an identifier. I would be happy if the system could allow me to view students’ marks online.”) (see page 110 paragraph 2 under Section 4.3.4)</td>
<td>Reporting function</td>
<td>The system interface should have option for educators to view or print detail of student submission information related to an assignment using group name as identifier.</td>
</tr>
<tr>
<td>4.</td>
<td>Educators give online tests (Verbal statement such as “For students in year one, students have to take online test at the dedicated time in the laboratory. Using multiple choice questions can test students knowledge on the subject matter concept, the system significantly reduce my time on marking and at the same time I know if students master the subject matter before giving them assignment.”) (see page 108 paragraph 2 under Section 4.3.3) (“Only 15 marks is given to the multiple choice practice, students have to retake the tests if they fail.”) (see page 108 paragraph 2 under Section 4.3.3)</td>
<td>Testing</td>
<td>The system should allow educators to create and modify tests online. The system should mark tests online ([1] in Figure 6-1). The system should allow educators to write prescription based on students’ results. For instance, remedial prescription such as take the test again. ([2] in Figure 6-1) The system should record and report students tests results ([3] and [4] in Figure 6-1)</td>
</tr>
<tr>
<td>5.</td>
<td>Educators wanted to guide student learning. (Verbal statement such as “I will be able to write my project question, guidelines, upload files, create hyperlinks, FAQs and provide my feedback.”) (see page 110 paragraph 1 under Section 4.3.4)</td>
<td>Record keeping</td>
<td>The system should have an interface where educators can place their guidelines, upload related files and hyperlinks, FAQs for student references.</td>
</tr>
</tbody>
</table>
### Table 6-1, continued

<table>
<thead>
<tr>
<th>No</th>
<th>Extracted from Interviews Transcript</th>
<th>CMI functions</th>
<th>Proposed Users’ requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>Educators wanted to comment on students’ reports. (verbal statement such as “My students have to submit a short report at different checkpoints so that I can monitor their work progress and support groups which seem to be going astray in their work. It will also instil good practice among the students. Providing timely feedback is important for students to ascertain that they have carried out the assignment correctly, such as whether the correct methodology had been used, or the required scope had been covered. This is an important task and cannot be overlooked as it could subsequently influence students’ understanding and hence their results.”) (see page 106 paragraph 1 under Section 4.3.2) (“I think the system should allow educators to put down their comments and monitor students using their team name. My students can then read feedback and get their grade instantly.”) (see page 110 paragraph 3 under Section 4.3.4)</td>
<td>Prescription</td>
<td>The system should have features or text area where educators can give advice and comments (judgmental basis) for the submitted reports using group name. In particular, the diagnosis and prescription would not be automated.</td>
</tr>
<tr>
<td>7.</td>
<td>Educators wanted to have e-mail address for contact purposes (Verbal statement such as “The system must store student’s e-mail address so that I do not need to search for them.”) (see page 110 paragraph 1 under Section 4.3.4)</td>
<td>Record keeping</td>
<td>The system should have utilities function to enable users to maintain their personal data. The system should have interface that enable educators to retrieve student’s e-mail easily.</td>
</tr>
<tr>
<td>8.</td>
<td>Educators wanted to keep track of student learning progress. (Verbal statement such as “I would like to use a system that can keep record of my students learning progress and that can manipulate the records using team/group name.”) (see page 109 paragraph 4 under Section 4.3.4)</td>
<td>Reporting function</td>
<td>The system should allow educators to view online or print students’ results.</td>
</tr>
</tbody>
</table>

### 6.2.2. Document Analysis to Determine User Requirements for a CMI-based Tool

The researcher examined and analysed 12 samples of assignments questions format collected from the following IS courses: System Analysis and Design, Object-Oriented Analysis and Design, Accounting Management System, Information Systems
Requirement Analysis, Development and Evaluation of A CMI-based LMS

Development Practices, Analysis and Design of Information Systems, Decision Support Systems, and Information Retrieval. The sample assignment questions provide information on the following:

a) Course Information;

b) Objectives of the assignment given;

c) Individual or student team work;

d) Number of educators involved;

e) The chronology of deliverables that take place in the IS assignments;

f) Guidelines given to students on how to conduct research, write and produce report;

g) Types of reference resources provided to students;

h) Deadlines for submission;

i) Mode of submission (such as online, e-mail or hardcopy);

j) Evaluation components and procedures.

The information gathered from the document analysis has various implications for the design of a CMI-based learning management system (Table 6-2). Information extracted from assignment questions leads to the CMI functions delineated in Baker (1978) and Leiblum (1982) and the proposed user requirements are detailed in Table 6-2. Some of the requirements identified in the extended field notes are repeatedly found in this analysis, which further confirm on these requirements needed to support IS instructions.
### Table 6-2

User Requirements Extracted from Document Analysis of Assignment Questions

<table>
<thead>
<tr>
<th>No</th>
<th>Extracted from Assignment Questions</th>
<th>CMI functions</th>
<th>Proposed Users’ requirements</th>
</tr>
</thead>
</table>
| 1. | Course Information  
(Statements such as Analysis and Design of Information Systems, Information Systems Development Practices, Object Oriented Analysis and Design, Accounting Management System.) | Record keeping | The system should have an area to specify the course information of the assignment given. |
| 2. | Objectives of the assignment given  
(Statements such as The purpose of this assignment is to assess a student’s ability to: 1. Understand the basic concepts or theories learned in the subject or unit. 2. Critically analyse and understand relevant issues involved a selected case study organization pertaining to principles of analysis and design of systems. 3. Apply their knowledge gained from the various topics (where relevant) to the case study organisation. Students may use the materials available in the textbook or notes but are also strongly encouraged to supplement supporting evidence of reading and further research from other textbooks or articles beyond the basic text to argue their findings and to present their answers. 4. Present a written assignment in a proper, clear, interesting and logical manner orally in class, as well as submitting them in hardcopy in the form of documentation [Retrieved from AACS2184 – ANALYSIS AND DESIGN OF INFORMATION SYSTEM].) | Record keeping | The system should have a text area that enables educators to put down the objectives of the assignment. |
<table>
<thead>
<tr>
<th>No</th>
<th>Extracted from Assignment Questions</th>
<th>CMI functions</th>
<th>Proposed Users’ requirements</th>
</tr>
</thead>
</table>
| 3. | Individual or student team work  
(Statements such as  
Formation of Groups  
Students are required to form small groups of 4 – 5 (i.e. minimum of 4 and maximum of 5) students and to carry out active group discussions on the case study organization activities assigned outside the class. Each individual class representative will assist the tutor in the formation and submission of name lists during the first week of semester. Where it is not possible to form between 4 – 5 students in a group then one last group may be allowed odd numbers of either 3 or 6 where appropriate. In order to avoid confusion, the group members formed for the Case Study class may be similar to that formed for the tutorial group, and other units, such as Windows Application Programming and Database Development and Applications.  
[Retrieved from AACS2184 – ANALYSIS AND DESIGN OF INFORMATION SYSTEM])  
Each group must consist of 5 members only, which will be decided by the lecturer.  
[Retrieved from WXES2104 SYSTEM ANALYSIS AND DESIGN]  
Group yourself into a team of maximum 4 persons per team for this project.  
[Retrieved from AACS4264 OBJECT ORIENTED ANALYSIS AND DESIGN]  
The assignment will be done by students in suitable group sizes of about between 4 - 5 to be approved by the lecturer or tutor concerned.  
[Retrieved from AACS2184 – ANALYSIS AND DESIGN OF INFORMATION SYSTEM]) | Record keeping | The system should have features where educators can specify the number of students allowed to work on an assignment. The members shall be able to decide on their own group members or the member lists must gain approval from the educators or tutors or the member lists are assigned by an educator. These functions selected act as input function for record keeping purpose. |
| 4. | Number of educators involved  
(Statements such as Tutor for this work are Ms X, Ms. Y, and Ms. Z  
[Retrieved from AACS4264 OBJECT ORIENTED ANALYSIS AND DESIGN]  
Students are required to form into small groups of about 4 – 5 students. Each group will be assigned a business system from a list of four below by the respective tutor.  
[Retrieved from AACS2184 – ANALYSIS AND DESIGN OF INFORMATION SYSTEM]) | Record keeping | The system should allow more than one educators to supervise one assignment. |
Table 6-2, continued

<table>
<thead>
<tr>
<th>No</th>
<th>Extracted from Assignment Questions</th>
<th>CMI functions</th>
<th>Proposed Users’ requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>The chronology of deliverables that take place in the IS assignments (Statements such as You are required to prepare: week 2&amp;3 – prepare functional lists for video rental system, one activity diagram. Week4 &amp;5 – use case diagram, description, initial class diagram. Week 6 &amp; 7 – activity diagram for four use case. Analysis collaboration diagrams for the basic scenario for the each of the use case. Week 8&amp;9 - Design sequence diagrams for the basic scenario for the each of the use case (Include boundary, control and entities classes). week 10&amp;11 - A final class diagram with generalization, data types and class operations. Activity Diagrams for two class operations. Week 12&amp;13 Prepare two state charts for two classes. Prepare the package diagram(s), component diagram(s), and deployment diagram for the new system. Week 14 - Discussion with the students. [Retrieved from AACS4264 OBJECT ORIENTED ANALYSIS AND DESIGN] Phase I : System requirements and design - submit report on week 9. Phase II: System presentation – submit report on week 13. [Retrieved from WMES3104 ACCOUNTING MANAGEMENT SYSTEM] )</td>
<td>Record keeping</td>
<td>The system interface should have option for educators to select events and deliverables required in an assignment.</td>
</tr>
</tbody>
</table>
Table 6-2, continued

<table>
<thead>
<tr>
<th>No</th>
<th>Extracted from Assignment Questions</th>
<th>CMI functions</th>
<th>Proposed Users’ requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>Guidelines given to students on how to conduct research, write and produce report (Statements such as Choose an organization as a model (real world model) i. For example: MPH bookshop in Mid-Valley Megamall or Klinik Murthi near University Towers. ii. Problems might face: For security purpose some organizations might not like your presence, so find other organizations. iii. Do not go too detail to see their systems, just understand their business workflow and data flow, that’s ALL! iv. Finally, get the organizations signature/official cop to certify your presence there. Put it in your report as appendix. You may also include photos of your members with the organization as well. vi. Act professionally, make appointments….don’t be a disturbance to the organizations IMPORTANT ! Students are not allowed to use or present any of the previous student’s systems. Report Format: • Font: Arial 11 • Justify (Alignment) • Make sure to include ALL the group members name and matrix no. [Retrieved from WMES3104 ACCOUNTING MANAGEMENT SYSTEM - GROUP PROJECT]</td>
<td>Record keeping</td>
<td>The system interface should have a text area that enables educators to put down the guidelines, hyperlinks of resources or a softcopy of the guidelines. [Retrieved from AACS2184 – ANALYSIS AND DESIGN OF INFORMATION SYSTEM].)</td>
</tr>
</tbody>
</table>
### Table 6-2, continued

<table>
<thead>
<tr>
<th>No</th>
<th>Extracted from Assignment Questions</th>
<th>CMI functions</th>
<th>Proposed Users’ requirements</th>
</tr>
</thead>
</table>
| 7. | Types of reference resources provided to students  
(Statements such as  
*When preparing your report, it is important that you acknowledge all sources that you have consulted. This refers to books, journal articles or web site references. Students are recommended to use Harvard’s Referencing System (please search for such information in the relevant web sites*  
[Retrieved from AACS2184 – ANALYSIS AND DESIGN OF INFORMATION SYSTEM]) | Record keeping | The systems should have functions have an text area that enable educators to put down the type of resources to use, link of resources or a softcopy of the resource. |
| 8. | Deadlines for submission  
(Statements such as  
*Weekly Assignment. For the weekly assignment, students are required to report their progress on a properly written and typed copy of the deliverables for the week on the day of class. The assignment should be delivered in a well written, typed and well formatted report (e.g. in Word format).*  
*Final Documentation. The final documentation is on or before Week 14 (i.e. Friday being the last day of the week). The submitted final document must comply with the presentation and format requirements stated.*  
[Retrieved from AACS2184 – ANALYSIS AND DESIGN OF INFORMATION SYSTEM])  
Submission deadline: 10 August 2007  
[Retrieved from WXES 2104 SYSTEM ANALYSIS AND DESIGN]. | Reporting function | The system interface should have option for educators to select deadlines for the respective events and deliverables required in assignment |
| 9. | Mode of submission  
(Statement such as  
*Hardcopy and softcopy of both the written report.*  
[Retrieved from UAMA 2043 E-COMMERCE]) | Record keeping and reporting function | The system interface should have an option for students to submit deliverables in softcopy. |
| 10. | Evaluation components and procedure  
(Statements such as  
*criteria for marking*  
1. Content(30 marks)  
Degree of completion and meeting assignment requirements.  
Ability to apply concepts to practical areas and relevant  
Points presented are correct and relevant to the topic  
2. Presentation Format (10 marks)  
Points are logically developed (easy-to-read)  
Compliance with prescribed formatting requirement.  
[Retrieved from AACS2184 – ANALYSIS AND DESIGN OF INFORMATION SYSTEM]) | Record keeping | The systems should have functions that enable educators to input students’ results. The systems should be able to show individual students results to the students and the educators. |
As shown in Table 5-1 (page 132), the CMI elements consists of objective banking, learning resources banking, learning material banking, item banking, item generation, test generation, assessments, reporting, evaluation, assignment, counselling, and scheduling. From the information gathered in the interviews and document analysis, the management of student instructional processes identified requires the CMI elements such as objective banking, learning resources banking, learning material banking, test generation, assessments, reporting, assignment and scheduling. As such, these elements meet the requirements for a system to be called a CMI system. The description of each CMI element for the system are summarised in Table 6-3.

<table>
<thead>
<tr>
<th>No</th>
<th>CMI elements</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Objective Banking</td>
<td>A collection of behavioral or performance objectives stored in a file or presented in a page online which can be accessed by students or educators for determining the objectives of assignments and tests given.</td>
</tr>
<tr>
<td>2.</td>
<td>Learning resources banking</td>
<td>Educators can maintain lists of instructional resources for tasks given to students to meet the behavioral objectives. For instance, files name, books, slides, hyperlinks, and learning package, which are the references that can be accessed by students to complete the task given. The learning resources can be listed and presented under phases of system development life cycle.</td>
</tr>
<tr>
<td>3.</td>
<td>Learning material banking</td>
<td>Educators can store the actual learning material in the system. It can be accessed by students to complete the task given. The learning resources can be ordered and presented under phases of system development life cycle.</td>
</tr>
<tr>
<td>4.</td>
<td>Test generation</td>
<td>A simple test generation template where the educator input test items which have certain characteristics he requires for individual tests. The difficulty level of a test item is indicated by the score given to the test item. The feedback mechanism is provided to support different scores range.</td>
</tr>
<tr>
<td>5.</td>
<td>Assessments</td>
<td>It takes the form of scoring individual performance on a given test or on scoring a task taken by a group. Tests scoring feature can include provision of score for a test and/or teacher graded questions, for example essay types question which can be scored by hand and entered into the system. The results of tests or/and essay types questions are used to determine if objectives have been mastered.</td>
</tr>
<tr>
<td>6.</td>
<td>Reporting</td>
<td>The ability to produce reports on tests, assignments, and/or discussion performance for individual or group progress. The system is designed to allow students or educators to view and print the reports online.</td>
</tr>
</tbody>
</table>
Table 6-3, continued

<table>
<thead>
<tr>
<th>No</th>
<th>CMI elements</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Assignment/prescription</td>
<td>Refer to assignments of tasks prepared by educators such as reading material, lessons to be followed, and problems to be solved based on phases of system development life cycle to be covered. The tasks can be accessed online by students and educators.</td>
</tr>
<tr>
<td>8.</td>
<td>Scheduling</td>
<td>Refer to allocation of IS educators to the different groups of students in a course.</td>
</tr>
</tbody>
</table>

6.3. The Development of the System Functionality

This section presents the development of the requirements analysed in Section 6.2. The following subsections discuss the development platform and the development of the proposal system functionality.

6.3.1. Development Platform

The system has been developed in Apache web server running on the Microsoft Windows platform, PHP with MySQL. JavaScript, a client-side scripting language embedded into an HTML page, is used to validate input and interact with users. The core modules of the prototype take several phases to develop and implement. They include creation of enrolment, assignment creation, test generation, student work group, monitoring and feedback mechanism, instructor allocation, and participation in an assignment.

The CMI-based LMS has three (3) categories of users: a system administrator, course instructors or instructors (IS educators) and students. The system administrator’s module is developed to provide a user friendly interface to manage student information, IS educators information and the courses they teach, stages and deliverables of information system development life cycle. IS educators and students have to register themselves as users of the system. A user has student role by default. Once the system administrator has been notified by educators about their role, he would change the
educator’s role from student to instructor. The system administrator can open a course space for the instructor in charge of the course. The system administrator can edit and delete stages and deliverables of information system development life cycle using the interface provided. The system administrator can then avoid running multiple queries from the command line interface to manage such information.

6.3.2. Event-driven Model

The CMI-based LMS benefits from event-driven programming because it suits the inherently event-driven nature of many aspects of the real world. The learning management system developed is event-driven software. One of the keys to creating dynamic web pages is the use of event handlers. An event handler is codes, typically a function or routine written in a scripting language that receives control when the corresponding event occurs. This allows developers to execute specific scripting codes in response to user or system initiated actions. Programming an event-driven system is therefore a matter of writing the event handlers of the system, to match the required behavior identified in Section 6.2.

6.3.3. System Interface Design

The user interface employs one of the standard interfaces that can be found in the web. It has 3 sections namely: (a) Title bar, (b) Navigation pane, and (c) Main pane (Figure 6-2). The user interface is consistent throughout each page of the CMI-based LMS. Title bar is at the top of each page. The name of the system is displayed on the left of the title bar. Three (3) hyperlinks are located at the top right hand corner for global navigation. The hyperlinks are (a) Forum – to bring up the forum main page, (b) Contact – to send feedback e-mail to webmaster, (c) Help – to bring up the help page. Hyperlinks have their destination page in a new window. If a user is already logged in to the system, the user name and identification (ID) will be displayed beside the hyperlinks.
The Faculty logo (in this case, the Faculty of Computer Science and Information Technology, University of Malaya) is displayed at the top of the navigation pane. The faculty name is displayed as tool tips when the mouse is moved over the logo. Clicking the logo brings user to the faculty's website. Navigation items are displayed below the faculty logo. There are 4 different sets of navigation items depend on the user's role named under: (a) Login - No one login to the system, (b) Student - A user with student role login to the system, (c) Instructor - A user with instructor role login to the system, and (d) Administrator - A user with administrator role login to the system. Navigation items are divided into sections. The active navigation item is highlighted in bold with a dark red dot. Main pane is a pane where the details of each page are displayed. All operations such as view, addition, deletion and modification are performed in this pane.
6.3.4. System Features

The section presents the features that the system performs under navigation pane according to the requirements identified in Section 6.2. The functionalities supported by the system for IS educators under the title of enrolment, manage assignment, manage workgroup, monitor assignment, report, view list, and utilities.

a) Enrolment

This is a standard module required to allow the course instructor (IS educator) to verify the students’ identity before allowing them to access the system. A student needs to enrol in a course before he can access to the course assignments. Once a student has enrolled himself in a course through the "Enrol Course" page, his enrolment will be classified under pending state. The course instructor is able to view a list of students’ name pending for approval in “Approve Enrolment” page. The course instructor can approve or reject a student enrolment. If the instructor decides to “undo” the decision of approval or rejection, the enrolment state of the student can be revert back to pending state. The enrolment status of a student that has already joined an assignment group cannot be changed. An instructor can also enrol students by importing the student list file in "Import Enrolment" page. A student list file is a text file with one student ID per line. Only students that have registered to the system can be enrolled (Figure K2 and K3 in Appendix K).
b) Manage assignment

This module is developed to meet the requirements as stated in Item 1, 2, and 5 of Table 6-1 and Item 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 of Table 6-2. The system should enable the course instructor to create new assignment, edit, and delete an existing assignment. The course instructor should be able to manage the assignments under his or her course(s).

The information presented in Table 6-4 is required when creating a new assignment. The screen capture of creating assignment and editing assignment is presented in Figure K4 and K5 in Appendix K respectively.

<table>
<thead>
<tr>
<th>No</th>
<th>Information</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Course</td>
<td>This refers to the course the assignment is linked to. It presents list of courses that the instructor is in charge of.</td>
</tr>
<tr>
<td>2</td>
<td>Title</td>
<td>This refers to the title of the assignment.</td>
</tr>
<tr>
<td>3</td>
<td>Description</td>
<td>This refers to a brief description of the assignment such as the introduction or objectives. An optional text area.</td>
</tr>
<tr>
<td>4</td>
<td>Instructor In Charge</td>
<td>This refers to the instructors who manage the assignment. This can be the course instructor or an instructor delegated by the course instructor</td>
</tr>
<tr>
<td>5</td>
<td>Deadline</td>
<td>This refers to the deadline for final report. This date cannot be earlier than today.</td>
</tr>
<tr>
<td>6</td>
<td>Minimum and Maximum Member</td>
<td>This refers to the number of students allowed for each student group. The number of students in a group cannot exceed the maximum group member value setup by the instructor.</td>
</tr>
<tr>
<td>7</td>
<td>Group allocation</td>
<td>This refers to the methods for creating student group.</td>
</tr>
<tr>
<td>8</td>
<td>Final Mark</td>
<td>This refers to the mark given to the final report.</td>
</tr>
<tr>
<td>9</td>
<td>Deliverable</td>
<td>This refers to the report required for submission. At least one deliverable has to be selected.</td>
</tr>
<tr>
<td>10</td>
<td>Submission</td>
<td>It presents a list of options for submission of interim report.</td>
</tr>
<tr>
<td>11</td>
<td>Deliverable's submission date and mark</td>
<td>This is needed only if interim report submission is required. The submission date needs to be between today and assignment final report deadline.</td>
</tr>
<tr>
<td>12</td>
<td>Description for each phase</td>
<td>This refers to description specific to a phase. An optional text area.</td>
</tr>
<tr>
<td>13</td>
<td>Forum</td>
<td>This refers to a checkbox where a forum topic is automatically created in the Internet forum if the checkbox is checked.</td>
</tr>
</tbody>
</table>

The course instructor can select the predefined reports as deliverables. It also can specify a ‘customize’ report for each phase as the deliverable. When an assignment is created, it is put under pending state.
The course instructor or the instructor in charge of the assignment can change an assignment's details, delete an assignment, change an assignment's status, and add test and references to an assignment (Figure K6 in Appendix K).

An assignment can have the following status:

i. **Pending**: The assignment is created but still under construction. Students cannot view the assignment.

ii. **Active**: The assignment is ready. Students can view the assignment and create group under this assignment.

iii. **Suspended**: Students can view the assignment but cannot upload report or create group under this assignment. This is typically used for assignments when the instructor wants student to view its feedback after deadline.

iv. **Completed**: The assignment is no longer available for student. This is used for reporting or reference purpose.

An assignment can be edited only if its status is pending. The course instructor can edit all details of an assignment except the course and forum topic. The course an assignment linked to is fixed when creating the assignment. A forum topic for an assignment can be created only if it has not been created before. When the title and description of an assignment changed, the forum will be automatically updated.

Tests (Item 4 of Table 6-1) can be created in the "Edit Assignment" page. Analysis of the test questions that were given by the IS educators are: (i) Single answer (Only one answer can be selected); (ii) Multiple answer (Multiple answers can be selected); and (iii) Keyword (The answer is a keyword). Each test item is given a mark. For single and multiple answer questions, an instructor can give up to six (6) answers. For keyword
answer question, an instructor can give multiple keywords by separating them with commas. The course instructor can arrange the questions by clicking the "Up" button. An instructor can provide comment or prescription to student’s performance based on the students’ marks. The system can also be set to allow student to retry a test (when the marks are too low).

References are external learning materials related to an assignment. Editing assignment reference can be performed in the "Edit Assignment" page. There are 3 types of references (Item 5 of Table 6-1, Item 6 of Table 6-2): (i) Links (A hypertext link to an external website); (ii) File (A file or document uploaded to the system); (iii) Text (A plain text description such as assignment guidelines). The references are grouped into phases of information system development life cycle. A special group called "General" can be used for general references not belong to any phases. Order of the references is based on phases. Order of the phases cannot be changed. An instructor can change the order of the references within a phase (by clicking the "Up" button). The instructor can preview the references (by clicking the "View References" hyperlink). This hyperlink is available only if there is at least one reference.

c) Monitor Assignment

This module is developed to meet the requirements as stated in Item 6, 8 of Table 6-1 and Item 10 of Table 6-2. The instructor can monitor the report submission and marking for each assignment via the "Assignment Status" page. It lists all groups and all reports for an assignment in a tabular form. The submission date and marks for each report are displayed. The instructor can choose to hide the members so that the table can be more compact. In this view the ‘members’ column is hidden and replaced. Instead a member icon is placed in front of the group name (Move the mouse over the icon will display the
group members as tool tips). The "Workgroup Summary" page allows the instructor to monitor assignment status of all groups under his supervision (Figure K1 in Appendix K). Three (3) statuses are displayed in the summary:

(i) Overdue: number of reports that have not been submitted after the submission deadline;

(ii) Late: number of reports submitted after the submission deadline;

(iii) Unmarked: number of reports submitted but has not been marked.

The "Details" button (at the far left of the summary) leads the instructor to the "Assignment Status" page for the assignment stated. The instructor in charge can download the submitted report, give marks to a report, and give comments of the group stated after clicking on “Details” button (under the "Group" column). Due to the structure of higher education level courses, the student is responsible for a considerable portion of the instructional management. The prescriptions and other messages inform the student as to what he can do to remediate difficulties, or what he can do to extend his knowledge of the content. The student is responsible for actually implementing most of the prescriptions, allocating study time, and making use of the available resources.

d) Manage workgroup

This module is developed to meet the requirements as stated in Item 1 in Table 6-1 and Item 3 and Item 4 in Table 6-2. Assignment group allocation can be done in three (3) different ways: (i) The instructor allocates students into assignment group; (ii) Students create and join own assignment group; (iii) Students create and join own assignment group with instructor's approval. The decision on the option for workgroup allocation was made when the course instructor creates a new assignment in “Create Assignment” page.
If “An instructor allocates students into assignment group” option for an assignment is selected, the instructor is responsible to allocate students with unique group name manually. By default only students not in any group will be shown. The instructor can check "Show allocated students" checkbox to show all students enrolled to the course. Besides allocating students, the instructor needs to allocate the instructor in charge for the groups as well. This works similar to how students are allocated. Alternatively, the instructor can also import assignment group allocations from a comma delimited file via the "Import Allocation" page. Four (4) file formats are accepted (Student, "Group Name" [, Instructor]; "Group Name", Student [, Instructor]; "Group Name", Instructor; Instructor, "Group Name”; see Figure K8 of Appendix K).

If “Students create and join own assignment group” option is selected for an assignment, students are responsible for selecting their group members and this does not require the instructor consent. If an instructor selects “Students create and join own assignment group with instructor's approval” option for an assignment, the instructor approves assignment group via the "Approve Assignment" page. The instructor can only approve groups under his/her supervision. An assignment group can be approved or rejected. The approval status will be shown to the members in the "Join Group" page. An instructor can rollback the ‘approval’ status and the group status will revert to ‘Ready’. An approved or rejected group can also be dropped. When a group is dropped, it will not be visible to the members anymore. This is normally done if a group is wrongly created.
f) Reports

This module is developed to meet the requirements as stated in Item 3 and Item 8 in Table 6-1. Three types of report supported by the system: workgroup, marks, and submission (Figure 6-3).

The "Workgroup Reports" allows the instructor in charge to list the students, groups, and instructors allocated to an assignment (Figure K10 in Appendix K). There are three (3) different views: (i) Instructor List (With Group): this list is sorted by instructor and group. It presents the groups, students and the instructor in charge; (ii) Instructor List (Without Group): this list is sorted by instructor. It shows the students and the instructor in charge; (iii) Student List: this list is sorted by student. It displays the group and the instructor in charge.
The "Marks Report" allows the instructor in charge to list the students' marks for an assignment (Figure K11 in Appendix K). The instructor can choose to display marks of the different reports submitted for an assignment. Tests and forum performance indicator that tie to the assignment can be selected and displayed if available. The instructor can select what to be displayed if a report has not been submitted and if a report has not been marked.

The "Submission Report" allows the instructor in charge to list the report(s) a student has submitted (Figure K12 in Appendix K). An instructor can choose which reports of an assignment to be displayed. If a report has been submitted by a student, the submission date and the filename is displayed. If a report has not been submitted, the instructor can choose what to be shown, either a blank, a dash, or the word "Not Submitted".

g) View list
This module is developed to meet the requirement as stated in item 7 of Table 6-1. A student or an instructor can view the details of assignments, courses, instructors, and students in the system. The detail presented is as follows:

i. The detail information displayed for students in the system includes: User ID, Name, and E-mail.

ii. The instructors’ information presented includes: User ID, Name, and E-mail.

iii. For Group detail, a user need to select the assignment before the groups for the selected assignment are displayed. The group detail shown includes: Group Name, Instructor In Charge, Members, and Status. A user can choose to hide the members so that the table can be more compact. In this view, the
‘members’ column is replaced with an icon. Moving the mouse over the icon will display the group members as tool tips. The instructor in charge of a course can view details of a group via the ‘Details’ button. The instructor can also choose to display only groups under its supervision.

iv. The detail information about an assignment includes: Title, Course (ID and Name), Instructor (ID and Name). Similar to viewing groups' details, an instructor can also choose to view only assignment under his supervision. User can click the "Details" button to view assignment details. If there are groups under the assignment, a user can click the "Groups" button to view details of the groups under the assignment.

v. For Course detail, the information presented includes: Course ID, Course Name, and Instructor (ID and Name).

h) Utilities

This module is developed to meet the requirement are Item 7 as stated in Table 6-1. A utility function such as modifying records is essential in CMI-based systems (Gorth and Nassif, 1984). There are two (2) features under utilities: (i) My Profile that displays the details of a user account. Information displayed includes: User ID, Name, E-mail, Role, and Status. A user can change his/her name and e-mail address; (ii) Change Password where a user can change his/her own password. For security reason a user need to re-enter his/her existing password when changing to new password.

The event handlers, database tables and entity-relationship diagram for the features developed for the CMI-based learning management system are presented in Appendices L, M, and N respectively.
6.4. System Evaluation

6.4.1. Method of Evaluation

Results of the system evaluation are sufficient to indicate if the system is usable from the educator’s perspectives, and can assist with the detection of usability flaws. Detecting the usability of the tool is important before the tool can be used in a real setting. Therefore, the evaluation of the CMI-based prototype was conducted on December, at the end of second semester of 2007 academic year. Twelve (12) IS educators from three universities were contacted separately and they volunteered to participate in the system evaluation. Software usability evaluation (SUMI) requires only a minimum of twelve (12) respondents. Due to the difficulty to gather all participants at the same time for the prototype evaluation, the evaluation was conducted at the time convenient to the participant. As a result, the prototype evaluation took two (2) weeks to complete. It was arranged in such a way that one IS educator evaluate the prototype at one time. The evaluation was not unusual as many organisations have set up usability laboratories to carry out software evaluation involving the setting of performance criteria and experimental testing with users (Noyes and Harriman, 1995). System evaluation in laboratories was also carried out in these universities. It is clearly impossible for developers to cater for the wide range of possible user requisites.

The evaluation was carried out in the respective IS educators’ rooms or in a discussion room with personal computer installed. A notebook computer with the preinstalled software was used in the evaluation to avoid the occurrence of the network reliability problem. The evaluation procedure consisted of ten minutes’ briefing on the purpose of the prototype, twenty minutes’ demonstration on the functionality of the system modules, and twenty five minutes for the respondents to manipulate on the system functionalities using an assignment question. The researcher took the role as a student to
submit tasks to evaluate the monitoring features of the system. A questionnaire (Appendix H) was completed at the end of the session. The questionnaires were then checked for completeness (i.e. that all questions had been answered).

6.4.2. Results of the Evaluation

To get a clearer picture of the respondents’ agreement on statements regarding ease of use, the number of respondents who answered ‘Agree’ or “Strongly agree” for a statement was added together to form a single ‘Agree’ category. The number of respondents who answered ‘Disagree’ or “Strongly disagree” for a statement was added together to form a ‘Disagree’ category. In calculating the mean and standard deviation for items in Table 6-5, the following scores were used: “Strongly disagree” = 1, ‘Disagree’ = 2, “Somewhat Agree” = 3, ‘Agree’ = 4 and “Strongly agree” = 5. Table 6-5 presents the analysis.

The analysis of responses to the questions in Part A (statements which evaluate the ease of use of the prototype) of the evaluation questionnaire shows that the responses were positive (All 20 items have more than 58% respondents rated positive) for all questions asked. This may indicate that the IS educators had minimal difficulty in using the prototype, and that the user interface is clearly usable.

Table 6-6 shows the analysis of responses to the questions in Part B (statements which evaluate the functionality of the prototype modules). In calculating the mean and standard deviation for items in Table 6-6, the following scores were used: “Very poor” = 1, ‘Poor’ = 2, ‘Satisfactory’ = 3, ‘Good’ = 4 and ‘Excellent’ = 5. It was decided that in an educational organisation, the software package should at least provide all of the features requested by the novice users of the system and at least 80% of those requested
by experts. Functionality criterion levels were therefore set at 100% for novices and 80% for experts (Noyes and Harriman, 1995). In this study, satisfaction for the functionality was set at 80% for all users. If the end-users returned an average rating of more than 80%, then the software package would be considered to be of acceptable quality for its application. It can be seen that all modules were rated ‘satisfactory’ and above for its functionality (all IS educators were satisfied with the modules’ functionality). Six (6) of the seven (7) modules have mean score above 4 (it means good in term of module functionality). As such, the modules generally had an appropriate functionality designed for the IS educators to handle the system.

Table 6-5
Analysis of responses for Ease of Use (n=12)

<table>
<thead>
<tr>
<th>Items</th>
<th>Disagree (%)</th>
<th>Somewhat Agree (%)</th>
<th>Agree (%)</th>
<th>Mean*</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>The instructions and prompts are helpful.</td>
<td>0</td>
<td>8.3</td>
<td>91.7</td>
<td>4.08</td>
<td>0.515</td>
</tr>
<tr>
<td>The speed of this software is fast enough.</td>
<td>0</td>
<td>8.3</td>
<td>91.7</td>
<td>4.50</td>
<td>0.674</td>
</tr>
<tr>
<td>I would recommend this software to my friends.</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4.17</td>
<td>0.389</td>
</tr>
<tr>
<td>It is easy to make the software do exactly what you want.</td>
<td>0</td>
<td>25.0</td>
<td>75.0</td>
<td>4.00</td>
<td>0.739</td>
</tr>
<tr>
<td>Working with this software is satisfying.</td>
<td>0</td>
<td>8.3</td>
<td>91.7</td>
<td>3.92</td>
<td>0.289</td>
</tr>
<tr>
<td>Learning how to use new functions is difficult.</td>
<td>83.3</td>
<td>8.3</td>
<td>8.3</td>
<td>2.00</td>
<td>0.853</td>
</tr>
<tr>
<td>The way that system information is presented is clear and understandable.</td>
<td>0</td>
<td>8.3</td>
<td>91.7</td>
<td>4.08</td>
<td>0.515</td>
</tr>
<tr>
<td>The software has helped me overcome any problems I have had in using it.</td>
<td>0</td>
<td>16.7</td>
<td>83.3</td>
<td>3.83</td>
<td>0.389</td>
</tr>
<tr>
<td>I feel in command of this software when I am using it.</td>
<td>0</td>
<td>8.3</td>
<td>91.7</td>
<td>4.00</td>
<td>0.426</td>
</tr>
<tr>
<td>Learning to operate this software initially is full of problems.</td>
<td>91.7</td>
<td>8.3</td>
<td>0</td>
<td>1.67</td>
<td>0.651</td>
</tr>
<tr>
<td>The organization of the menus or information lists seems quite logical.</td>
<td>0</td>
<td>8.3</td>
<td>91.7</td>
<td>4.08</td>
<td>0.515</td>
</tr>
<tr>
<td>It is obvious that user needs have been fully taken into consideration.</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4.17</td>
<td>0.389</td>
</tr>
<tr>
<td>It takes too long to learn the software commands.</td>
<td>75.0</td>
<td>16.7</td>
<td>8.3</td>
<td>1.92</td>
<td>0.996</td>
</tr>
<tr>
<td>Using this software is frustrating.</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>1.50</td>
<td>0.522</td>
</tr>
<tr>
<td>I can understand and act on the information provided by this software.</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4.08</td>
<td>0.289</td>
</tr>
<tr>
<td>It is easy to see at a glance what the options are at each stage.</td>
<td>0</td>
<td>8.3</td>
<td>91.7</td>
<td>4.25</td>
<td>0.622</td>
</tr>
<tr>
<td>It is relatively easy to move from one part of a task to another.</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4.25</td>
<td>0.452</td>
</tr>
</tbody>
</table>
Table 6-5, continued

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have to look for assistance most times when I use this software.</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>1.83</td>
<td>0.389</td>
</tr>
<tr>
<td>Tasks can be performed in a straightforward manner using this software</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4.0</td>
<td>0</td>
</tr>
<tr>
<td>The software has a very attractive presentation.</td>
<td>0</td>
<td>41.7</td>
<td>58.3</td>
<td>3.58</td>
<td>0.515</td>
</tr>
</tbody>
</table>

* ‘Strongly disagree’ = 1, ‘Disagree’ = 2, ‘Somewhat Agree’ = 3, ‘Agree’ = 4 and ‘Strongly agree’ = 5

Table 6-6

Analysis of responses for the functionality the modules (n=12)

<table>
<thead>
<tr>
<th>Items</th>
<th>Very poor (%)</th>
<th>Poor (%)</th>
<th>Satisfactory (%)</th>
<th>Good (%)</th>
<th>Excellent (%)</th>
<th>Mean*</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrolment.</td>
<td>0</td>
<td>0</td>
<td>16.7</td>
<td>58.3</td>
<td>25</td>
<td>4.08</td>
<td>0.669</td>
</tr>
<tr>
<td>Manage Assignment.</td>
<td>0</td>
<td>0</td>
<td>8.3</td>
<td>58.3</td>
<td>33.3</td>
<td>4.25</td>
<td>0.622</td>
</tr>
<tr>
<td>Workgroup.</td>
<td>0</td>
<td>0</td>
<td>8.3</td>
<td>58.3</td>
<td>33.3</td>
<td>4.25</td>
<td>0.622</td>
</tr>
<tr>
<td>Monitor Assignment.</td>
<td>0</td>
<td>0</td>
<td>16.7</td>
<td>50.0</td>
<td>33.3</td>
<td>4.17</td>
<td>0.718</td>
</tr>
<tr>
<td>Report.</td>
<td>0</td>
<td>0</td>
<td>50.0</td>
<td>41.7</td>
<td>8.3</td>
<td>3.58</td>
<td>0.669</td>
</tr>
<tr>
<td>View Lists.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>66.7</td>
<td>33.3</td>
<td>4.33</td>
<td>0.492</td>
</tr>
<tr>
<td>Utilities.</td>
<td>0</td>
<td>0</td>
<td>8.3</td>
<td>58.3</td>
<td>33.3</td>
<td>4.25</td>
<td>0.622</td>
</tr>
</tbody>
</table>

*“Very poor” = 1, ‘Poor’ = 2, ‘Satisfactory’ = 3, ‘Good’ = 4 and ‘Excellent’ = 5

IS educators made comments on their experiences of using the system written in the Part C: General comments of the questionnaire (‘Q1. In your opinion, what are the strong points of the tool (if any)? Q2. In your opinion, what are the weaknesses of the tool (if any)? Q3. Please give your comments and recommendations (if any) on other issues that would help to improve your satisfaction on the use of the tool.’). Selected verbatim statements are stated in Table 6-7.

From the list of strength given by the IS participants, it shows that they seem to see the benefits of the CMI-based tool. They generally agreed that the developed tool meet their requirements in managing and monitoring the IS assignments activities. The participants have recommended to separate the tests from managing assignment module. They have
suggested some added features such as alerting features, calculation category for reports and integrate the CMI-based system with other system.

<table>
<thead>
<tr>
<th>The list of strength given:</th>
<th>The list of limitation and further improvement given:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Minimizing some management work from the instructor</td>
<td>a) More system alert mechanism for matters like remind instructors to approve/reject course enrolment when students request to enrol</td>
</tr>
<tr>
<td>b) The tool helps the educator in monitoring the students performance especially in their assignment</td>
<td>b) Tests may be split out from assignment and shown at the navigation as one of the option.</td>
</tr>
<tr>
<td>c) Save time and more organised</td>
<td>c) Reports can cover average calculation, lowest marks and highest mark in the class.</td>
</tr>
<tr>
<td>d) Able to track student’s progress through various milestones of the assignment.</td>
<td>d) It would be good if the tool can connect to result processing system.</td>
</tr>
<tr>
<td>e) The deliverables list under each phase is comprehensive. So, creation of the online assignment is easier</td>
<td></td>
</tr>
<tr>
<td>f) Can control and manage students’ assignment effectively</td>
<td></td>
</tr>
<tr>
<td>g) Meet the requirement to handle assignment such as monitoring and reporting</td>
<td></td>
</tr>
<tr>
<td>h) It is obvious that user requirement is taken into consideration.</td>
<td></td>
</tr>
</tbody>
</table>

### 6.5. Summary

This chapter has presented (a) the user requirements from the data gathered in interviews as presented in Chapter 4 and document analysis; (b) development of the requirement identified; (c) results on the usability and functionality of the tool developed from educator’s perspective. The CMI-based system is functioning satisfactorily but, like any other new educational system, several problems remain and others have yet to be defined. It is, however, a system which reduces the workload of educators from managing instructional processes, and concentrate on more specialized topics. The usability of the system from students’ perspective was not carried out as it is beyond the scope of this study.
7.1. Introduction

The findings of the second survey detailed in Chapter 4 (page 112-124) have presented a set of IS educators’ requirements to facilitate an Internet forum to manage students class participation. This chapter aims to (a) determine the user requirements from the data gathered in the second questionnaire as presented in previous chapter; (b) present the system development of the requirement identified; and (c) report on the usability of the software adopted and the accuracy of the proposal solution to predict the actual grade of students for their contributions to the Internet forums for IS courses. Research questions 5 and 6 are addressed in this chapter. Finally, a summary of the chapter is presented.

7.2. Analysing Survey Results to Determine User Requirements

As shown in Figure 5-1 of Chapter 5, the general CMI model consists of testing, record keeping, prescription and reporting. Findings from the second survey, leads to the CMI functions delineated in Baker (1978) and Leiblum (1982) and the proposed user requirements are detailed in Table 7-1. As such, the management of student discussion can be illustrated as in Figure 7-1. An instructional module can be executed either through the computer or studied via other means, such as books. The computer processes the students’ discussion and, based on the students’ performance scores, advise the students on their contribution to the Internet forum. For instance, positive comments are given for the student’s active participation. The cycle is completed as the student begins to discuss in a new forum. Figure 7-1 presents the cycle from the
Requirement Analysis, Development and Evaluation of A CMI-based Collaboration Tool

perspective of the student, the computer, and the instructor. An educator administers and guides the instructional processes using a computer. The computer becomes an information system that records students discussion, compute performance indicator for individual student discussion, and furnishes this information to the educator and the student.

Figure 7-1
A model for CMI-based Internet Forum
Table 7-1
User’s Requirements from the second survey findings

<table>
<thead>
<tr>
<th>No</th>
<th>User needs from Survey Findings</th>
<th>CMI functions</th>
<th>Proposed Users’ requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Functions selected:</td>
<td>Record keeping</td>
<td>The systems should have functions that enable educators to set up student groups, approve or deny students participation, suspend or resume students’ participation. These functions enable meaningful data manipulation and correct record keeping of students’ forum data. ([2] in Figure 7-1)</td>
</tr>
<tr>
<td></td>
<td>“Set up student grouping”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Approve/deny a student’s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>participation”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Suspend/resume a student’s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>participation”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(see page 119 under Section 4.4.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Functions selected:</td>
<td>Record keeping</td>
<td>The system interface should have features where users can categorise their own postings. Educators should be able to change students’ posting category if found inappropriate. Students can not change post category after posting. These functions selected act as input function for record keeping purpose. ([2] in Figure 7-1)</td>
</tr>
<tr>
<td></td>
<td>“Categorize posting”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Change a posting’s category”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(see page 119 and 122 under Section 4.4.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Posting category selected for</td>
<td>Record keeping</td>
<td>The system interface must have option for educators to select posting category for assessment. This can be done by allowing educators to input an arbitrary value for the coefficient for each post category since the survey result indicated assessment criteria are idiosyncratic to individual educators. Each post and its posting category must be stored in the database. To keep track of users’ posting category. ([2] in Figure 7-1)</td>
</tr>
<tr>
<td></td>
<td>assessment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘Analysis’, ‘Resources’, ‘</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘Evaluative’, ‘Questioning’,”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘Synthesis’, ‘Summarizing’,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘Clarification’, ‘Acknowledging’,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘Social’, ‘Resolution’, ‘</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘Broadened’.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(see page 117 under Section 4.4.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Criteria selected for students’</td>
<td>Testing</td>
<td>The system interface must have options that enable educators to decide on the criteria for assessing student participation in forum. This can be done by allowing educators to input an arbitrary value for the coefficient for each criteria since the survey result indicated assessment criteria are idiosyncratic to individual educators. To keep track of assessment criteria used for users’ contribution. ([1] in Figure 7-1)</td>
</tr>
<tr>
<td></td>
<td>contribution:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“timeliness of posting”,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Categories of posting”,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Number of discussions posted”,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Length of posting”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(see page 120 under Section 4.4.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Reporting functions for</td>
<td>Reporting function</td>
<td>The systems should have functions that enable educators to rank the student performance indicator based on predefined criteria, view only a group of students, and export student performance indicator in group(s) in comma separated value (CSV) format for further processing. To generate reports on students’ performance for educators. ([3] in Figure 7-1)</td>
</tr>
<tr>
<td></td>
<td>educators:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Rank based on predefined</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>criteria used in a performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>indicator”,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Filter to view only a group</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>of students”,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Plain text or comma delimited</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>format exportable for further</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>processing”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(see page 121 under Section 4.4.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Reporting functions for</td>
<td>Reporting function</td>
<td>The systems should have functions that enable students to view their performance indicator score, count of each criterion used in performance indicator, and option to category posting. To generate report to individual student on his own discussion performance. ([3] in Figure 7-1)</td>
</tr>
<tr>
<td></td>
<td>students:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“A performance indicator score</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for each individual student”,”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Frequency on the criteria used in a performance indicator”.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(see page 122 under Section 4.4.2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The prescription function (feedback) of the computer is not part of the requirement as the accuracy of the assessment criteria (PI score) is still unknown at the point of the software development. The prescription (feedback) mechanism is proposed to be implemented once the PI score is found reliable. This is to ensure that the correct feedback is given to students.

7.3. Development of a CMI-based collaboration tool

This section presents the development of the requirements analysed in Section 7.2. As the open source approach is adopted towards the system development, the system has to select an open source forum software to develop the features identified in Table 7-1.

The open source development model is clearly different from the traditional development model, which follows the waterfall software model of collecting requirements, designing, implementing, testing, and then releasing. The open source development model (Weinberg, 2006), as illustrated in Figure 7-2, starts with an idea for a new project or new capability for an existing open source software (OSS) component. It is followed by designing and implementing the new capabilities. Once the software runs, it is released as a development release, even though it may contain known and unknown bugs. The software will be tested by the community, which discusses the software and provides feedback. The feedback is recorded and taken into consideration, and then a new development release will be made available. This cycle happens as many times as needed until project members feel the implementation is stable.
Using OSS, the researcher does not have to develop the basic features available in existing Internet forums. As such, the researcher can focus on the features as described in Table 7-1. These new features require several phases to be developed according to the open source development model. It is important for the researcher to (a) understand the adopted OSS in order to insert the new features; (b) understand the flows of the forum software by running it with different sets of input data; and (c) understand the meanings of the different variables name, event calls, event handler’s name, and tables. Then, the researcher identifies where in the programme source codes the insertion of the new codes or modifications of the programme source codes are to be made. The researcher then implements the requirements stated in Table 7-1 into the running software. It is important to save a backup copy of the forum programme source codes so that if any coding problem occurs with the existing copy, there is a backup copy that can be used to trace back, rather than to perform installation of the forum software again.

The subsequent sections present a discussion on open source program selection and the development of a CMI-based collaboration tool.
7.3.1. A Collaboration Tool Selection

Woolley (2006) has listed a wide range of forum software and its product review, which serves as an independent guide to discussion forum software. The list contains commercial web forum software, OSS and free web forum software. Unlike commercial forum software, OSS are programmes whose licences give users the freedom to run the programme for any purpose, to study and modify the programme, and to redistribute copies of either the original or modified programme (without having to pay royalties to previous developers). In this research, OSS has been adopted for the development of features in the collaboration tool of the present study.

After reviewing the list of forum software (Woolley, 2006), class-1 forum software (Class-1 Web Consultants n.d.) is adopted in this research for the following reasons:

a) Its medium of instruction is English language;

b) It is written and distributed under the GNU General Public License which means that its source is freely-distributed and available to the general public;

c) It can run with different web browsers. It is platform independent.

Class-1 forum software is a linear forum where each new message is added onto the end of the discussion. It supports features such as user-selectable theme, image attachment, and full unread message tracking, access to private messages, e-mailing to other users, and gives groups of user’s privileged access to the forum. The last updated version for the forum software is v0.24.4 and dated 26 August 2004. Class-1 Forum Software is a PHP and MySQL driven web forum.
7.3.2. Development Platform

Since *class-1* forum software is a web-based application, it needs a web server. The Apache web server running on a Microsoft Windows platform was chosen as it is the most popular web server used in the Internet with almost 70% of the Internet websites hosted by the Apache web server (Netcraft Ltd, 2005). Besides Microsoft Windows, it also runs on the Linux platforms, making the forum software platforms independent. The user interface of the forum software is developed using HTML. Dynamic web pages are written in PHP Hypertext Preprocessor (PHP), which is a server-side scripting language that provides an easy interface to interact with the MySQL DBMS.

As a web-based application, all users interact with the forum software through a browser. The *class-1* forum software has been tested with different web browsers such as Internet Explorer (IE), Mozilla, Mozilla FireFox, Safari, Netscape, and Opera. In this way, the forum software is completely platform independent. For the development of the identified features, IE has been chosen due to its wide spread installation base.

7.3.3. Event-driven Model

Forum software benefits from event-driven programming because they suit the inherently event-driven nature of many aspects of the real world. The *class-1* forum software is event-driven software. One of the keys to creating dynamic web pages is the use of event handlers. An event handler is codes, typically a function or routine written in a scripting language that receives control when the corresponding event occurs. This allows developers to execute specific scripting codes in response to user or system initiated actions. Event-driven programmes typically consist of a number of small programmes called event handlers, which are to be called in response to external events. The external events may be a keyboard or mouse operation, or a timer event. A
dispatcher which calls the event handlers often uses an event queue to hold unprocessed events. The event-driven programme starts, waits for an event and only stops when told to do so by an event. Programming an event-driven system is thus a matter of rewriting the event handlers of the system, to match the required behavior. Graphical user interface event-driven programmes, network and system management tools, and computer operating systems are classic examples of event-driven programmes. In this research, some of the class-1 forum software event handlers were modified and some new event handlers were created to meet the requirements for assessing students’ contributions to Internet forums as reported in Section 7.2.

7.3.4. A Summary of the New Features for class-1 Forum Software

In this section, discussion is focused on the key features identified that needed to be implemented into class-1 forum software. Some of the class-1 features can be used without change, some features required modification, and some new features are added to meet the requirements for assessing students’ contributions to Internet forums identified in Chapter 4. The subsection starts with a description of the user interface design of class-1 forum software, followed by new features added to the forum software to support forum discussion. The new features that were not supported by the adopted forum software were identified and developed in this research.

7.3.5. User Interface Design of the Class-1 Forum Software

The class-1 forum software supports three types of users: administrators, moderators and members. An administrator has control of the entire forum and as such has full control over moderation of forums, banning of users, etc. Moderators have the ability to ban users and to control posts within the confines of the forums that they moderate. They take care of the day-to-day running of a forum and are generally there to keep discussions on-topic and non-abusive. Members can view and post messages to
discussion forums that are visible to them. In this research, the researcher and the IS educators have the role of administrators while the student plays the role of member.

i. Administrator Interface

Only administrators have the rights to access this interface (Figure P4 to P10 in Appendix P). In class-1 forum software, the administrator identity is always checked before any information is loaded. The administrator interface layout can be divided into two (2) parts as described below:

a) Navigation pane at the left of the page

The navigation pane has a list of hyperlinks for administrators to perform the administrative operations. The main titles for these hyperlinks are forum administration, group administration, and user administration. Hyperlinks under forum administration title are forum statistics, forum configuration, forum layout, forum locks, message purge, censored word list, smilies, attachments, extension control, and backup. Under group administration, there are hyperlinks for create new group, delete group, add members to group, remove members from group, and permissions. Ban control hyperlink and edit user details hyperlink are under the user administration title. Clicking on the hyperlink would invoke the appropriate function and cause the appropriate information to appear in the right pane.

b) Pane at the right of the page

The right pane displays the relevant information or the operation to be performed of the selected hyperlink in the navigation pane. All operations such as view, addition, deletion and modification are performed in this pane.
Class-1 forum software supports forum administration, group administration and user administration. A new feature named forum assessment was developed in this research to meet the requirements for assessing the students’ contributions to Internet forums. The hyperlinks under the forum assessment title are message category statistics, group performance statistics, set performance indicator and export statistics.

ii. Forum Interface

Administrators, moderators and members have access to the forum interface (Figure P1 in Appendix P). In the forum interface, seven hyperlinks are located at the top right hand corner for global navigation. Global navigation is defined as links to a site's top-level categories that occur on every page of the site. These hyperlinks are namely forum index, FAQ, search member list, edit profile, private message, and log out. In this research, private message is removed and replaced by my post summary which is one of the requirements identified in the second survey to support reporting function (see Item 6 of Table 7-1).

In the forum interface, forums are listed in a table along with the forum’s name, description, number of topics, number of posts and last post information such as day, date, time and author user name. In a forum, topics are listed in a table with subject title, author, number of replies, number of views, and last post information such as day, date, time, and author username. Each discussion topic is listed in a table using a linear system. Breadcrumb navigation is shown before the table. Breadcrumb navigation shows the user's path to its current location. The post and reply message interface contains user input text fields for subject, message content area field, formatting bar, smilies bar, “Post Message” and “Clear Message” buttons and FILE attachments feature. A new feature which is the SCAFFOLD checkboxes were developed and integrated to

7.3.6. The New Features

This subsection discusses the key features identified for assessing students’ contributions to Internet forums. “Suspend or resume student’s participant”, “Approve/deny a student’s participation” and “set up student groupings” are supported by class-1. As such, there is no development for these features (see Item 1 of Table 7-1). The key features added are editing students’ posts categories, students’ posts category statistics, group performance statistics, set performance indicator, file with comma delimited format for further processing, participate in an internet forum and my posts summary.

i. Editing Students’ Posts Categories

In the forum interface, administrators and moderators can create forums, post new topics and reply to messages (Figure P2 in Appendix P). Administrators and moderators are able to edit and delete students’ posts. These features are supported by class-1 forum software. However, the forum software does not support categorizing of messages using SCAFFOLD. With the addition of SCAFFOLD checkboxes, administrators and moderators should be able to change a posted message’s category by a member if it is found incorrect. The forum software should update the database with the changes made by moderators. The feature has been developed to meet the requirement “Change a posting’s category” (see Item 2 of Table 7-1).
ii. Students’ Posts Statistics

The system enables administrators to view statistics of all forums’ posts categories. Class-1 forum software does not support this feature. The statistics include total number of messages and total counts for each post category for the selected forum (Figure P4 and P5 in Appendix P). The statistics also reports on each student’s total number of messages posted, total message lengths, total counts for each SCAFFOLD category posted by each student and his performance indicator score for the selected forum. The administrator ables to rank the report based on the assessment criteria used in the performance indicator. The feature has been developed to fulfil the requirement “Rank based on predefined criteria used in a performance indicator” (See Item 5 in Table 7-1).

iii. Group Performance Statistics

An administrator is able to view the statistics for students in a group (Figure P6 and P7 in Appendix P). This enables the administrator to generate reports on the student group discussion activities such as total number of posts, total length posted, and total count for each post category. The feature has been developed to meet the requirement “Filter to view only a group of students” (Item 5 in Table 7-1).

iv. Setting of Criteria for the Performance Indicator

The forum software enables administrators to set the coefficient for the criteria for the performance indicator for each forum. Coefficients that can be set in a performance indicator are those for total number of messages, total length, each post category of SCAFFOLD, and the deadline before which messages should be taken for assessment purpose (Figure P8 and P9 in Appendix P). Each criterion is given a coefficient to be filled in by administrators. This feature allows administrators to select the preferred grading criteria (Item 3 and 4 of Table 7-1). The formula used as shown in (1).
Performance indicator score = \( x \times TP + y \times TL + SCAFFOLD \) \hspace{1cm} (1)

and

\[
SCAFFOLD = a \times \text{Count\_Acknowledging} + b \times \text{Count\_Analysis} + c \times \text{Count\_Broadened} + d \times \text{Count\_Evaluative} + e \times \text{Count\_Clarification} + f \times \text{Count\_Questioning} + g \times \text{Count\_Resolution} + h \times \text{Count\_Resources} + i \times \text{Count\_Social} + j \times \text{Count\_Summarizing} + k \times \text{Count\_Synthesis};
\]

Where

- \( a, b, c, d, e, f, g, h, i, j, k, x, y \) are coefficients of float data type;
- \( TP = \) Total messages posted by a member;
- \( TL = \) Total message lengths posted by a member;
- \( \text{Count\_Acknowledging} = \) total count of ‘acknowledging’ messages posted by a member;
- \( \text{Count\_Analysis} = \) total count of ‘analysis’ messages posted by a member;
- \( \text{Count\_Broadened} = \) total count of ‘broadened’ messages posted by a member;
- \( \text{Count\_Evaluative} = \) total count of ‘evaluative’ messages posted by a member;
- \( \text{Count\_Clarification} = \) total count of ‘clarification’ messages posted by a member;
- \( \text{Count\_Questioning} = \) total count of ‘questioning’ messages posted by a member;
- \( \text{Count\_Resolution} = \) total count of ‘resolution’ messages posted by a member;
- \( \text{Count\_Resources} = \) total count of ‘resources’ messages posted by a member;
- \( \text{Count\_Social} = \) total count of ‘social’ messages posted by a member;
- \( \text{Count\_Summarizing} = \) total count of ‘summarizing’ messages posted by a member;
- \( \text{Count\_Synthesis} = \) total count of ‘synthesis’ messages posted by a member;

A zero coefficient indicates that the criterion would not be used for grading. A criterion that is preferred to be used for grading by IS educators would be given a higher
coefficient value. For timeliness of posting, a date is required so that the system only includes messages that fall before the input date for assessment purpose. All posts after the specified input date will not be updated to the posts statistic.

v. File with Comma Delimited Format for Further Processing

The forum software enables administrators to export the data from the selected forum if required (Figure P10 in Appendix P). This feature enables administrators to use the file to perform further processing using other application software such as Microsoft Excel or statistical software such as SPSS. The comma delimited file should contain *user name*, *matrix number*, *forum name*, *total posts*, *total message length*, and *total count for each post category of SCAFFOLD*. The feature meets with the requirement “Plain text or comma delimited format exportable for further processing” (see Item 5 in Table 7-1).

vi. Participation in an Internet Forum

The forum software enables its members to post a new topic, view other members’ postings and reply them. The forum interface supports features such as *post a new topic*, *edit and delete individual posted messages* and *reply to a message*; however, it does not support categorizing individual posts. SCAFFOLD checkboxes has been developed and integrated into *class-1* forum software to allow members to categorize their messages (Figure P2 in Appendix P). A hyperlink was created (“What is this?” hyperlink) and linked to a HTML file that contained the definition and indicators of each item in SCAFFOLD. Alternatively, members can move the mouse over a message category name to display its definition. Each message may contain more than one unit of meaning. Each unit of meaning is analyzed and categorized along the SCAFFOLD. A member is required to select SCAFFOLD checkbox to reflect the message content before posting. The forum software captures and updates the database with student’s
message, message count, message length as well as the message categories once the member posted his message. In this research, *edit* and *delete posted message* by member (author) in the *class-1* forum software are disabled. Any changes required on a posted message would require the member to post another message for rectification. The feature meets with the requirement “categorize posting” (see Item 2 of Table 7-1).

**vii. My Posts Summary**

The forum software should enable a member to view his posts information such as date of latest post, total number of messages posted, total message lengths, total count for each category posted by the member, as well as the performance indicator score(s) if any (Figure P3 in Appendix P). This feature is important as more than 60% of the IS educators sampled selected it as one of the new features in the student’s interface. The overall forum performance on the criteria would be displayed to allow the student to compare individual performance with the overall performance. This feature benefits members by providing a real-time analysis of member’s discussions performance. The features meet with the requirements for reporting purpose (see Item 6 of Table 7-1).

As described above, assessing students’ contributions to Internet forums is not supported by *class-1* forum software. The event handlers added and modified, database tables added and entity-relationship diagram for the features developed are presented in Appendices Q, R, and S.

**7.4. Evaluation of the Collaboration Tool**

The main objective of the evaluation is to determine the accuracy of the assessment formula in predicting students’ grades for their contributions to Internet forums. In addition, the usability of the Internet forum was also investigated. This is to ensure that
users did not use the forum software due to reasons other than its usability. To determine the usability of the forum software, an electronic questionnaire was developed using questions in the Software Usability Measurement Inventory (SUMI) (Human Factors Research Group, 1992). Twenty (20) questions (which were relevant to the forum software) were adopted from SUMI and put together into an electronic questionnaire. To measure the accuracy of the assessment formula, Pearson product-moment correlations between the performance indicator (PI) scores and the actual grades were calculated.

7.4.1. Method of Evaluation

The evaluation of the Internet forum was conducted in the second semester of 2006/07 academic year. Two (2) IS educators from the Faculty of Computer Science and Information Technology, University of Malaya agreed to participate in the evaluation of the Internet forum. Two IS courses with a total of 64 (not 70 because 6 students took both IS courses) students were involved in the evaluation. The students registered the IS courses that required them to complete a project; hence they had a suitable background required for the evaluation. The university was selected since permission had been given by the faculty administration to use the computer facilities in the university for evaluation of the Internet forum. A personal computer located in one of the faculty laboratories was allocated for this evaluation exercise and was configured to become a web server. The Internet forum was tested and was accessible using a personal computer at any location. Table 7-2 presents the information on the IS courses involved in the evaluation.

<table>
<thead>
<tr>
<th>ID</th>
<th>Course Name</th>
<th>Total number of students</th>
<th>Number of students in a group</th>
<th>Project Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>Information Retrieval</td>
<td>47</td>
<td>2</td>
<td>6 weeks</td>
</tr>
<tr>
<td>W2</td>
<td>Knowledge Management</td>
<td>23</td>
<td>2</td>
<td>3 weeks</td>
</tr>
</tbody>
</table>
During the evaluation, the researcher and the two (2) IS educators acted as administrators, and students registered for both IS courses were the members of the Internet forum. Both IS educators involved used ICT to support the instructional processes of their IS courses. They had developed their respective homepages to disseminate information related to the IS courses, such as project details. However, they had no experience in using Internet forums. The majority of the students involved were also new in using Internet forums in their studies. The students were briefed on the objective of the Internet forum by the researcher together with the IS educators during lecture. The students were told to register themselves as members of the Internet forum through given URL (http://202.185.109.149/forum/index.php). A student guide was created to direct students in using the Internet forum (Appendix T). Students were advised not to register as anonymous, since anonymous postings would pose some challenges in monitoring mischievous behavior (University of Technology Sydney, 2007). The students were told to contact the administrators via e-mail if they had any technical problems related to the use of the Internet forum. The researcher grouped students into their respective courses using the students’ list given by the faculty. The students were told that they would be able to use the Internet forum after grouping. The Internet forum was available for student discussion throughout the project duration.

The Internet forum was used by the students to share and discuss information. A forum was created for the students to familiarize themselves with the forum features, and another forum for discussion on project issues. Good practice guidelines (Appendix U) on Internet forum usage were posted to a forum for student reference. The students were encouraged by the respective IS educators to use the Internet forum for discussions. The
Internet forum did not replace their existing class meetings; rather it augmented face to face contact outside of those meetings.

At the end of the project duration, an electronic questionnaire on the usability of the Internet forum was sent to the students via their e-mail accounts, which had been stored in database when the members registered for the forum. The students were given one week to complete an electronic questionnaire (Appendix G). Two follow-up e-mails were sent to the students who did not return the electronic questionnaire one week from the initial e-mailing date. The Internet forum was available for the students participants to complete the electronic questionnaire even though the student discussions in the forums were over. The answered electronic questionnaires were checked for completeness (that is to say all questions were answered) before conducting the analysis.

To evaluate the assessment formula, all the student discussions were compiled into tables. Sample discussion data for ID W1 and W2 are presented in Appendix V. Each table contains posts details such as posts subjects, time and date of posts, and aggregate contribution of a student in the Internet forum. If thirteen (13) students participated in the discussion forum, then thirteen (13) tables containing posts details of the students involved were created for assessment. The researcher took two hours to compile the forum data into tables. The compiled data files were sent to the two IS educators involved for assessment purpose. This is a common approach for manual grading.

Three (3) other IS educators who acted or played the role as assessors of the students’ contributions to Internet forums for both the IS courses were contacted independently. These educators who were earlier sampled in the surveys express their willingness to participate in the evaluation. All the assessors have more than six (6) years teaching
experience of IS courses. The assessors felt comfortable reviewing the discussions. The Internet forum was available for the IS assessors (a total of five assessors) to view the learning context even though the students’ discussions were over. The project titles and descriptions were sent to the three assessors as well. The assessors were given 1 week to complete the grading of files for the two courses involved (Appendix V). Two follow-up e-mails were sent to the IS assessors who did not return the marks one week from the initial e-mailing date. The assessors were asked to estimate how long it took them to assess the two data files for the two IS courses involved.

7.4.2. Findings of the User Testing and Evaluation

The results obtained were summarized using a statistical software package - Statistical Package for the Social Sciences (SPSS) version 12.0. The following subsections present the evaluation results.

7.4.3. Results of the Evaluation for the Usability of the Internet Forum

A total of 64 electronic questionnaires (Appendix G) were transmitted and 49 usable sets were returned. Thus, the respondents represent about 76.6% of the total number of students who participated in the evaluation of the Internet forum. In calculating the mean and standard deviation for items in Table 7-3, the following scores were used: ‘Agree’ = 1, “Don’t know” = 2, and ‘Disagree’ = 3.

Table 7-3 shows the analysis of responses to the questions on usability. It shows that the responses were positive (18 items out of 20 have more than 50% respondents rated positive) for most of the questions asked. This may indicate that the students had minimal difficulty in using the Internet forum.
Students also made comments on their experiences of using the Internet forum. The following are examples of their opinions regarding the Internet forum written in the “Any suggestion/comment:” (Q21) section of the questionnaire:

a) keep up the good job…thank you.

b) Design a more attractive interface

c) I think every course should have one forum session like this. Not only discuss assignment but also coursework.

d) I am not a person who use forum to look out for an answer for my problems. The discussion in the forum sometimes not actually 100 percent true. I prefer to ask somebody more professional like a lecturer or etc…

The comments given shown that the students seem to enjoy using the Internet forum in their study. One student requested to have forum discussion for all learning activities. Another student make personal request to have a more attractive interface. However, one particular student commented that he discusses problems with his educators instead of discussing with peers online as he does not trust the reliability of the content presented in the forum. This could be the reason why some students lack interest to join an Internet forum. This also indicated that some students rely on their educators as they trust their educator as the expert in the subject matter.

7.4.4. Results of the Evaluation for the Accuracy of the Assessment Formula

The PI score of each student was calculated using the four measures derived from the class messages. The assessment criteria is:

\[
PI \text{ score} = x \times TP + y \times TL + SCAFFOLD
\]
Table 7-3
Analysis of Responses for Software Usability (n=49)

<table>
<thead>
<tr>
<th>Items</th>
<th>Agree (%)</th>
<th>Don’t know (%)</th>
<th>Disagree (%)</th>
<th>Mean* (Std Dev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The instructions and prompts are helpful.</td>
<td>95.9</td>
<td>4.1</td>
<td>0</td>
<td>1.04 (0.200)</td>
</tr>
<tr>
<td>The speed of this software is fast enough.</td>
<td>73.5</td>
<td>20.4</td>
<td>6.1</td>
<td>1.33 (0.591)</td>
</tr>
<tr>
<td>I would recommend this software to my friends.</td>
<td>67.3</td>
<td>28.6</td>
<td>4.1</td>
<td>1.37 (0.566)</td>
</tr>
<tr>
<td>It is easy to make the software do exactly what you want.</td>
<td>57.1</td>
<td>24.5</td>
<td>18.4</td>
<td>1.61 (0.786)</td>
</tr>
<tr>
<td>Working with this software is satisfying.</td>
<td>81.6</td>
<td>14.3</td>
<td>4.1</td>
<td>1.22 (0.511)</td>
</tr>
<tr>
<td>Learning how to use new functions is difficult.</td>
<td>26.5</td>
<td>18.4</td>
<td>55.1</td>
<td>2.29 (0.866)</td>
</tr>
<tr>
<td>The way that system information is presented is clear and understandable.</td>
<td>83.7</td>
<td>10.2</td>
<td>6.1</td>
<td>1.22 (0.550)</td>
</tr>
<tr>
<td>The software has helped me overcome any problems I have had in using it.</td>
<td>57.1</td>
<td>30.7</td>
<td>12.2</td>
<td>1.55 (0.709)</td>
</tr>
<tr>
<td>I feel in command of this software when I am using it.</td>
<td>49.0</td>
<td>42.8</td>
<td>8.2</td>
<td>1.59 (0.643)</td>
</tr>
<tr>
<td>Learning to operate this software initially is full of problems.</td>
<td>8.2</td>
<td>22.4</td>
<td>69.4</td>
<td>2.61 (0.640)</td>
</tr>
<tr>
<td>The organization of the menus or information lists seems quite logical.</td>
<td>59.2</td>
<td>34.7</td>
<td>6.1</td>
<td>1.47 (0.616)</td>
</tr>
<tr>
<td>It is obvious that user needs have been fully taken into consideration.</td>
<td>53.1</td>
<td>42.8</td>
<td>4.1</td>
<td>1.51 (0.582)</td>
</tr>
<tr>
<td>It takes too long to learn the software commands.</td>
<td>4.1</td>
<td>16.3</td>
<td>79.6</td>
<td>2.76 (0.522)</td>
</tr>
<tr>
<td>Using this software is frustrating.</td>
<td>4.1</td>
<td>12.2</td>
<td>83.7</td>
<td>2.80 (0.499)</td>
</tr>
<tr>
<td>I can understand and act on the information provided by this software.</td>
<td>83.7</td>
<td>12.2</td>
<td>4.1</td>
<td>1.20 (0.499)</td>
</tr>
<tr>
<td>It is easy to see at a glance what the options are at each stage.</td>
<td>71.4</td>
<td>20.4</td>
<td>8.2</td>
<td>1.37 (0.636)</td>
</tr>
<tr>
<td>It is relatively easy to move from one part of a task to another.</td>
<td>75.5</td>
<td>12.3</td>
<td>12.2</td>
<td>1.37 (0.698)</td>
</tr>
<tr>
<td>I have to look for assistance most times when I use this software.</td>
<td>18.4</td>
<td>20.4</td>
<td>61.2</td>
<td>2.43 (0.791)</td>
</tr>
<tr>
<td>Tasks can be performed in a straightforward manner using this software.</td>
<td>73.5</td>
<td>24.5</td>
<td>2.0</td>
<td>1.29 (0.500)</td>
</tr>
<tr>
<td>The software has a very attractive presentation.</td>
<td>34.7</td>
<td>32.6</td>
<td>32.7</td>
<td>1.98 (0.829)</td>
</tr>
</tbody>
</table>

*Agree: mean = 1; Don’t know: mean = 2; Disagree: mean = 3;
and

$$SCAFFOLD = a \times \text{Count\_Acknowledging} + b \times \text{Count\_Analysis} + c \times \text{Count\_Broadened} + d \times \text{Count\_Evaluative} + e \times \text{Count\_Clarification} + f \times \text{Count\_Questioning} + g \times \text{Count\_Resolution} + h \times \text{Count\_Resources} + i \times \text{Count\_Social} + j \times \text{Count\_Summarizing} + k \times \text{Count\_Synthesis}$$

Where

$a, b, c, d, e, f, g, h, i, j, k, x, y$ are coefficients of float data type;

$TP = \text{Total messages posted by a member; }$

$TL = \text{Total message lengths posted by a member; }$

$\text{Count\_Acknowledging} = \text{total count of ‘acknowledging’ messages posted by a member;}$

$\text{Count\_Analysis} = \text{total count of ‘analysis’ messages posted by a member;}$

$\text{Count\_Broadened} = \text{total count of ‘broadened’ messages posted by a member;}$

$\text{Count\_Evaluative} = \text{total count of ‘evaluative’ messages posted by a member;}$

$\text{Count\_Clarification} = \text{total count of ‘clarification’ messages posted by a member;}$

$\text{Count\_Questioning} = \text{total count of ‘questioning’ messages posted by a member;}$

$\text{Count\_Resolution} = \text{total count of ‘resolution’ messages posted by a member;}$

$\text{Count\_Resources} = \text{total count of ‘resources’ messages posted by a member;}$

$\text{Count\_Social} = \text{total count of ‘social’ messages posted by a member;}$

$\text{Count\_Summarizing} = \text{total count of ‘summarizing’ messages posted by a member;}$

$\text{Count\_Synthesis} = \text{total count of ‘synthesis’ messages posted by a member;}$

For timeliness of posting, two different dates were set for both IS courses (after referring to the respective IS educators) so that the system only included messages that fall before the date specified for assessment.
The researcher set the coefficients \((a, b, c, d, e, f, g, h, i, j, k)\) of \(SCAFFOLD\) to \(1, x = 1\) and \(y = 0.001\). The same coefficients were set for the two (2) IS courses throughout the evaluation. This is because the IS assessors’ grading criteria were unknown. However, when the grading criteria are known, it is easy to adjust the coefficients to reflect the grading criteria.

Table 7-4 summarizes the PI scores of the two (2) IS courses. A total of 64 (N) students were registered to participate in the Internet forum. However, only 39 (n) from the total of 64 students contributed to the discussion. Almost 39% (25 students) of the students were silent or invisible in the forum and these students would very likely get zero marks for the discussion. The researcher decided not to include these invisible students in the comparison of the PI scores with the students’ actual grades assigned by the IS assessors for the two courses involved (Table 7-5). This is simply because it may increase the correlation between the PI scores and the actual grades, and subsequently may not reflect the accuracy of the assessment formula.

The accuracy of the assessment formula is evaluated by comparing the calculated PI with the actual grades assigned by the IS assessors. The time taken for the IS assessors to assess the data files ranged from half an hour to one hour. The Pearson product-moment correlations between the PI and the actual grades were calculated. Correlations between individual measures (except for timeliness) and the actual grades were also calculated as shown in Table 7-6 for W1 and Table 7-7 for W2. The results in each row of Table 7-6 and Table 7-7 demonstrate the correlation between the PI and the actual grades given by different IS assessors. The results in the second column of Table 7-6 and Table 7-7 \((R (PI-G))\) demonstrate that there is a high correlation between the PI and the actual grades \((0.827 – 0.996)\).
Table 7-4
Summary of the PI scores (n=39)

<table>
<thead>
<tr>
<th>ID</th>
<th>N</th>
<th>n</th>
<th>Total posts</th>
<th>PI Range</th>
<th>Mean (Std. Dev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>47</td>
<td>26</td>
<td>56</td>
<td>2.01- 16.88</td>
<td>2.93 (4.07)</td>
</tr>
<tr>
<td>W2</td>
<td>23</td>
<td>13</td>
<td>29</td>
<td>2.00 – 17.20</td>
<td>2.77(4.46)</td>
</tr>
</tbody>
</table>

W1 = Information Retrieval, W2 = Knowledge Management

Table 7-5
Summary of Actual Grades given by Assessors and PI score generated by the system

<table>
<thead>
<tr>
<th>ID</th>
<th>Actual Grades</th>
<th>PI score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assessor 1</td>
<td>Assessor 2</td>
</tr>
<tr>
<td>W1</td>
<td>Student 1</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Student 2</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>Student 3</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Student 4</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Student 5</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Student 6</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Student 7</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>Student 8</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Student 9</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Student 10</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Student 11</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Student 12</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Student 13</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>Student 14</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>Student 15</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Student 16</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Student 17</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Student 18</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>Student 19</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Student 20</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Student 21</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Student 22</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Student 23</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Student 24</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Student 25</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Student 26</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Student 39</td>
<td>2.0</td>
</tr>
</tbody>
</table>

W1 = Information Retrieval, W2 = Knowledge Management
According to a report in the essay grading literature, agreement between computer graders and human judges varies from 0.4 to 0.9 approximately, and that is comparable to or even better than agreement between two human graders (Williams, 2001). The results also show that, in most cases, PI performs slightly better than any of the three measures that are total message count, total message lengths and SCAFFOLD.

Table 7-6
Correlations for course W1(Information Retrieval)

<table>
<thead>
<tr>
<th></th>
<th>R (PI-G)</th>
<th>R(TM-G)</th>
<th>R(TL-G)</th>
<th>R(S-G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS Assessor 1</td>
<td>0.988</td>
<td>0.979</td>
<td>0.887</td>
<td>0.980</td>
</tr>
<tr>
<td>IS Assessor 2</td>
<td>0.852</td>
<td>0.806</td>
<td>0.905</td>
<td>0.857</td>
</tr>
<tr>
<td>IS Assessor 3</td>
<td>0.936</td>
<td>0.928</td>
<td>0.758</td>
<td>0.935</td>
</tr>
<tr>
<td>IS Assessor 4</td>
<td>0.885</td>
<td>0.900</td>
<td>0.797</td>
<td>0.863</td>
</tr>
</tbody>
</table>

R (PI-G): correlation between the PI and the actual grades
R(TM-G): correlation between the total message count (TM) scores and the actual grades
R (TL-G): correlation between the total message lengths (TL) scores and the actual grades
R(S-G): correlation between the SCAFFOLD and the actual grades

Table 7-7
Correlations for course W2(Knowledge Management)

<table>
<thead>
<tr>
<th></th>
<th>R (PI-G)</th>
<th>R(TM-G)</th>
<th>R(TL-G)</th>
<th>R(S-G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS Assessor 1</td>
<td>0.996</td>
<td>0.993</td>
<td>0.853</td>
<td>0.991</td>
</tr>
<tr>
<td>IS Assessor 2</td>
<td>0.930</td>
<td>0.923</td>
<td>0.905</td>
<td>0.926</td>
</tr>
<tr>
<td>IS Assessor 3</td>
<td>0.942</td>
<td>0.937</td>
<td>0.835</td>
<td>0.939</td>
</tr>
<tr>
<td>IS Assessor 4</td>
<td>0.827</td>
<td>0.789</td>
<td>0.901</td>
<td>0.848</td>
</tr>
</tbody>
</table>

R (PI-G): correlation between the PI and the actual grades
R(TM-G): correlation between the total message count (TM) scores and the actual grades
R (TL-G): correlation between the total message lengths (TL) scores and the actual grades
R(S-G): correlation between the SCAFFOLD and the actual grades

7.5. Summary

This chapter has presented (a) the user requirements from the data gathered in the second survey; (b) the development of some of the CMI requirements using open source forum software; and (c) a report of the usability of the an open source software and the accuracy of the assessment criteria to predict the actual grade of students for their contributions to the Internet forums in IS instructional processes.

For the usability of the Internet forum, the analysis of responses to the survey questions shows that the responses were positive for most of the questions asked. This indicated
that the students may had minimal difficulty in using the Internet forum. On the other hand, the researcher found that the performance indicator scores generated from the assessment formula was highly correlated with the actual grades assigned by the IS assessors. The difference between the judgments of different IS assessors grading the same class independently is also low. It is reasonable to assume that such correlation is comparable to what has been reported in the automatic essay grading literature (Williams, 2001). Thus, the evaluation results suggest that the performance of the assessment formula is comparable to, if not better than, that of a human instructor. Therefore, the validity of the assessment criteria is established. Consequently, the research objective 6 has been achieved. The tool can be implemented to help IS educators obtain a reference to students’ performance without reading through the huge amount of class messages, which is a tedious and intensive procedure. The tool could be employed as a supplementary grader to help IS educators make better judgments and give comments on students’ contribution.
Chapter 8

Discussion and Conclusion

8.1. Introduction

This study found that among the three (3) types of computer use in education, namely CAI, CMI, and CEI, IS educators are more inclined to use CMI in supporting instructional processes. As such, CMI has then been used as an approach of the research. The objectives of this research are as follows:

i. Determine the extent of ICT usage and the factors affecting the use of ICT tools in teaching and learning of IS in Malaysian higher education;

ii. Identify area(s) where current ICT tools used are inadequate to support IS instructional processes, as perceived by the IS educators;

iii. Design and develop a tool to support the area(s), revealed in (ii) and;

iv. Evaluate the feasibility of the tool to support IS instructional processes.

This study uses the case study approach where IS educators in Malaysia is chosen as the case. The study adopts multiple data collection techniques which include: (a) a literature review to understand the use of computer in higher education; present the use of computer in higher education; the use and perception of ICT tools in Malaysian higher education and IS education; CMI functions and system flow; the implementation of CMI in open source LMS worldwide; and mapping CMI features obtained from literature with the open sources LMS under study; (b) a questionnaire designed to identify the extent of use of ICT tools and the factors associated with the use of ICT tools in teaching and learning of IS; (c) interviews to further investigate in-depth on the use of ICT tools in teaching and learning of IS; (d) document analysis of student assignment questions to further understand the requirements of IS learning activities; (e)
a second questionnaire to collect data on a specific aspect of IS education (identified in the interviews) in order to seek the requirements of IS teaching community to alleviate the problem identified; and (f) user testing and evaluation of the developed system.

8.2. Answering the Research Questions

The thesis has contributed to the research field on ICT used in teaching and learning of IS. The following summarizes the findings for the research questions posed in Chapter 1.

8.2.1. What are the ICT tools used in teaching and learning of IS?

The ICT tools such as LCD projectors, the Internet, search tools, spreadsheets, presentation software and word processing software were used extensively by the IS educators sampled. These ICT tools were considered as the standard facilities required for teaching and learning among the respondents in institutions of higher education. ICT tools such as electronic file sharing facilities, e-mail, and the web were categorised as ‘often used’ by the IS respondents. Whereas ICT tools such as scanners, FTPs, LMS, HTML generators, online notice boards, and digital libraries were considered as ‘sometimes used’ by the respondents based on the mean value calculated. Authoring tools, online chat rooms, computer assisted assessments, calendar tools, online discussion forums, database applications and courseware were ‘seldom used’ by the respondents. Streaming video, video conferencing, streaming audio (distance learning solutions) and voice messages were not used by the majority of the respondents. Ten (10) software/tools (word processing software, presentation software, spreadsheet, search tools, Internet, LCD projector, web, e-mail, files sharable, digital library) have been adopted by Laggards in IS instructions, eight (8) software/tools (online notice board, HTML generator, LMS, ftp, scanner, courseware, database application, online discussion forum) have been adopted by the Late Majority in IS instructions, six (6)
software/tools (calendar tools, computer assisted assessment, online chat rooms, authoring tools, voice messages, streaming audio) have been adopted by the Early Majority, and two (2) tools (video conferencing, streaming video) that have only diffused into the Early Adopters categories in the Rogers innovation diffusion (Figure 8-1). Among the three (3) types of computer used in education, namely CMI, CAI, or CEI, the research found that CMI has a higher mean value of usage among the respondents (Section 4.2.4.) This indicated that the respondents are inclined to use ICT for instructional management purpose.

![Figure 8-1](ict_innovation_curve.png)

**Figure 8-1**
ICT Innovation curve for IS education

**8.2.2. What are the areas of concern perceived by the IS educators in using these tools in teaching and learning of IS?**

The five (5) most important benefits (from a total of 14 items) of using ICT in teaching identified from this study are that (a) educators are able to refer to a wider range of resources using ICT; (b) amendment of learning materials become easier; (c) educators’
job satisfaction are improved; (d) efficient communication; and (e) shorter time required for analysing students results. The similar findings are found in other studies such as ICT tools increase the opportunities for accessing various sources of information (Hernández-Jorge et al., 2003; Osborne and Hennessy, 2003; Littlejohn and Higgison, 2003), teaching material stored in digital form can be easily amended and updated (Littlejohn and Higgison, 2003), and communication becomes easier for both lecturers and students with the integration of ICT tools (Boettcher, 1994; Littlejohn and Higgison, 2003).

The five (5) most significant obstacles (from a total of 23 items) identified from the first survey findings are (a) fast development in ICTs requires IS educators to keep current with the technology; (b) provision of time and effort is required to integrate ICT in teaching; (c) lack of incentive; (d) poor network connectivity; and (e) absence of formal evaluation on integration of ICT tools in teaching. These findings are consistent with others such as Butler and Sellbom’s (2002) findings which shows that the second biggest concern of faculty was the time it took to learn to use new technologies. Rogers (2000) described that the use of ICT tools can be complicated and time consuming until it has been mastered. Spotts (1999) reported that in addition to time for training, a lecturer needs time to experiment with new technologies and to develop material using the new technologies. He also commented that most lecturers are reluctant to give up more time than what they already have. Wilson (2003) reported that lack of faculty reward systems is one of the most common obstacles to the use of ICT tools in teaching and learning. Institutions have to reassess the relative balance in faculty rewards between teaching and research (Rogers, 2000). Lecturers would be more likely to use ICT tools when clear vision and incentives system for using it are established. It will affect how the lecturers perceive the value of integrating ICT tools in teaching and
learning, and subsequently affect the amount of effort and time spent on using it. It will also affect the willingness of the lecturers in exploring new ICT tools and trying to integrate them in teaching (Spotts, 1999). Spotts (1999) has pointed out that the lack of ICT vision, incentives system, and recognition are the few reasons for the slow adoption of ICT tools in teaching and learning. Other studies have also shown that lack of equipment, unreliable and poorly maintained equipment, and poor network infrastructure are the prominent obstacles to the use of ICT tools in teaching and learning (Wilson, 1994; Johnston and McCormack, 1996; Thomas et al., 1996; Jacobsen, 2000; Butler and Sellbom, 2002). Through factor analysis, the 23 items were factored into six factors. The factors are namely change management, equipment readiness, peer and students influence, reliability of support, ease of learning, and personal enthusiasm. The factors and its description is presented in Table 8-1.

<table>
<thead>
<tr>
<th>No</th>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Change Management</td>
<td>IS educators want the deans and heads to play an active role in the change process. They want the deans in the institution to provide direction, clear instruction, proper evaluation and incentives during implementation.</td>
</tr>
<tr>
<td>2</td>
<td>Equipment readiness</td>
<td>IS educators view equipment as an important variable in the implementation process. Before integrating ICT tools in teaching, IS educators want to know if the equipments are in place.</td>
</tr>
<tr>
<td>3</td>
<td>Peer and students influence</td>
<td>IS educators are concerned about peer comments, students’ ICT skills, feedback and attitude on ICT tools support teaching. IS educators will be more likely to integrate ICT tools in teaching if their students give good feedback on ICT tools used in teaching, and have the ICT skills and willing to learn using ICT tools. They would like to hear positive comments on ICT tools integration from peers as well.</td>
</tr>
<tr>
<td>4</td>
<td>Reliability of support</td>
<td>IS educators would like to know if there are technical staff support, reliable network connection as well as reliable ICT tools if they use ICT tools in teaching.</td>
</tr>
<tr>
<td>5</td>
<td>Ease of learning</td>
<td>IS educators are concerned about the difficulty of learning and the rate of change of ICT tools. They will be more likely to use those ICT tools which are user friendly and where the rate of change is low.</td>
</tr>
<tr>
<td>6</td>
<td>Personal enthusiasm</td>
<td>IS educators are more likely to use ICT tools in teaching if enough time is allocated for ICT integration and strong motivation and guidance are given.</td>
</tr>
</tbody>
</table>
8.2.3. What are the factors perceived by the IS educators that contribute towards the successful use of ICT tools in teaching and learning of IS?

The five (5) most significant factors (from a total of 20 items) identified from the first survey findings are (a) IS educators must have high enthusiasm in using ICT to support teaching; (b) peers success; (c) student attitude; (d) peer encouragement; and (e) management vision. The findings are consistent with Livingston (2003) for peer encouragement, Spotts (1999) for management vision, and Staman (1990) for peer success stories. Through factor analysis, the 20 items were factored into four (4) factors. The factors are namely change management, equipment readiness, peer influence and personal enthusiasm, and students learning power. The factors and its description are presented in Table 8-2.

<table>
<thead>
<tr>
<th>No</th>
<th>Factors</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Change Management</td>
<td>IS educators wanted the deans and heads to play an active role in the change process. They want the deans in the institution to provide direction, clear instruction, integration master plans and programs for training, evaluation and incentives during implementation.</td>
</tr>
<tr>
<td>2</td>
<td>Equipment readiness</td>
<td>IS educators view equipment and infrastructure as important variables in the implementation process. Before integrating ICT tools in teaching, lecturers want to know if the equipment and infrastructure are in place and in good condition.</td>
</tr>
<tr>
<td>3</td>
<td>Peer influence and personal enthusiasm</td>
<td>IS educators are concerned about encouragement and success stories of peers. They have to know the benefits of using ICT tools and their own interest in using such tools in teaching.</td>
</tr>
<tr>
<td>4</td>
<td>Students learning power</td>
<td>IS educators are concerned about students’ ICT skills, feedback and attitude on ICT tools-supported teaching. They will be more likely to use ICT tools in teaching if their students give good feedback, have the ICT skills and attitude to learn how to use ICT tools.</td>
</tr>
</tbody>
</table>

8.2.4. What are the areas that the current tools used lack of in IS instructional processes?

Findings of the interviews revealed that in general, the six (6) IS educators involved rely on ICT tools to support IS instructions. ICT tools were used in preparation of learning
materials, dissemination of information, online tests and reporting. However, they expressed difficulty in using ICT for managing instructional activities such as student assignment and student discussion in Internet forums. The IS educators managed student assignments manually and reluctant to spend time for discussion in Internet forums. The results of an analysis revealed that current ICT tools are too general and inadequate to solve the problem identified. Document analysis and second survey were conducted to further understand IS educators’ needs and variables involved in managing the learning activities. CMI model is adopted to guide the research as the results of the findings shown that the IS educators are inclined to use ICT as CMI to support IS instructions.

8.2.5. What are the IS educators’ perceived requirements to address the areas in 8.2.4?

A list of IS educators’ perceived requirements were gathered from the findings of the interviews, document analysis and second survey. The requirements gathered from the interviews are (Figure 8-2):

a) Online tests as students assessment method
b) Assignments as students assessment method
c) Record keeping of individual or group assignment
d) Record keeping of learning materials and guidelines
e) Record keeping of student contact such as e-mail addresses
f) Prescription on students’ assignments reports and online tests
g) Reporting functions for students assignment submission
h) Reporting functions for student workgroup
i) Reporting functions for students learning progress
The requirements gathered from the second survey are (Figure 8-3):


b) Functions selected to support IS educators use of Internet forums includes categorize posting, change a posting’s category, report students’ posts statistics, report only a selected group of students posts statistics, export students’ posts statistics in comma delimited format.

c) Functions selected to support students use of Internet forums includes categorize posting, report individual student’s posts statistics.

Figure 8-2
The CMI-based LMS structure
The requirements were further confirmed with document analysis of assignment questions are (Figure 8-2):

a) Record keeping of course information, objectives or descriptions of the assignment given, individual or student team work, number of educators involved, the chronology of deliverables that take place in the implementation of IS assignments, guidelines for students to conduct research, write and produce report, types of resources provided to students, deadlines for submission, mode of submission, evaluation criteria of assignment

b) Reporting functions for submission of assignment reports

8.2.6. How well does the tool perform in terms of usability, functionality and accuracy to address the requirements identified?

The usability of the open source learning management system using CMI concept is evaluated with twelve (12) IS educators. The result of the system usability shows that the open source learning management system is well accepted by the IS educators. The
functionality of the majority of the modules were rated positive by the IS educators. The CMI-based system is working satisfactorily but, the system still can improve further. It is, however, a system which reduces the time of educators in managing instructional processes. The CMI-based system can be used to support IS instructions to complement the traditional class.

The usability of the open source Internet forum and reliability of the assessment formula was evaluated with a total of sixty four (64) students from two (2) different IS courses and five (5) IS educators. The students employed the open source online discussion forum to discuss issues related to the assignment given in a semester. The results of the system usability show that the Internet forum is well accepted by the students. The performance indicator scores generated by the assessment formula were highly correlated with the actual grades assigned by the five (5) IS educators. The difference between the judgments of different IS educators grading the same class independently is also low. The evaluation results suggest that the performance of the assessment model is comparable to, if not better than, that of a human instructor.

8.3. Problematic Issues Encountered

This section discusses issues that incur during the implementation and testing phases. Following is the list of the issues, how they were worked around, and what improvements can be made in the future.

8.3.1. Use of Post Category in Internet Forums

The implementation of post category for each contribution to the Internet forum is rather new. The different post categories are namely ‘broadened’ (increased the scope of the discussion), ‘evaluative’ (was evaluative, assessing the meaningfulness or validity
of ideas being shared), ‘questioning’ (raised thoughtful questions about the topic), ‘synthesis’ (contained well formed, clear, connected, and synthesized ideas), ‘analysis’ (provided analysis of the problem being discussed), ‘summarizing’ (summarized the topic discussion overall), ‘resolution’ (promoted cooperation to resolve issues of debate or disagreement), ‘acknowledging’ (responded to another contribution), ‘clarification’ (supplied or sought clarification as needed in responses), ‘resources’ (exchanged useful resources with others such as links or citations), and ‘social’ (conversational or social in nature, interjected personal commentary or experiences). Users (students, educators, moderators and system administrators) are responsible for their own contribution and its post category. Before users post any comments or questions, they are required to check the SCAFFOLD checkboxes for the post category. Therefore, in order to get an accurate statistics for students’ contribution to Internet forums, users must understand their own contribution and check the correct post category(s).

Based on the students’ contributions to the Internet forum as presented in Appendix Q, it can be seen that some posts have incorrect post category label to it even though a brief orientation session was given. This is expected as some students might not attend the briefing session or perhaps some students were shy to inform their difficulty in understanding the post category during the orientation. The researchers believe that it could be improved by giving some explanations to students that have difficulty to understand it for future implementation.

8.3.2. Building Internet Forum Community

The Internet forum relies on its community to post questions, ideas, and feedback on a given topic. As students write contributions to Internet forums, they learn by sharing and reflecting upon their perspectives and providing feedback to one another online.
Internet forums allow assimilation, collaboration and reflection among students. Knowlton (2001) quoted that knowledge construction is best accomplished through collaboration. The willingness to share information among users is crucial to create a “constructive atmosphere” for ongoing discussion in the Internet forum.

Two forums were set up for each of the two IS courses (W1 and W2) during the system evaluation (Chapter 7). However, it was observed that the students’ discussion for course W1 were richer, the discussion was continuous and relevant to the topic given as compared to students’ discussion for course W2, where the discussion was disconnected after a few discussion. The actual reason for what happen in the forum for course W2 is unknown. On the other hand, a student reported that he discussed the learning problems with his educators instead of discussing it with peers online as he does not trust the reliability of the content presented in the Internet forum. The researcher feels that the success of Internet forums depends on the enthusiasm of the students to collaborate and student mindset concerning the use of Internet forums.

8.4. Significance of the study

In addition to answering the above research questions, the thesis has also contributed the following significance:

i. In the mid-70s, CMI meant little more than a database for testing, record keeping, prescribing and reporting of student performance, where the administrator could monitor who takes what course, who manages the course, the dates, and the aggregated statistics. The LMSs developed based on the CMI approach have common functionalities so that they can be used across various academic disciplines. In this research, the focus is on the Information Systems academic
Discussion and Conclusion

discipline where the IS educators with information systems background, organize and manage teaching routine (pedagogical knowledge) with respective to the IS development concepts and activities (content knowledge). Content knowledge (IS development concepts that includes IS development life cycles such as analysis, design, development, implementation and testing) and instructional activities (instructional methods used such as tests, discussion, assignments or projects for individual or team work) integrated with CMI concepts (testing, prescripting, record keeping, reporting) for managing the IS instructional processes is a new contribution in the IS research literature.

ii. In addition to support the CMI features (testing, record keeping, prescripting, and reporting), the CMI-based tool enables the educators to upload other applications such as CAI (tutorials or drill and practice) and CEI (simulation) into the system or links to the system. These features supported by the CMI-based tool enable IS educators to make any CAI and CEI application available to the students. CAI and CEI application can be invoked from the system and the students run CAI or CEI that are stored in the system. For hyperlinks, the students run the CAI or CEI in a new window or tab. The CMI-based tool is used as a tool that serves three different purposes that are (a) as a platform that contains application for reinforcement of factual learning on the knowledge level (drill and practice or tutorials program) and simulations; (b) as a repository that contains information related to general enrichment in relatively unstructured exercises designed to simulate and motivates students (programming tool, modeling software, application tools); (c) as a tool to support the management of instructional processes performed by the IS educators.

iii. Internet forums are used to support interaction between any numbers of members in an asynchronous, text-based environment. Messages in the Internet forums are displayed as ‘threads’ organised according to subject referents and allow the history
of the online conversation to be easily followed (McKenzie and Murphy, 2000). Internet forums with the CMI functions (testing, prescribing, record keeping and reporting) are thought of as a novel contribution in the IS research literature as the application of CMI in Internet forums is not known before. With the added feature, it is easy to show which student posted the messages, how many messages posted, the total length of the messages, the category of the messages posted, and in which forums. The CMI functions implemented in an open source Internet forum has contributed to general understanding of designing, implementing and evaluating of such tool.

iv. The total length of messages, total number of messages, and the category of messages posted are used as assessment criteria for students’ contributions to Internet forums for a given period of time. The assessment formula of a performance indicator for students’ contributions to Internet forums is also new. The formula can be implemented as a teaching tool to help IS educators obtain a reference to students’ performance without reading through the huge amount of class messages. The tool could be employed as a supplementary grading tool to help IS educators make better judgments in student assessment. It could serve as a guideline for others to further this research.

8.5. Further Research

The current investigation was undertaken to implement a CMI concept to support IS instructions. The logic developed for this CMI could be used with any set of instructional materials which have been organized and can be evaluated using true-false, multiple choice-single answer, multiple choice – multiple answers and keywords questions. Appropriate unit descriptions, test questions and criteria would replace the existing ones. This research can be further expanded to study the possibility of
incorporating other CMI elements into a learning management system to make it a total solution in education, such as

i. Extend the management level of existing system from instructional level and course level to program level, where the educator is concerned with the educational program of a student or group of students. As this research encompasses only IS courses, there is no program level of management.

ii. Future researchers of the course logic could make several changes in the CMI system to make it operate more effectively. With the information gained from the students’ evaluation (CMI-based Internet forums) and the IS educators’ evaluation (CMI-based LMS), the feedback mechanism and report functions could be further enhanced. For example, the My profile module to store more personal information, the tool should notify students about the assessed assignment via their e-mail account.

iii. As CMI, consisting of a set of functionalities which allow learning objects to be launched in the LMS and to exchange data with it. To facilitating the adoption of CMI functionalities in LMSs, a framework has to be proposed so that a complete reference on the way in which the launch and the communication can take place.

iv. Broaden the investigation of the context of research and scope of the CMI to other academic disciplines.

v. Investigate the impact of CMI upon the student such as the extent of CMI affect student attitudes towards learning.

8.6. Summary

The process of gathering requirements, designing, developing, implementing and testing the CMI-based LMS is rather challenging but it is a fruitful one. The case study
Discussion and Conclusion

approach used in this study selected all IS educators in Malaysia as the case. The first survey and interviews findings show that among CAI, CEI and CMI, the IS community are inclined to use CMI for instructional processes as compared to other. There are very few local resources or similar systems that related to CMI in Malaysia that can be used as reference. As such, the functional development was mainly based on the literature read about such ventures abroad associated with the development of CMI and an understanding of the IS domain’s environment within the Malaysian higher education context. The CMI-based system is developed based on the requirements extracted from the interviews, the second survey and document analysis of assignment questions. The CMI-based system provides constant feedback on student performance in collaboration tools (Internet forums), tests and assignments (individual or team work), enable prescription, record keeping, reporting, and human resources (IS educators) distribution, import CAI and CEI into the system are the strength of the systems that specifically design for the IS courses, that could not be found in other system. The successfully implementation of the CMI-based system is depend on the enthusiasm of both IS educators and students in using ICT to support instructional processes.
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Appendix A: An E-mail Addressed to the Dean of the Faculty of Computer Science in Malaysian Universities to Obtain Permission to Conduct a Survey for the First Survey

Dear Sir,

Application to Conduct a Survey

I would like to apply to conduct a survey with title A Survey on Utilisation of Information and Communications Technology (ICT) Tools in Teaching and Learning of Information Systems (IS) in Universities.

2. The purpose of the survey is to gauge the use of information and communication technology (ICT) in Information Systems education. The respondents of the survey will be the lecturers who are teaching Information Systems courses in your faculty. The same survey will be conducted in all universities in Malaysia. This survey is meant for research purposes only. To ensure the confidentiality of the information, the analysis of the survey will not be done based on individual university, rather it will be done based on public universities as a whole. I assure you completing this survey will take maximum 20 minutes time.

3. I appreciate very much if your faculty would participate in this survey. If you agree, please provide me the list of full time and on duty lecturers who teach information system courses (as attached) and their contact information such as email address and telephone number. Kindly send the information to me via my email.

Thank you.

Yours faithfully,

WEE MEE CHIN
PhD candidate
Faculty of Computer Science and Information Technology
University of Malaya
Phone: 012-2922349
Email: weemc@perdana.um.edu.my or mcwee@yahoo.com

cc. zab@um.edu.my
Appendix B: A Survey on Utilisation of Information and Communications Technology (ICT) Tools in Teaching and Learning of Information Systems (IS) in Universities

Purpose: The goals of this survey are to gauge the use of Information and Communications Technology (ICT) tools in teaching and learning of Information Systems (IS). The survey seeks information on how ICT tools have boosted teaching, the obstacles to their use, and the factors that contribute to their successful usage in teaching.

Please answer ALL questions. There are no right or wrong answers. If you are unsure what your answer is, simply indicate your best answer from the options. This survey contains Section A – D in 8 printed pages (excluding this page). Please tick (✓) the appropriate box where applicable.

Read the questions carefully before answering. If you have any query, please contact me at mcwee@yahoo.com or call me at 016-6320768.

Note: This survey is meant for research purposes only. All data collected and analysis from it will be treated with the strictest confidentiality. The results of the analysis will not in any way be prejudicial or detrimental to the image of individuals or groups/sections within the institution. Returned survey forms will duly be destroyed upon completion of the research project.

Thank you very much for participating in this study.

Wee Mee Chin  
PhD candidate  
University of Malaya

Please fill up the information below:

Name: ..................................................
Address: ..................................................
Faculty/Division: ..................................................
University/Institution: ..................................................
Email Address: ..................................................
Section A: Demographic Information

1. Age Group

- 30 and below
- 31 – 35
- 36 – 40
- 41 – 45
- 46 – 50
- 51 – 55
- 56 – 70

2. Gender

- Male
- Female

3. Highest Educational Attainment (as applicable)

- PhD, Major & Minor: ..............................................
- Master’s, Major & Minor: ..........................................
- Bachelor’s, Major & Minor: ......................................

4. Years of teaching experience (total)

- 0 – 5 years
- 6 – 10 years
- 11 – 15 years
- 16 – 20 years
- Above 20 years

5. The Information Systems (IS) subjects that you have taught:

<table>
<thead>
<tr>
<th>Name of the IS subjects</th>
<th>Level (undergraduate/postgraduate)</th>
<th>Number of Semester*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems Analysis and Design (for e.g.)</td>
<td>undergraduate</td>
<td>2</td>
</tr>
</tbody>
</table>

*How many times (in term of semester) that you have taught the IS subject excluding tutorials.
1.1.1. Section B: Utilisation of ICT tools in Teaching and Learning of IS

Teaching refers to activities in

- preparation of the lesson
- delivery of the lesson includes lectures, tutorials, laboratory sessions and consultation sessions
- student assessment

Information communications and technology tools are defined as the tools used to access, retrieve, store, organize, manipulate, produce, present and exchange information by electronic and other automated means.

Please rank your usage of the following technologies in supporting your teaching on a 5-point scale ranging from:

<table>
<thead>
<tr>
<th></th>
<th>Never (0%)</th>
<th>Seldom (&lt; 25%)</th>
<th>Sometimes (25% - 50%)</th>
<th>Often (50% - 75%)</th>
<th>Always (&gt; 75%)</th>
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<td>5</td>
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</tr>
</tbody>
</table>

How frequent do you use the following ICT tools in your teaching?

1. I use calendar tools (such as Microsoft Outlook) to plan my teaching activities.
2. I use word processing software (such as Microsoft Word, WordPerfect) to key in my lecture notes, tutorial questions, and lab exercises.
3. I use presentation software (such as Microsoft PowerPoint) to prepare my presentation slides.
4. I use HTML generator (such as Microsoft FrontPage, Macromedia Dreamweaver) to develop my web pages for students reference.
5. I use authoring tools (such as Macromedia Flash) to animate some of my teaching materials.
6. I surf the Internet to look for teaching materials.
7. I use search tools (such as Google, Yahoo) to search for teaching material available in the Internet.
8. I use scanner to scan in photos and documents to put into my teaching materials.
9. I use digital library to look for materials related to my teaching and research.
10. I use online discussion forum for interaction between students and tutors.
11. I use online chat rooms to chat with my students.
12. I deliver my lectures using streaming audio (such as digital audio delivered via the Web).
<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>13. I deliver my lectures using <strong>streaming video</strong> (such as digital video delivered via the Web).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. My teaching materials are available on the <strong>web</strong>.</td>
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</tr>
<tr>
<td>15. My students <strong>use voice messages</strong> or voicemail to leave message to me.</td>
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<td></td>
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<tr>
<td>16. I post notices on <strong>online notice board</strong> for students to refer.</td>
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</tr>
<tr>
<td>17. I use <strong>courseware</strong> in my teaching.</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>18. I use <strong>computer assisted assessment</strong> (such as Questionmark) for formative or summative assessment.</td>
<td></td>
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</tr>
<tr>
<td>19. My students submitted their assignment to me through <strong>e-mail, ftp or e-assignment</strong>.</td>
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<tr>
<td>20. I use <strong>spreadsheet</strong> (such as Microsoft Excel) to help me to calculate my students results.</td>
<td></td>
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<tr>
<td>21. I use <strong>database application</strong> (such as Microsoft Access) to store my students personal information and results.</td>
<td></td>
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</tr>
<tr>
<td>22. I use <strong>Learning Management System</strong> (such as WebCT, Blackboard etc) to support my teaching.</td>
<td></td>
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</tr>
<tr>
<td>23. Other ICT tool (specify)</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>24. Other ICT tool (specify)</td>
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</tbody>
</table>
1.1.2. Section C: How have ICT tools boosted teaching and learning in IS

Please respond to the following questions on a 6-point scale ranging from:

<table>
<thead>
<tr>
<th>N/C</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Comment</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Slightly Disagree</td>
<td>Slightly Agree</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

Note: If you have never encountered the situation mentioned, please specify as “no comment”.

<table>
<thead>
<tr>
<th>How have ICT tools boosted your teaching?</th>
<th>N/C</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I amended and updated my teaching materials easily.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. I referred to a wider range of resources to prepare richer teaching materials.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. I took less time to search for teaching resources.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>4. My time spent on administrative is reduced by making routine information available online.</td>
<td>☐</td>
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<td>☐</td>
<td>☐</td>
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<td>☐</td>
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</tr>
<tr>
<td>5. I communicated with peers or students faster and more efficiently.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>6. My students visualised and understood teaching material better using ICT supported illustration.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>7. My students learned more independent using ICT tools.</td>
<td>☐</td>
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<tr>
<td>8. With multimedia features, my teaching materials have stimulated students’ interest in learning.</td>
<td>☐</td>
<td>☐</td>
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<td>☐</td>
<td>☐</td>
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<tr>
<td>9. My students learned to share learning issues effectively using online discussion board.</td>
<td>☐</td>
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<tr>
<td>10. Computer assisted assessment saved my time on marking.</td>
<td>☐</td>
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<tr>
<td>11. I tabulated and analysed my students’ results faster.</td>
<td>☐</td>
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<tr>
<td>12. I monitored my students’ learning progress effectively.</td>
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<tr>
<td>13. My job satisfaction was increased using ICT tools.</td>
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<tr>
<td>14. My students had shown their satisfaction with ICT supported teaching.</td>
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<tr>
<td>15. Other (specify).................................................</td>
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<tr>
<td>16. Other (specify).................................................</td>
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</table>
1.1.3. Section D: What were the obstacles you encountered and what were the success factors that contributed to your usage of ICT tools.

Please respond to the following questions on a 6-point scale ranging from:

<table>
<thead>
<tr>
<th>N/C No Comment</th>
<th>1 Strongly Disagree</th>
<th>2 Disagree</th>
<th>3 Slightly Disagree</th>
<th>4 Slightly Agree</th>
<th>5 Agree</th>
<th>6 Strongly Agree</th>
</tr>
</thead>
</table>

Note: If you have never encountered the situation mentioned, please specify as “no comment”.

What were the obstacles you encountered in using ICT tools to support your teaching?

<table>
<thead>
<tr>
<th></th>
<th>N/C</th>
<th>1</th>
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</thead>
<tbody>
<tr>
<td>1. I had to spend extra time and effort in teaching after integrating ICT tools in teaching.</td>
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<td>2. I found myself difficult to change from my current teaching practice to integrate ICT tools in teaching.</td>
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<tr>
<td>3. Certain software (such as Macromedia Flash) was difficult to learn and use.</td>
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<td>4. ICT tools are changing too fast to keep current.</td>
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<td>5. My peers have been giving negative comments about using ICT tools.</td>
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<tr>
<td>6. Some of my peers have failed to integrate ICT tools in their teaching.</td>
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<tr>
<td>7. The management did not have any vision on integration of ICT tools in teaching.</td>
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<tr>
<td>8. The management did not provide any clear instruction on how to integrate ICT tools in my teaching.</td>
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<td>9. The management did not provide any incentive for lecturers to integrate ICT tools in their teaching.</td>
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<td>10. The management did not initiate any program (such as seminar and workshop) to encourage ICT supported teaching.</td>
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<td>11. The management did not have any evaluation on integration of ICT tools in teaching.</td>
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<tr>
<td>12. Students had negative attitude towards ICT supported teaching.</td>
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<tr>
<td>13. Students were lack of ICT skills.</td>
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<td>14. Students gave negative feedback on ICT supported teaching.</td>
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<td>15. I have had problem getting quality training program.</td>
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<td>16. I have had difficulty getting support from technical staff.</td>
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<td>17. There is no long term staff development to support the integration of technology into instruction.</td>
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<td>18. The software available was not sufficient to accommodate ICT supported teaching.</td>
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<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Comment</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Slightly Disagree</td>
<td>Slightly Agree</td>
<td>Agree</td>
<td></td>
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<tr>
<td>19. The software available had already outdated to accommodate ICT supported teaching.</td>
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<td>20. The hardware available was not sufficient to accommodate ICT supported teaching.</td>
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<td>21. The hardware available had already outdated to accommodate ICT supported teaching.</td>
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<td>22. The network connectivity was poor.</td>
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<tr>
<td>23. The ICT tools were not always reliable.</td>
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<tr>
<td>24. Other factor (specify)</td>
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<td>25. Other factor (specify)</td>
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Note: If you have never encountered the situation mentioned, please specify as “no comment”.

N/C 1 2 3 4 5 6

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<td>N/C</td>
<td>1</td>
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<tr>
<td>19. The software available had already outdated to accommodate ICT supported teaching.</td>
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<tr>
<td>20. The hardware available was not sufficient to accommodate ICT supported teaching.</td>
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<tr>
<td>21. The hardware available had already outdated to accommodate ICT supported teaching.</td>
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<tr>
<td>22. The network connectivity was poor.</td>
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<tr>
<td>23. The ICT tools were not always reliable.</td>
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<td>24. Other factor (specify)</td>
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<td>25. Other factor (specify)</td>
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</tbody>
</table>
Please respond to the following questions on a 6-point scale ranging from:

<table>
<thead>
<tr>
<th>N/C</th>
<th>1 Strongly Disagree</th>
<th>2 Disagree</th>
<th>3 Slightly Disagree</th>
<th>4 Slightly Agree</th>
<th>5 Agree</th>
<th>6 Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Comment</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Note: If you have never encountered the situation mentioned, please specify as “no comment”.

What were the success factors that have contributed towards the use of ICT tools in support your teaching?

1. I spent less time and effort to prepare my teaching after integrating ICT tools in teaching. ☐ ☐ ☐ ☐ ☐ ☐
2. My enthusiasm towards ICT supported teaching was high. ☐ ☐ ☐ ☐ ☐ ☐
3. My peers have been encouraging me to use ICT tools. ☐ ☐ ☐ ☐ ☐ ☐
4. Some of my peers have successfully integrated ICT tools into their teaching. ☐ ☐ ☐ ☐ ☐ ☐
5. The management had clear vision on integration of ICT tools in teaching. ☐ ☐ ☐ ☐ ☐ ☐
6. The management provided clear instruction on how to integrate ICT tools in teaching. ☐ ☐ ☐ ☐ ☐ ☐
7. The management provided incentives for lecturers to integrate ICT tools in their teaching. ☐ ☐ ☐ ☐ ☐ ☐
8. The management initiated programs (such as seminar and workshop) to encourage ICT supported teaching. ☐ ☐ ☐ ☐ ☐ ☐
9. A committee was set up to plan, coordinate, and evaluates ICT tools integration in teaching. ☐ ☐ ☐ ☐ ☐ ☐
10. Students had positive attitude towards ICT supported teaching. ☐ ☐ ☐ ☐ ☐ ☐
11. Students had received training on ICT tools. ☐ ☐ ☐ ☐ ☐ ☐
12. Students have given positive feedback on ICT supported teaching. ☐ ☐ ☐ ☐ ☐ ☐
13. I was given quality training program. ☐ ☐ ☐ ☐ ☐ ☐
14. I was getting good support from technical staff. ☐ ☐ ☐ ☐ ☐ ☐
15. There is a long term staff development to support the integration of technology into instruction. ☐ ☐ ☐ ☐ ☐ ☐
16. The software was sufficient to accommodate ICT supported teaching. ☐ ☐ ☐ ☐ ☐ ☐
17. The software was up to date to accommodate ICT supported teaching. ☐ ☐ ☐ ☐ ☐ ☐
18. The hardware was sufficient to accommodate ICT supported teaching. ☐ ☐ ☐ ☐ ☐ ☐
19. The hardware was up to date to accommodate ICT supported teaching. ☐ ☐ ☐ ☐ ☐ ☐
20. The network connectivity was good. ☐ ☐ ☐ ☐ ☐ ☐
<table>
<thead>
<tr>
<th></th>
<th>N/C No Comment</th>
<th>1 - Strongly Disagree</th>
<th>2 - Disagree</th>
<th>3 - Slightly Disagree</th>
<th>4 - Slightly Agree</th>
<th>5 - Agree</th>
<th>6 - Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Other factor (specify)</td>
<td></td>
<td></td>
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<tr>
<td>22</td>
<td>Other factor (specify)</td>
<td></td>
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</tbody>
</table>

Note: If you have never encountered the situation mentioned, please specify as “no comment”.

Please give any other comments or suggestions on ICT tools in supporting teaching.

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Appendix C: List of Universities Involved in the First Survey

This research required input from the faculty in the universities listed below:
1. Department of Information Science, Faculty of Computer Science and Information Technology, University of Malaya
2. Faculty of Information Science and Technology, National University of Malaysia
3. Faculty of Computer Science and Information Technology, University Putra of Malaysia
4. Faculty of Information Technology, Northern University of Malaysia
5. Faculty of Computer Science and Information System, University of Technology Malaysia
6. School of Engineering & Information Technology, University of Malaysia Sabah
7. Faculty of Computer Science and Information Technology, University of Malaysia Sarawak
8. School of Computer Science, University of Science Malaysia
9. Kulliyyah of Information and Communication Technology, International Islamic University Malaysia
10. Faculty of Information Technology, Multimedia University
11. Faculty of Information Technology, Tun Abdul Razak University
12. Faculty of Information and Communication Technology, Tunku Abdul Rahman University
13. Faculty of Information Technology and Multimedia Communications, Open University of Malaysia
14. Faculty of Information Technology, Malaysia University of Science and Technology
15. Faculty of Industrial Information Technology, Industrial University of Selangor
16. Faculty of Information and Communication Technology, Sultan Idris University of Education
17. Information Systems/Technology Division, Petronas University of Technology
18. Faculty of Information Technology and Quantitative Sciences, MARA University of Technology
19. Department of Computer Science and IT, Tenaga Nasional University
Appendix D: An E-mail Addressed to the Dean of the Faculty of Computer Science in Malaysian Universities to Obtain Permission to Conduct a Survey for the Second Survey

Dear Sir,

Application to Conduct a Survey

I would like to apply to conduct a survey with title A Survey on Requirements for Assessing Students’ Contributions to Internet Forums.

2. The purpose of the survey is to seek information on the requirements for assessing students’ contributions to Internet forums. The respondents of the survey will be the lecturers who are teaching Information Systems courses in your faculty. The same survey will be conducted in all public universities in Malaysia. This survey is meant for research purposes only. To ensure the confidentiality of the information, the analysis of the survey will not be done based on individual university, rather it will be done based on public universities as a whole. I assure you completing this survey will take maximum 20 minutes time.

3. I appreciate very much if your faculty would participate in this survey. If you agree, please provide me the list of full time and on duty lecturers who teach information system courses (as attached) and their contact information such as email address and telephone number. Kindly send the information to me via my email.

Thank you.

Yours faithfully,

WEE MEE CHIN
PhD candidate
Faculty of Computer Science and Information Technology
University of Malaya
Phone: 012-2922349
Email: weemc@perdana.um.edu.my or mcwee@yahoo.com

c.c. zab@um.edu.my
Appendix E: A Survey on Requirements for Assessing Students’ Contributions to Internet Forums

Purpose: The goal of this survey is to seek information on the requirements for assessing students’ contributions to Internet forums.

Universities Involved: Lists of educators were obtained from the faculties of the universities who have agreed to participate in this survey.

Please answer ALL questions. There are no right or wrong answers. If you are unsure of your answer, simply indicate your best answer from the options. This survey contains Sections A to D on 6 printed pages (excluding this page). Please tick (✔) the appropriate box where applicable.

Read the questions carefully before answering. If you have any query, please contact me at mcwee@yahoo.com or call me at 012-2922349.

Note: This survey is meant for research purposes only. All data collected and analysis from it will be treated with the strictest of confidentiality. The results of the analysis will not in any way be prejudicial or detrimental to the image of individuals or groups/sections within the institution. Returned survey forms will duly be destroyed upon completion of the research project.

Thank you very much for participating in this study.

Wee Mee Chin
PhD candidate
University of Malaya
Section A: Demographic Information

1. Age Group
   - 30 and below
   - 31 – 35
   - 36 – 40
   - 41 – 45
   - 46 – 50
   - 51 – 55
   - 56 – 60
   - 61 and above

2. Gender
   - Male
   - Female

3. Highest Educational Attainment (as applicable)
   - Doctorate
   - Master degree
   - Bachelor degree

4. Years of teaching experience (total)
   - 0 – 5 years
   - 6 – 10 years
   - 11 – 15 years
   - 16 – 20 years
   - Above 20 years

5. Information Systems (IS) courses that you have taught (You may choose more than one):
   - Information Systems
   - Systems Analysis and Design
   - Database Design and Management
   - Database Management Systems
   - Knowledge Management Systems
   - Information Systems Management
   - Information Technology
   - Management of Information Technology
   - Project management
   - IS and Strategy Management
   - Information System Planning
   - Information Systems: Theory and Practice
   - System Development Methodologies
   - Information system technology
   - Information Systems development and implementation
   - Organizational functions
   - Concepts and processes of organizational management
   - Information Processing
   - Networks and telecommunication
   - Electronic Business strategy, architecture and design
   - Programming, data, file and object structures

   Others: ..................................................
Section B: Requirements for Assessing Students’ Contributions to Internet Forums for the Teaching and Learning in IS

An Internet forum is essentially a website composed of a number of member-written threads. Each thread entails a discussion or conversation in the form of a series of member-written posts. These threads remain saved on the forum website for future reading indefinitely or until deletion by a moderator. It allows the learner to reflect over ideas, check references and take time to prepare a reply. Internet forums are also referred as online discussion forums, bulletin boards, and online discussion boards.

1. Would you find it useful to have an Internet forum that can generate performance indicator scores for students’ online contributions?
   - Yes
   - No

2. What is the primary objective or benefits that you would obtain from using a performance indicator score in an Internet forum? (Choose the most important one from the list.)
   - Saves time on evaluating students’ contributions
   - Student’s contributions will be more focused to meet those criteria used in the performance indicator
   - Encourages students to participate in Internet forums
   - Others: .................................................................

3. Ellis and Dringus’s findings suggest that students’ discussions can be categorised based on content and then grouped into three levels of reflection in learning, ie. content level, process level, and premise level. If you would like to assess your students’ discussions, which of the following categories of discussions under each reflection level would you choose to assess? (You may choose more than one)

   a. Content level reflection
      - Broadened: increased the scope of the discussion
      - Evaluative: was evaluative, assessing the meaningfulness or validity of ideas being shared
      - Questioning: raised thoughtful questions about the topic
      - Synthesis: contained well formed, clear, connected, and synthesized ideas

   b. Process level reflection
      - Analysis: provided analysis of the problem being discussed
      - Summarizing: summarized the topic discussion overall
      - Resolution: promoted cooperation to resolve issues of debate or disagreement

   c. Premise level reflection
      - Acknowledging: responded to another contribution
      - Clarification: supplied or sought clarification as needed in responses
      - Resources: exchanged useful resources with others such as links or citations
      - Social: conversational or social in nature, interjected personal commentary or experiences
4. In your opinion, which of the following modules and features would help in assessing students’ contributions to Internet forums?

a. Basic features available to support moderating of an Internet forum are as follow:
- Register to participate in the discussion
- Create, Modify, and Delete a thread
- View threads by date
- View postings by date
- Post/reply to a thread

What other features that you would like to have? (You may choose more than one)
- [ ] Approve/deny a student’s participation
- [ ] Suspend/resume a student’s participation
- [ ] Set up student groupings
- [ ] Categorize posting (such as the categories mentioned in Question 3)
- [ ] Allow students to self-categorize posting
- [ ] Change a posting’s category
- [ ] Other: ...........................................................................................................

b. What criteria would you like to use in a performance indicator to assess students’ contributions? (You may choose more than one).
- [ ] None
- [ ] Number of discussion threads posted
- [ ] Length of posting/discussion
- [ ] Categories of posting/discussion
- [ ] Timeliness/Consistency of the student’s contributions
- [ ] Other: ...........................................................................................................

c. How would you like a performance indicator score to be presented (You may choose more than one)?
- [ ] Filter to view only a group of students
- [ ] Rank/sort based on predefined criteria used in a performance indicator
- [ ] Plain text or comma delimited format exportable for further processing
- [ ] Other: .............................................................................................................
5. Which of the following features and modules would help to improve your students’ contributions to Internet forums?

Basic features available to support participating in an Internet forum are as follow:
- Register to participate in the discussion
- View threads by date
- View postings by date
- Reply to a thread

What other features would you suggest? (You may choose more than one):

☐ Self-categorize posting (such as categories mentioned in Question 3)
☐ Frequency on the criteria used in a performance indicator for each individual student’s contributions
☐ A performance indicator score for each individual student’s contributions
☐ Other: ............................................................................................................................... 

Section D: Other Questions

1. Please give any other comments or suggestions on features that could help in supporting the assessing Internet forums.

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Thank you very much for your time and support.
Appendix F: List of Universities Involved in the Second Survey

This research required input from the faculty in the universities listed below:
1. Department of Information Science, Faculty of Computer Science and Information Technology, University of Malaya
2. Faculty of Information Science and Technology, National University of Malaysia
3. Faculty of Computer Science and Information Technology, University Putra of Malaysia
4. Faculty of Information Technology, Northern University of Malaysia
5. Faculty of Computer Science and Information System, University of Technology Malaysia
6. School of Engineering & Information Technology, University of Malaysia Sabah
7. Faculty of Computer Science and Information Technology, University of Malaysia Sarawak
8. School of Computer Science, University of Science Malaysia
9. Kulliyyah of Information and Communication Technology, International Islamic University Malaysia
10. Faculty of Information and Communication Technology, Sultan Idris University of Education
11. Faculty of Information Technology and Quantitative Sciences, MARA University of Technology
12. Kolej Universiti Sains dan Teknologi Malaysia (KUSTEM)
13. Kolej Universiti Teknologi Tun Hussein Onn (KUiTTHO)
Appendix G: Software Usability Evaluation for a CMI-based Internet Forum

Software Usability Evaluation

Course code:
Name of software: My Assignment Forum software

The goal of this electronic questionnaire is to evaluate the software usability of “My Assignment” forum software.

Please answer ALL questions. There are no right or wrong answers. If you are unsure of your answer, simply indicate your best answer from the options. In marking the left or right box you are not necessarily indicating strong agreement or disagreement but just your general feeling most of the time. Please tick (✓) in the box of your choice.

This survey is meant for research purposes only. All data collected and analysis from it will be treated with the strictest of confidentiality. The results of the analysis will not in any way be prejudicial or detrimental to the image of individuals or groups/sections within the institution. Returned questionnaire forms will duly be destroyed upon completion of the research project.

Thank you.

Administrator of the forum software.
University of Malaya

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Agree</th>
<th>Don’t know</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The instructions and prompts are helpful.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>The speed of this software is fast enough.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>I would recommend this software to my friends.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4.</td>
<td>It is easy to make the software do exactly what you want.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5.</td>
<td>Working with this software is satisfying.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6.</td>
<td>Learning how to use new functions is difficult.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7.</td>
<td>The way that system information is presented is clear and understandable.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8.</td>
<td>The software has helped me overcome any problems I have had in using it.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>No</td>
<td>Item</td>
<td>Agree</td>
<td>Don’t know</td>
<td>Disagree</td>
</tr>
<tr>
<td>----</td>
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</tr>
<tr>
<td>9</td>
<td>I feel in command of this software when I am using it.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10</td>
<td>Learning to operate this software initially is full of problems.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11</td>
<td>The organization of the menus or information lists seems quite logical.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12</td>
<td>It is obvious that user needs have been fully taken into consideration.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13</td>
<td>It takes too long to learn the software commands.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14</td>
<td>Using this software is frustrating.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15</td>
<td>I can understand and act on the information provided by this software.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16</td>
<td>It is easy to see at a glance what the options are at each stage.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>17</td>
<td>It is relatively easy to move from one part of a task to another.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>18</td>
<td>I have to look for assistance most times when I use this software.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>19</td>
<td>Tasks can be performed in a straightforward manner using this software</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>20</td>
<td>The software has a very attractive presentation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

21. Any suggestion/comment:
Appendix H: System Usability Evaluation for a CMI-based LMS

System Evaluation Questionnaire

The goal of this questionnaire is to evaluate the usefulness of the Learning Management System in practice. This questionnaire is divided into four parts:

- Part A: ease of use;
- Part B: overall assessment;
- Part C: general comments.

Please answer **ALL questions** by ticking (✓) the appropriate box where applicable.

This questionnaire is meant for **research purposes only**. All data collected and analysis from it will be treated with the strictest confidentiality. Returned survey forms will duly be destroyed upon completion of the research project.

Thank you very much for participating in this study.

Wee Mee Chin
PhD candidate
University of Malaya

Please fill up the information below:

Date: _____________________

Name: ____________________

Email: ____________________

Organization: _______________
Part A: Ease of Use

Please tick (✓) the appropriate box based on the following rating:

1. Strongly Disagree
2. Disagree
3. Somewhat Agree
4. Agree
5. Strongly Agree

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The instructions and prompts are helpful.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The speed of this software is fast enough.</td>
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</tr>
<tr>
<td>3. I would recommend this software to my friends.</td>
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<tr>
<td>4. It is easy to make the software do exactly what you want.</td>
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</tr>
<tr>
<td>5. Working with this software is satisfying.</td>
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<tr>
<td>6. Learning how to use new functions is difficult.</td>
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</tr>
<tr>
<td>7. The way that system information is presented is clear and understandable.</td>
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<tr>
<td>8. The software has helped me overcome any problems I have had in using it.</td>
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</tr>
<tr>
<td>9. I feel in command of this software when I am using it.</td>
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</tr>
<tr>
<td>10. Learning to operate this software initially is full of problems.</td>
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<tr>
<td>11. The organization of the menus or information lists seems quite logical.</td>
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</tr>
<tr>
<td>12. It is obvious that user needs have been fully taken into consideration.</td>
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</tr>
<tr>
<td>13. It takes too long to learn the software commands.</td>
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<tr>
<td>14. Using this software is frustrating.</td>
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<tr>
<td>15. I can understand and act on the information provided by this software.</td>
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</tr>
<tr>
<td>16. It is easy to see at a glance what the options are at each stage.</td>
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</tr>
<tr>
<td>17. It is relatively easy to move from one part of a task to another.</td>
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</tr>
<tr>
<td>18. I have to look for assistance most times when I use this software.</td>
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</tr>
<tr>
<td>19. Tasks can be performed in a straightforward manner using this software</td>
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<tr>
<td>20. The software has a very attractive presentation.</td>
<td></td>
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</tr>
</tbody>
</table>
Part B: Overall Assessment

Functionality of the Modules

Please tick (✓) the appropriate box based on the following rating:

1. Very Poor
2. Poor
3. Satisfactory
4. Good
5. Excellent

<table>
<thead>
<tr>
<th>How would you rate the overall functionality of :-</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrollment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manage Assignment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workgroup.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor Assignment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Report.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>View Lists.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilities.</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Part C: General Comments

1. In your opinion, what are the strong points of the Tool (if any)?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. In your opinion, what are the weaknesses of the Tool (if any)?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. Please give your comments and recommendations (if any) on other issues that would help to improve your satisfaction on the use of the Tool.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Appendix I: List of IS Courses that are taught by IS Respondents in the First Survey

List of IS courses that are taught by respondents

1. Information Systems in Organization
2. File processing
3. Management of Information Technology
4. Database and Information retrieval
5. Operating systems
6. Statistic for information technology
7. Decision support system
8. Database
9. Project management
10. Management of Information System
11. Systems Analysis and Design
12. Database Design and Management
13. Introduction to ICT
14. Database System
15. Accounting Information Systems
16. Advanced Database
17. Auditing Information system
18. Database Programming
19. Information system technology
20. Introduction to computer
21. System Development
22. System Development Application
23. Computer Security
24. Object Oriented analysis and design
25. IT Management
26. IS and Strategy Management
27. Computer Project Management
28. Knowledge Management System
29. Human Computer Interface
30. Enterprise Information Architecture
31. Enterprise Framework
32. IS Audit & Control
33. IS Engineering
34. Information System Planning
35. E-commerce Technology
36. Managing IT Projects
37. Information System Analysis
38. E-Commerce
39. Computer Organization
40. Executive Information System
41. Geographical Information System
42. Project Management
43. Project Management in IT
44. Information Retrieval
45. Information System: Theory and Practices
46. Fundamental of databases
47. Internet and Web technology
48. Information Processing
49. System Development Methodology
50. Data Structure and algorithm
51. Accounting and Transaction Processing Systems
52. Data communication
53. Algorithm Analysis
54. Web Database
Appendix J: List of IS Courses that are taught by IS Respondents in the Second Survey

List of IS courses that are taught by IS respondents

1. Information Systems
2. Systems Analysis and Design
3. Database Design and Management
4. Database Management Systems
5. Knowledge Management Systems
6. Information Systems Management
7. Information Technology
8. Management of Information Technology
9. Project management
10. IS and Strategy Management
11. Information System Planning
12. Information Systems: Theory and Practice
13. System Development Methodologies
14. Information system technology
15. Information Systems development and implementation
16. Organizational functions
17. Concepts and processes of organizational management
18. Information Processing
19. Networks and telecommunication
20. Electronic Business strategy, architecture and design
21. Programming, data, file and object structures
22. IT Security, Internet Applications
23. E-commerce Application
24. Computer Ethics
25. Multimedia, 3D modeling and Animation
26. Information Systems Engineering, Information Systems Audit and Control
27. Human Computer Interaction
28. Decision Support Systems
29. Database Programming
Appendix K: Sample Screen Captures for A CMI-based LMS

This appendix contains some screen captures of the CMI-based system.

i) Figure K1 shows the screen capture of Workgroup Summary (1st page loaded after instructor log in the system) (An instructor’s view)
ii) Figure K2 shows the screen capture of Approve Enrolment (An instructor’s view)
iii) Figure K3 shows the screen capture of Import Enrollment (An instructor’s view)
iv) Figure K4 shows the screen capture of Create Assignment where Instructor can put down the assignment objectives and requirements for students to meet. (An instructor’s view)
v) Figure K5 shows the screen capture of assignment editing page. (An instructor’s view)
vi) Figure K6 shows the screen capture of Create Test template where an instructor can create test, diagnosis and give prescription. (An instructor’s view)
vii) Figure K7 shows the screen capture of Approve Group (An instructor’s view)

Figure K7: Screen capture of Approve group
viii) Figure K8 shows the screen capture of Import Group (An instructor’s view)

![Figure K8: Screen capture of Import Group](image-url)
viii) Figure K9 shows the screen capture of Assignment Status (An instructor’s view)
x) Figure K10 shows the screen capture of Workgroup Report (An instructor’s view)
xi) Figure K11 shows the screen capture of Marks Report (An instructor’s view)
xii) Figure K12 shows the screen capture of Submissions Report (An instructor’s view)
xiii) Figure K13 shows the screen capture of setting deliverables for each phase (An administrator’s view).
xiv) Figure K14 shows the screen capture of student Assignment (A student’s view).

![Screen capture of Student Assignment](image)

**Figure K14: Screen capture of Student Assignment**
Appendix L: Event Handlers for a CMI-based LMS

Table L summarizes the event handlers developed to meet the requirements identified.

Table L
Event handlers developed for a CMI-based Learning Management system

<table>
<thead>
<tr>
<th>Event handler</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Login</td>
<td>• Can be accessed by all users&lt;br&gt;• To validate user to ensure authorised access to the system.&lt;br&gt;• Direct the user to the appropriate user interface based on one role.</td>
</tr>
<tr>
<td>Approve enrollment</td>
<td>• Can be accessed by instructors in charge of the course&lt;br&gt;• Approve and reject student’s enrolment to a course&lt;br&gt;• Rollback approval and rejection&lt;br&gt;• Drop enrolment</td>
</tr>
<tr>
<td>Import enrollment</td>
<td>• Can be accessed by instructors in charge of the course&lt;br&gt;• Enrol students by importing enrolment list from a text file</td>
</tr>
<tr>
<td>Create assignment</td>
<td>• Can be accessed by instructors in charge of the course&lt;br&gt;• Create new assignment</td>
</tr>
<tr>
<td>Edit assignment</td>
<td>• Can be accessed by instructors in charge of the course or assignment&lt;br&gt;• Edit assignment details</td>
</tr>
<tr>
<td>Delete assignment</td>
<td>• Can be accessed by instructors in charge of the course or assignment&lt;br&gt;• Delete assignment</td>
</tr>
<tr>
<td>Assignment status</td>
<td>• Can be accessed by instructors in charge of the group&lt;br&gt;• View summary status of assignment reports submission for each assignment group&lt;br&gt;• Show reports submission status and date</td>
</tr>
<tr>
<td>Assignment reference</td>
<td>• Can be accessed by instructors in charge of the course or assignment&lt;br&gt;• Add, remove, and arrange references for an assignment</td>
</tr>
<tr>
<td>Create Tests</td>
<td>• Can be accessed by instructors in charge of the course or assignment&lt;br&gt;• Edit assignment test&lt;br&gt;• Add test questions, answers, and comments&lt;br&gt;• Arrange test questions</td>
</tr>
<tr>
<td>Workgroup summary</td>
<td>• Can be accessed by instructors in charge of the group&lt;br&gt;• View summary status of assignment reports submission for all assignment given for a course&lt;br&gt;• Show total overdue, late submission, and unmarked reports&lt;br&gt;• Download assignment reports</td>
</tr>
<tr>
<td>Approve group</td>
<td>• Can be accessed by instructors in charge of the group&lt;br&gt;• Approve and reject assignment groups&lt;br&gt;• Rollback approval and rejection&lt;br&gt;• Drop groups</td>
</tr>
<tr>
<td>Import group</td>
<td>• Can be accessed by instructors in charge of the course or assignment&lt;br&gt;• Allocate students to assignment groups by importing student and group names from a text file&lt;br&gt;• Allocate instructors to assignment groups by importing instructor and group names from a text file&lt;br&gt;• Students, instructors, and groups can all be imported in one single text file</td>
</tr>
<tr>
<td>Allocate group</td>
<td>• Can be accessed by instructors in charge of the course or assignment</td>
</tr>
<tr>
<td>Event handler</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Allocate Instructor</td>
<td>• Can be accessed by instructors in charge of the course or assignment&lt;br&gt;• Allocate instructors to assignment groups</td>
</tr>
<tr>
<td>Workgroup report</td>
<td>• Can be accessed by instructors in charge of the course, assignment, or group&lt;br&gt;• View group allocation report (instructor, group name, members, programme)</td>
</tr>
<tr>
<td>Marks report</td>
<td>• Can be accessed by instructors in charge of the course, assignment, or group&lt;br&gt;• View marks report&lt;br&gt;• Option to include test marks and forum’s performance indicator</td>
</tr>
<tr>
<td>Submission report</td>
<td>• Can be accessed by instructors in charge of the course, assignment, or group&lt;br&gt;• View submission report</td>
</tr>
<tr>
<td>View Student List</td>
<td>• Can be accessed by students and instructors&lt;br&gt;• Display list of students in the system</td>
</tr>
<tr>
<td>View Instructor list</td>
<td>• Can be accessed by students and instructors&lt;br&gt;• Display list of instructors in the system</td>
</tr>
<tr>
<td>View Group list</td>
<td>• Can be accessed by students and instructors&lt;br&gt;• Display list of groups and its members for a given assignment</td>
</tr>
<tr>
<td>View Assignment list</td>
<td>• Can be accessed by students and instructors&lt;br&gt;• Display list of available assignments</td>
</tr>
<tr>
<td>View Course list</td>
<td>• Can be accessed by students and instructors&lt;br&gt;• Display list of courses in the system</td>
</tr>
<tr>
<td>My profile</td>
<td>• Can be accessed by all users&lt;br&gt;• Change user name and e-mail address&lt;br&gt;• Student can change the enrolled program</td>
</tr>
<tr>
<td>Change password</td>
<td>• Can be accessed by all users&lt;br&gt;• Change own password</td>
</tr>
<tr>
<td>New user</td>
<td>• Can be accessed by all users&lt;br&gt;• Create new user</td>
</tr>
<tr>
<td>Reset password</td>
<td>• Can be accessed by all users&lt;br&gt;• Reset forgotten password</td>
</tr>
<tr>
<td>Take assignment</td>
<td>• Can be accessed by students&lt;br&gt;• View assignment details&lt;br&gt;• Submit assignment report&lt;br&gt;• View instructor’s comments</td>
</tr>
<tr>
<td>Take tests</td>
<td>• Can be accessed by students&lt;br&gt;• Work on test&lt;br&gt;• View test result</td>
</tr>
<tr>
<td>My assignment</td>
<td>• Can be accessed by students&lt;br&gt;• View assignment&lt;br&gt;• Option to work assignment and test</td>
</tr>
<tr>
<td>Create/join group</td>
<td>• Can be accessed by students&lt;br&gt;• Create new group&lt;br&gt;• Join existing assignment group</td>
</tr>
<tr>
<td>My group</td>
<td>• Can be accessed by students&lt;br&gt;• View status of own groups&lt;br&gt;• Leave a group&lt;br&gt;• Submit group for approval</td>
</tr>
<tr>
<td>Event handler</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| Logout        | • Can be accessed by all users  
|               | • Remove session information and then redirect to login page |
Appendix M: Database Design for a CMI-based LMS

Table M shows the tables and their attributes that required for the database. The data attribute(s) (in bold) is the primary key(s) for each table. These data elements can be of two classes: (1) attribute data, such as student name, ID, courses, group, programme enroll, and (2) performance data, such as test scores, scores on each stage of assignments and performance indicator.

<table>
<thead>
<tr>
<th>Table Name</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer</td>
<td>Test (INT), Student (CHAR), Answer (INT), Keyword (TEXT)</td>
</tr>
</tbody>
</table>
| assignment | ID (INT), Course (CHAR), Title (CHAR), Description (text), Deadline (DATETIME), Owner (CHAR), GroupMax (INT), GroupMin (INT), Allocation (INT), Mark (INT), Forum (INT), Status (INT), P1 (INT), P1Desc (text), P1Submission (INT), P1Date (DATETIME), P1Mark (INT), P1D0 (INT), P1D0Name (CHAR), P1D0Date (DATETIME), P1D0Mark (INT), P1D1 (INT), P1D1Date (DATETIME), P1D1Mark (INT), P1D2 (INT), P1D2Date (DATETIME), P1D2Mark (INT), P1D3 (INT), P1D3Date (DATETIME), P1D3Mark (INT), P1D4 (INT), P1D4Date (DATETIME), P1D4Mark (INT), P1D5 (INT), P1D5Date (DATETIME), P1D5Mark (INT), P1D6 (INT), P1D6Date (DATETIME), P1D6Mark (INT), P1D7 (INT), P1D7Date (DATETIME), P1D7Mark (INT), P1D8 (INT), P1D8Date (DATETIME), P1D8Mark (INT), P1D9 (INT), P1D9Date (DATETIME), P1D9Mark (INT), P2 (INT), P2Desc (TEXT), P2Submission (INT), P2Date (DATETIME), P2Mark (INT), P2D0 (INT), P2D0Name (CHAR), P2D0Date (DATETIME), P2D0Mark (INT), P2D1 (INT), P2D1Date (DATETIME), P2D1Mark (INT), P2D2 (INT), P2D2Date (DATETIME), P2D2Mark (INT), P2D3 (INT), P2D3Date (DATETIME), P2D3Mark (INT), P2D4 (INT), P2D4Date (DATETIME), P2D4Mark (INT), P2D5 (INT), P2D5Date (DATETIME), P2D5Mark (INT), P2D6 (INT), P2D6Date (DATETIME), P2D6Mark (INT), P2D7 (INT), P2D7Date (DATETIME), P2D7Mark (INT), P2D8 (INT), P2D8Date (DATETIME), P2D8Mark (INT), P2D9 (INT), P2D9Date (DATETIME), P2D9Mark (INT), P3 (INT), P3Desc (TEXT), P3Submission (INT), P3Date (DATETIME), P3Mark (INT), P3D0 (INT), P3D0Name (CHAR), P3D0Date (DATETIME), P3D0Mark (INT), P3D1 (INT), P3D1Date (DATETIME), P3D1Mark (INT), P3D2 (INT), P3D2Date (DATETIME), P3D2Mark (INT), P3D3 (INT), P3D3Date (DATETIME), P3D3Mark (INT), P3D4 (INT), P3D4Date (DATETIME), P3D4Mark (INT), P3D5 (INT), P3D5Date (DATETIME), P3D5Mark (INT), P3D6 (INT), P3D6Date (DATETIME), P3D6Mark (INT), P3D7 (INT), P3D7Date (DATETIME), P3D7Mark (INT), P3D8 (INT), P3D8Date (DATETIME), P3D8Mark (INT), P3D9 (INT), P3D9Date (DATETIME), P3D9Mark (INT), P4 (INT), P4Desc (TEXT), P4Submission (INT), P4Date (DATETIME), P4Mark (INT), P4D0 (INT), P4D0Name (CHAR), P4D0Date (DATETIME), P4D0Mark (INT), P4D1 (INT), P4D1Date (DATETIME), P4D1Mark (INT), P4D2 (INT), P4D2Date (DATETIME), P4D2Mark (INT), P4D3 (INT), P4D3Date (DATETIME), P4D3Mark (INT), P4D4 (INT), P4D4Date (DATETIME), P4D4Mark (INT), P4D5 (INT), P4D5Date (DATETIME), P4D5Mark (INT), P4D6 (INT), P4D6Date (DATETIME), P4D6Mark (INT), P4D7 (INT), P4D7Date (DATETIME), P4D7Mark (INT), P4D8 (INT), P4D8Date (DATETIME), P4D8Mark (INT), P4D9 (INT), P4D9Date (DATETIME), P4D9Mark (INT), TestDesc (TEXT)

<p>| Course     | ID (CHAR), Name (CHAR), Instructor (CHAR) |</p>
<table>
<thead>
<tr>
<th>Table Name</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enroll</td>
<td><strong>Course</strong> (CHAR), <strong>Student</strong> (CHAR), Student (INT)</td>
</tr>
<tr>
<td>Group</td>
<td><strong>ID</strong> (INT), Assignment (INT), Name (CHAR), Instructor (CHAR), Comment (TEXT), Status (INT), FinalName (CHAR), FinalDate (DATETIME), FinalMark (INT), P1Name (CHAR), P1Date (DATETIME), P1Mark (INT), P1D0Name (CHAR), P1D0Date (DATETIME), P1D0Mark (INT), P1D1Name (CHAR), P1D1Date (DATETIME), P1D1Mark (INT), P1D2Name (CHAR), P1D2Date (DATETIME), P1D2Mark (INT), P1D3Name (CHAR), P1D3Date (DATETIME), P1D3Mark (INT), P1D4Name (CHAR), P1D4Date (DATETIME), P1D4Mark (INT), P1D5Name (CHAR), P1D5Date (DATETIME), P1D5Mark (INT), P1D6Name (CHAR), P1D6Date (DATETIME), P1D6Mark (INT), P1D7Name (CHAR), P1D7Date (DATETIME), P1D7Mark (INT), P1D8Name (CHAR), P1D8Date (DATETIME), P1D8Mark (INT), P1D9Name (CHAR), P1D9Date (DATETIME), P1D9Mark (INT), P2Name (CHAR), P2Date (DATETIME), P2Mark (INT), P2D0Name (CHAR), P2D0Date (DATETIME), P2D0Mark (INT), P2D1Name (CHAR), P2D1Date (DATETIME), P2D1Mark (INT), P2D2Name (CHAR), P2D2Date (DATETIME), P2D2Mark (INT), P2D3Name (CHAR), P2D3Date (DATETIME), P2D3Mark (INT), P2D4Name (CHAR), P2D4Date (DATETIME), P2D4Mark (INT), P2D5Name (CHAR), P2D5Date (DATETIME), P2D5Mark (INT), P2D6Name (CHAR), P2D6Date (DATETIME), P2D6Mark (INT), P2D7Name (CHAR), P2D7Date (DATETIME), P2D7Mark (INT), P2D8Name (CHAR), P2D8Date (DATETIME), P2D8Mark (INT), P2D9Name (CHAR), P2D9Date (DATETIME), P2D9Mark (INT), P3Name (CHAR), P3Date (DATETIME), P3Mark (INT), P3D0Name (CHAR), P3D0Date (DATETIME), P3D0Mark (INT), P3D1Name (CHAR), P3D1Date (DATETIME), P3D1Mark (INT), P3D2Name (CHAR), P3D2Date (DATETIME), P3D2Mark (INT), P3D3Name (CHAR), P3D3Date (DATETIME), P3D3Mark (INT), P3D4Name (CHAR), P3D4Date (DATETIME), P3D4Mark (INT), P3D5Name (CHAR), P3D5Date (DATETIME), P3D5Mark (INT), P3D6Name (CHAR), P3D6Date (DATETIME), P3D6Mark (INT), P3D7Name (CHAR), P3D7Date (DATETIME), P3D7Mark (INT), P3D8Name (CHAR), P3D8Date (DATETIME), P3D8Mark (INT), P3D9Name (CHAR), P3D9Date (DATETIME), P3D9Mark (INT), P4Name (CHAR), P4Date (DATETIME), P4Mark (INT), P4D0Name (CHAR), P4D0Date (DATETIME), P4D0Mark (INT), P4D1Name (CHAR), P4D1Date (DATETIME), P4D1Mark (INT), P4D2Name (CHAR), P4D2Date (DATETIME), P4D2Mark (INT), P4D3Name (CHAR), P4D3Date (DATETIME), P4D3Mark (INT), P4D4Name (CHAR), P4D4Date (DATETIME), P4D4Mark (INT), P4D5Name (CHAR), P4D5Date (DATETIME), P4D5Mark (INT), P4D6Name (CHAR), P4D6Date (DATETIME), P4D6Mark (INT), P4D7Name (CHAR), P4D7Date (DATETIME), P4D7Mark (INT), P4D8Name (CHAR), P4D8Date (DATETIME), P4D8Mark (INT), P4D9Name (CHAR), P4D9Date (DATETIME), P4D9Mark (INT)</td>
</tr>
<tr>
<td>Member</td>
<td><strong>Group</strong> (INT), <strong>Student</strong> (CHAR)</td>
</tr>
<tr>
<td>Program</td>
<td><strong>ID</strong> (INT), Name (TEXT)</td>
</tr>
<tr>
<td>Reference</td>
<td><strong>Assignment</strong> (INT), <strong>Phase</strong> (INT), <strong>Position</strong> (INT), Type (INT), Name (CHAR), Description (TEXT)</td>
</tr>
<tr>
<td>Test</td>
<td><strong>ID</strong> (INT), Assignment (INT), Position (INT), Question (TEXT), Type (INT), Option (INT), Mark (INT)</td>
</tr>
<tr>
<td>Testcomment</td>
<td><strong>Assignment</strong> (INT), <strong>Mark</strong> (INT), Comment (TEXT), Reset (INT)</td>
</tr>
<tr>
<td>Testitem</td>
<td><strong>Test</strong> (INT), <strong>Position</strong> (INT), Description (TEXT), Correct (INT)</td>
</tr>
<tr>
<td>Testmark</td>
<td><strong>Student</strong> (CHAR), <strong>Assignment</strong> (INT), <strong>Mark</strong> (INT)</td>
</tr>
<tr>
<td>User</td>
<td><strong>ID</strong> (CHAR), Name (CHAR), Password (CHAR), Email (CHAR), Role (CHAR), Program (INT), Status (INT), LastLogin (DATETIME), LastAccess (DATETIME), SessionID (CHAR)</td>
</tr>
</tbody>
</table>
Appendix N: Entity Relationship Diagram for a CMI-based LMS

Figure N shows the entity-relationship diagram for the CMI-based tool developed. Entity relationship diagram is a data modeling techniques that creates a graphical representation of the entities, and the relationships between entities, within an information system. The data attribute(s) (in bold) is the primary key(s). The full data attributes for each entity can be found in Table M (Appendix M).
Figure N
Entity Relationship Diagram for a CMI-based tool
Appendix P: Screen Captures of New Capabilities for class-1

This appendix contains the screen captures with a brief description for the new features added to the adopted forum software (class-1) for assessment purposes.

i) Forum Index

Once a student successfully logs in to the system, a list of forums under the student’s account is displayed in a table as shown in Figure P1. The “My posts summary” hyperlink located at the top right hand corner is one of the key features added.

![Figure P1: Forum Index](image)
ii) Post New Message or Reply Message

The Post New Message or Reply Message page (Figure P2) contains user input text fields for subject, message content area field, formatting bar, smilies bar, “Post Message” and “Clear Message” buttons and FILE attachments feature. A new component, SCAFFOLD checkboxes, was developed to allow administrators, moderators and members to categorize their messages before posting.

Figure P2: Post New Message or Reply Message
iii) My Posts Summary

This is one of the new pages added. This page allows a member to view his posts information such as date of latest post, total number of messages posted, total message lengths, total count for each SCAFFOLD category posted by the member, as well as the performance indicator score(s) if any. The overall forum performance on the criteria is displayed on the same table to enable the student to compare individual performance with the overall performance as shown in Figure P3.

Figure P3: My Posts Summary
iv) Message Category Statistics or Students’ Post Statistics

As shown in Figure P4, an administrator can select a forum from a table to view students’ posts statistics for the selected forum. The statistics include the total number of messages and total number of counts for each SCAFFOLD category for the selected forum, as shown in Figure P5. The statistics also report on each student’s total number of messages posted, total message lengths, total number of counts for each SCAFFOLD category posted by each student and his performance indicator score for the selected forum.
Figure P5: Students’ Posts Statistics for a Selected Forum.
v) Group Performance Statistics

This page displays a table that contains all forums and groups that have permission to join the forums, as shown in Figure P6. An administrator can select a forum for a group from the table to view the student posts statistics. This enables the administrator to generate reports on the student group discussion activities such as total number of posts, total length posted, and total count for each SCAFFOLD category, as shown in Figure P7.
Figure P7: Students Group Statistics
vi) Setting Performance Indicator

Administrators can set the coefficient for the assessment model of the performance indicator for each forum. Coefficients that can be set are coefficients for total number of messages, total length, each category of SCAFFOLD, and the deadline before which messages should be taken into account for the assessment, as shown in Figures P8 and P9.

Figure P8: Setting the Performance Indicator
Figure P9: Setting Performance Indicator (continued)
vii) Export Statistics

Using the screen in Figure P10, administrators can export the forum statistics as a comma delimited file. The file generated can be used for further processing using other application software such as Microsoft Excel or statistical software such as SPSS. The comma delimited file contains username, matrix number, forum name, total posts, total message lengths and total count for each category of SCAFFOLD.
Appendix Q: Event Handlers Added and Modified for *class-1* software

The purpose of this section is to describe the new event handlers that were added and some of the event handlers in *class-1* forum software that were modified for the purpose of assessing students’ contributions to Internet forums. Table Q summarizes the new event handlers that were added, and the existing event handlers that were modified for assessment purposes. All the events are trigger by external operation such as mouse operation.

<table>
<thead>
<tr>
<th>Event handler</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edit student’s posts form</td>
<td>• A modified event handler that displays the selected member’s message, subject and the message category in this form.</td>
</tr>
<tr>
<td>Post message</td>
<td>• A modified event handler that updates the database with messages, subject and the message category for a posted message in this form.</td>
</tr>
<tr>
<td>Student post category statistics</td>
<td>• A new event handler that displays forum post statistics and all members’ posts statistics for a selected forum in a table.</td>
</tr>
<tr>
<td></td>
<td>• The forum post statistics can be rank based on criteria used in a performance indicator</td>
</tr>
<tr>
<td></td>
<td>• The event handler checks user authorization to view statistics before displaying the forum post statistics.</td>
</tr>
<tr>
<td>Group performance statistics</td>
<td>• A new event handler that displays all members’ post statistics for the selected group and forum in a table.</td>
</tr>
<tr>
<td></td>
<td>• The event handler checks user authorization to view statistics before displaying the forum post statistics.</td>
</tr>
<tr>
<td>Setting of performance indicator</td>
<td>• A new event handler that displays fields for the administrator to input or change coefficients for criteria in a performance indicator for forums.</td>
</tr>
<tr>
<td></td>
<td>• The event handler checks user authorization to set parameter statistics.</td>
</tr>
<tr>
<td>Send Statistics to file</td>
<td>• An administrator can select forums and send the statistics to a file. A new event handler was created to perform the operation described.</td>
</tr>
<tr>
<td></td>
<td>• The event handler checks user authorization to export post statistics.</td>
</tr>
<tr>
<td>Post a new subject form or reply to a subject form</td>
<td>• A modified event handler that displays message form.</td>
</tr>
<tr>
<td></td>
<td>• A SCAFFOLD checkbox was integrated to allow members to categorize their messages.</td>
</tr>
<tr>
<td></td>
<td>• Members have to fill in the message, subject and select the message category from the SCAFFOLD checkbox in the form.</td>
</tr>
<tr>
<td>My Posts Summary</td>
<td>• A new event handler that displays member posts information in a table. Posts information includes date of latest post, total number of messages posted, total message length posted, total count for each SCAFFOLD category posted by the member, as well as the performance indicator score(s) if any. The overall class posts information is displayed in the same table to allow comparison of individual performance with the overall performance.</td>
</tr>
</tbody>
</table>
Appendix R: Tables Added for class-1 software

The class-1 forum software stores and updates its data in fourteen different tables. The tables used in the class-1 database are ‘message’ table, ‘user’ table, ‘forums’ table, ‘config’ table, ‘groups’ table, ‘group_permissions’ table, ‘bans’ table, ‘censor’ table, ‘privmsgs’ table, ‘readposts’ table, ‘smilies’ table, ‘sessions’ table, ‘extensions’ table, ‘attachments’ table. Some of the tables were modified and a few new tables were added for this research. Table R-1 shows that two tables (user and message) that were modified where data attributes (in bold) had been added. MatrixNo is added into the ‘user’ table since it can be used to identify student identity. Thread_id is added into the ‘message’ table to link to the SCAFFOLD table for message’s category. Table R-2 shows three new tables and their data attributes that were created for this research. ‘Scaffold’ table stores data that relate to the categories of each message for all forums created in the forum software. ‘Performance’ table contains the statistical data of each student’s contribution(s) in a forum and his performance indicator score for the forum that the student participated. ‘Coef_Pindicator’ table stores the parameters used in the performance indicator of each forum for all forums created in the forum software.

Table R-1: Tables and Data Attributes That Were Added

<table>
<thead>
<tr>
<th>Table Name</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>user_id INT NOT NULL AUTO_INCREMENT, PRIMARY KEY(user_id), username VARCHAR(50), email VARCHAR(100), password VARCHAR(50), join_date DATETIME, post_count INT, last_log_in_date DATETIME, matrixNo VARCHAR(30), icq VARCHAR(30), aim VARCHAR(30), msn VARCHAR(30), yahoo VARCHAR(30), website VARCHAR(100), location VARCHAR(60), occupation VARCHAR(50), interests VARCHAR(80), signature TEXT, hide_status INT, notify_private INT, post_count_per_page INT, date_format VARCHAR(20), allow_email INT, num_threads_per_page INT, msgs_per_page INT, style VARCHAR(20), inc_sig INT.</td>
</tr>
<tr>
<td>Message</td>
<td>id INT NOT NULL AUTO_INCREMENT, PRIMARY KEY(id), forum_id INT, user_id INT, message TEXT, subject VARCHAR(255), date DATETIME, reply_flag INT, reply_to_id INT, last_post_date DATETIME, last_post_user_id VARCHAR(50), ip_address VARCHAR(20), thread_lock INT, thread_keep INT, thread_views INT, sticky INT, thread_id INT.</td>
</tr>
</tbody>
</table>

Table R-2: New Tables and Data Attributes That Were Created

<table>
<thead>
<tr>
<th>Table Name</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaffold</td>
<td>thread_id INT NOT NULL AUTO_INCREMENT, PRIMARY KEY (thread_id), broadened INT, evaluative INT, questioning INT, synthesis INT, analysis INT, summarizing INT, resolution INT, acknowledging INT, clarification INT, resources INT, social INT.</td>
</tr>
<tr>
<td>Performance</td>
<td>User_id INT, forum_id INT, tot_message INT, tot_length INT, broadened INT, evaluative INT, questioning INT, synthesis INT, analysis INT, summarizing INT, resolution INT, acknowledging INT, clarification INT, resources INT, social INT, PIndicator_score DOUBLE.</td>
</tr>
<tr>
<td>Coef_Pindicator</td>
<td>Forum_id INT, tot_message DOUBLE, length DOUBLE, broadened DOUBLE, evaluative DOUBLE, questioning DOUBLE, synthesis DOUBLE, analysis DOUBLE, summarizing DOUBLE, resolution DOUBLE, acknowledging DOUBLE, clarification DOUBLE, resources DOUBLE, social DOUBLE.</td>
</tr>
</tbody>
</table>
Appendix S: Entity Relationship Diagram for new tables added in *class-1* software

Entity Relationship diagrams are often used by systems designers to help model the file or database (Kendall and Kendall, 2005). Figure S shows the entity-relationship diagram for the new features and documents relationships that must be represented in database processing. The data attributes (in bold) are the primary keys.

Figure S: Entity Relationship Diagram for the assessment features added
Appendix T: Sample of Student’s Guide for class-I software

This appendix contains the screen captures of the student’s guide added to the forum software adopted. Students were advised to go through the student’s guide before using the forum software.

i) Registration - After clicking on the ‘Manual’ from the global navigation in the ‘log in’ page, a list of forum features are displayed in student’s guide main page shown in Figure T1. Instructions for members registration is displayed as shown in Figures T2 and T3 after clicking on the ‘Registration’ hyperlink as in Figure T1.
Figure T2: Screen Capture for Member Registration

1. If you don’t have the username and password, please click on “Register” hyperlink at the top right hand corner of login interface (in red oval) to register yourself as a member.
2. Please input a username, your matrix number, email address, and password as shown in new user registration interface (figure 2). Then, click on “Register” button.
Figure 1: Login screen

1. If you don’t have the username and password, please click on “Register” hyperlink at the top right hand corner of login interface (in red oval) to register yourself as a member.
2. Please input a username, your matrix number, email address, and password as shown in new user registration interface (figure 2).
   Then, click on “Register” button.

Figure 2: New User Registration Interface

<Index> <Next>

Figure T3: Screen Capture for Member Registration (continued)
ii) Figure T4 shows the screen capture after a user successfully logs in the forum software. The forum index guide contains instructions for navigation and post messages in the forum index.

Figure T4: Screen Capture for Forum Index
iii) Figure T5 is the screen capture of FAQ in the student’s guide.
iv) Figure T6 shows the screen capture of the search function in the student’s guide.
v) Figure T7 shows the screen capture of the member list in the student’s guide.
vi) Figure T8 is the screen capture of Edit Profile in the student’s guide.
vii) Figure T9 shows the screen capture of My Posts Summary in the student’s guide.

![Figure T9: Screen Capture of My Posts Summary](image-url)
viii) Figure T10 shows the screen capture showing SCAFFOLD definitions in the student’s guide.
Appendix U: Good Practice Guidelines for Internet Discussion

For the benefit of all members these guidelines are gently enforced in the discussion forum. Don't be put off reading these guidelines by their length and detail - most of it is common sense, the rest will greatly help you to enjoy a fruitful participation in ours or other forums and online forums.

- **Keep your messages short** - if you want to write an essay put it on a web page or somewhere else where people can look at it if they choose, then send a short message to the forum announcing it.
  
  *Note:* Articles relevant to the related topics are welcome, put a link to the articles website.

- **Only reply if you have something new to add** - don't send messages just saying "I agree with Fred" or similar - unless Fred is isolated and really needs support. Silence is generally taken to imply agreement!

- **Reply to the forum not to the sender of the message** - messages to a discussion forum are intended for public discussion.

- **Keep your messages within the general topic area of the forum** - There are lots of other discussion and announcement places for other topics and general messages.

- **Special note: Announcements**

  Announcements of course related events are welcome but (a) please **send only the very basic details** (put the rest of the information on the web).

- **When replying to a message please use the same "subject" line** so that people will find it easy to follow the "thread" of a topic. (see below for when to "change topics")

  - If you are introducing a new topic **choose a new subject line that makes the subject of your message clear** to all.
  - Always **choose a new subject line when your reply moves the topic away from what most people would expect from the existing subject line**

  Example: Someone has been writing about
  - "How to get more people teleworking"
  - The subject has moved to a discussion of "barriers to telework"
  - From there it has moved on to "the lack of cheap Internet connections in some countries"

  As soon as you realise that your message is really about "Internet availability" not about telework, change the topic!

  This is an example of "topic drift". Never be afraid to change the subject line to
something more suitable when this kind of drift has taken place, even if you are not the first person to write about the new topic.

- **Use plain English** - remember that some people have English as a second or even third language may be trying to make sense of your message.
- **Be thoughtful and generous** in your response to other people's messages - try to consider what might be useful in what they are trying to say even if you disagree with it. Some would say this is the most important guideline of all!
- **Never be rude or dismissive** about someone's messages - if you have any complaints about other people's behaviour take it up with the administrator rather than trying to deal with it yourself. Being rude or dismissive leads to "flaming". Even if it doesn't, it makes lots of forum participants very uncomfortable, not only the person you are being rude about!
- **Always sign your messages** - please add your name at the end of your message, in the way you would normally introduce yourself, for example:

  Best wishes, Fred Bloggs

  or simply

  Fred Bloggs

  This helps to make the discussion friendly, since people can then say "I agree with Fred that . . . " or "Hello Fred, thanks for your useful comment. My own view is that . . . " This is particularly important if your name isn't clear from your username. For the discussion forum we insist that people sign with their names, it is not an appropriate place for anonymous debate.

**Please do not use the forum for . . .**

Please avoid using the discussion forum for the following purposes:

- **Sending attached files** - If someone raises a question that you think can best be answered by reference to an existing document, we suggest you either:
  - Post a message in the forum telling them it exists and how to get a copy or preferably;
  - put it on the www and provide the URL in your message

  Note that you must provide or obtain clearance from any copyright owners.

- **Advertising** - other than short, informative notices about course related events, programmes, publications and new products and services.
- **Discussing the purpose and/or management of the forum**, or the more general topic of **how to run discussion forums**. Experience has shown that such debate (discussion within a forum about its own purposes and organisation) is sterile and very off-putting for members.

**About "quoting" in replies to the forum**

A common practice in newsgroups, forums, e-mail discussion lists is "quoting" - you include part of the previous person's message and then reply to it. This is helpful in
providing context for your reply but its often overdone and can be irritating, for example:

You quote the whole of the last message;
Then the next person quotes the whole of your new message including the whole
of the earlier one that you quoted;
The next person quotes all of both messages . . .
You can easily see how this might escalate!

Here are some basic guidelines for "quoting":

- Only quote when its necessary - often the meaning and context of your message
  are clear without any quotes;
- Don't quote the whole message - it may be quicker and easier for you but
  remember, if you want other members to pay attention to you and your ideas, an
  extra few minutes to help them will be time well invested;
- Never put the whole of the prior message at the beginning or end of your
  message, this is never necessary and just adds more traffic to the networks, more
  phone time for everyone to download, more file space for anyone who wants to
  keep the messages for posterity, and no value whatever.
- Quoting may be more appropriate on a very busy forum, where there may be
  several threads running and people have difficulty keeping track of the
  discussion, but even then please use it selectively. Quoting may be appropriate
  in the kind of forum or newsgroup where people drift in, ask a question and drift
  out again.
- Don't relay whole texts from outside the forum to the forum (including messages
  from other lists). Quote selectively from outside texts in the context of a relevant
  discussion, and tell the forum where to find the original text or the discussion
  forum where it originated.

A special note for fluent English readers/writers
Many members have English as a second or even third language. In some cases they
have excellent and valuable contributions to make but they need time to read what has
been written and compose their response.

In contrast, those who are very fluent in English find it easy to read the message and
dash off a reply, so that on some occasions we find that the discussion of a topic moves
forward at a great pace - two people may exchange views in the forum more than once
in a single day.

Someone who may be trying to make a considered response could be deeply frustrated
by this, since the discussion has moved on and the exchange of messages means he or
she has to rewrite their contribution. This is a particular problem for someone whose
English may not be as fluent as yours. It also means that the practical limit of discussion
capacity in an e-mail based forum is taken up by only a very few people.

For these reasons we ask that fluent English readers and writers please:

- Constrain your contributions to the public discussion forum to a maximum of
two messages a day.
- Avoid "replying to a reply" on the same day that you posted your original message - allow 24 hours for other contributions before you move the discussion forward.

We believe this enhances the overall value of the forum to you as well as to others, since we will make space for useful insights from those whose English is slower (or who like to think before the speak (and write))!

**Note,** the above are not intended as "hard and fast" rules. Common sense should prevail, but please treat these suggestions as a general guide.

This guide is adapted from: [http://www.eto.org.uk/discuss/rules.htm](http://www.eto.org.uk/discuss/rules.htm) and is modified for this research.
Appendix V: Sample File for ID:W1 that was Sent to IS educators for Evaluation Purpose

1. Username: Fahimy Kamaruddin, total post: 1

<table>
<thead>
<tr>
<th>Under subject: Assignment 1</th>
<th>mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posted on: Thu, 11 Jan 2007, 3:28:33</td>
<td></td>
</tr>
<tr>
<td>Post subject: What's your approach to solve this assignment?</td>
<td></td>
</tr>
<tr>
<td>Post category: Synthesis</td>
<td></td>
</tr>
</tbody>
</table>

Let's see... 2 questions What's an IA & How IA is used to support the IR. Some people will browse through the internet to find some uncertain answer... But, should we retrieve the answer instead of browse?

Well, you can google for Intelligent Agent or IA + IR for browsing, but how about searching for the exact answer such as googling for "intelligent agent properties" or "IA's implementation".

I mean look for and answer not anything related to IA and IR.

What do you think?
Act speaks louder than words...

2. Username: kongpooiyee, total post: 7

<table>
<thead>
<tr>
<th>Under subject: Assignment 1</th>
<th>mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posted on: Mon, 15 Jan 2007, 3:48:42</td>
<td></td>
</tr>
<tr>
<td>Post subject: Multi-agent, distributed agent and mobile agent = Intelligent agent??</td>
<td></td>
</tr>
<tr>
<td>Post category: Questioning</td>
<td></td>
</tr>
</tbody>
</table>

Hi...😊
I have an question that is it Multi-agent, distributed agent and mobile agent same with Intelligent agent or there are a type of Intelligent agent?? So, can I use the article do not mention about the Intelligent Agent but mention more on Multi-agent, distributed agent and mobile agent?😊😊

Happy life...

| Posted on: Mon, 15 Jan 2007, 4:21:33 |      |
| Post subject: Answering and questioning |      |
| Post category: Analysis |      |

Hi..Jwee Ching and Soon Ee! I am also thinking of the question that can we use the article talk about the Multi-agent, distributed agent, mobile agent, intelligent multimedia agent (jwee ching mentioned) and information agent (soon ee mentioned)?
But this is what i found the definition of the intelligent agent and others.. but still dunno whether there are any differences between them..

Intelligent agent (IA) - is a software agent that exhibits some form of artificial intelligence that assists the user and will act on their behalf, in performing non-repetitive computer-related tasks.

Distributed agents - Since agents are well suited to include their required resources in their description, they can be designed to be very loosely coupled and it becomes easy to have them executed as independent threads and on distributed processors. Thus they become distributed agents and the considerations of distributed computing apply.

Multi-agent systems - distributed agents that do not have the capabilities to achieve an objective alone and thus must communicate.

Mobile Agent - Agent code that moves itself, including its execution state, on to another processor, to continue execution there. This is also referred to as mobile code.

Information Agent - In the Internet, an intelligent search tool that automatically seeks out relevant online information based on the user's specifications.

But Jwee Ching, the agent that you mentioned i can't find the definition of.. Can you state the definition for us?

Lastly, i need to ask again anybody know that can we use the article with Multi-agent, distributed agent, mobile agent, intelligent multimedia agent (jwee ching mentioned) and information agent (soon ee mentioned)?

Thank you.

Happy life...

**Posted on: Tue, 16 Jan 2007, 3:38:14**
**Post subject: Reply to Way Nah Question**
**Post category: Clarification**

I think the Distributed Agent that I mentioned is same with the Distributed Intelligent Agent. For this, you can refer to the definition that Jin Sze and I mentioned. I also got found some article that talk about the Distributed Intelligent Agent and Multi Intelligent Agent. At first i also confused that whether can use or not, but in my opinion, i think is can use. But we also need to ask opinion from our dear lecturer.

Happy life...

**Posted on: Tue, 16 Jan 2007, 8:33:59**
**Post subject: We need focus and specific on 1 topic only?**
**Post category: Questioning**

Hi, Bak Leng!
You got mentioned that "we NEED to SPECIFIC a problem or case and then explain how intelligent agent support intelligent retrieval based on the problem."

Is it means that we need to find article about problem that got explain how intelligent agent support intelligent retrieval based on the problem?
This morning I heard somebody said that we only need to focus on 1 topic only such as if the articles we found are about mobile agent, then we just focus on mobile agent only, but don't know true or not? Anybody got any idea?

Puan Norjihan, can you give some opinions to us? I think all of us also hope to get opinions from you. Thank you 😊

Happy life...

**Posted on: Wed, 17 Jan 2007, 5:20:50**  
**Post subject: Reply to Bak Leng**  
**Post category: Questioning, Acknowledging**

Hi...Bak Leng!!😊  
Thank you for your explaination. From your explaination, "we only need to specific a problem, understand problem scope and explain how IA can support IR to solve the particular problem." But I still got another question which is : if the article i found do not mention any specific problem but just talk about "How mobile agent use in Information Retrieval", something like talk about the function of mobile agent in Information Retrieval, then you think can do in this way which without specific the problem?

Anybody know also can give idea to me o.. Thank you😊

Happy life...

**Posted on: Wed, 17 Jan 2007, 5:40:50**  
**Post subject: What do you mean by Specific problem??**  
**Post category: Questioning**

Hi, Bak Leng!  
I am understanding you explaination, but i am not really understand what you mean by "need to specify a problem"?can you give us some example?

Thank you😊

Happy life...

**Posted on: Tue, 23 Jan 2007, 14:48:42**  
**Post subject: Comment for the assignment**  
**Post category: Analysis, Clarification**

Hi Everybody!!😊  
Today I also got asked Puan Norjihan some question about the assignment. I had show her what i already done and I hope to get some opinion from her. For the arrangement of assignment, first section I talk about "What is IA?"; Then second section is the title of "How IA support IR?", i explain in this way for this title: first i mention the problem faced by the IR nowaday,then I start to introduce one of the types of IA which is mobile agent (definition or information about mobile agent),follow by the explanation on how mobile agent solve the problem faced by IR (actually i think this mean the solution for the problem or answer the question how mobile agent support IR), lastly is your own conclusion.

Thats the arrangement of assignment i had show to Puan Norjihan and she
also said ok and no problem. Then i think should be ok. But i hope to get some opinions from you also.😊 Thanks...😊

Happy life...

3. Username: jwee_ching, total post: 3

<table>
<thead>
<tr>
<th>Under subject: Assignment 1</th>
<th>mark</th>
</tr>
</thead>
</table>
| **Posted on: Mon, 15 Jan 2007, 3:58:09**
| Post subject: Just focuses on only one type of IA? |
| Post category: Questioning |

Hi, Pooi Yee. After read your message, I got another question. Can we do our research for this project by focuses on only one type of intelligent agent such as intelligent multimedia agent that is developed for efficient retrieval and processing of information stored in multimedia databases, or in general?

**Posted on: Mon, 15 Jan 2007, 7:39:55**
| Post subject: Just an example... |
| Post category: Questioning |

Hi, Pooi Yee😊 The Intelligent Multimedia Agent that I mentioned is just one of the example of IA. It is almost same with the Information Agent that mentioned by Soon Ee, the only different thing is that IMA more for retrieving documents that contains very large data objects such as images and video. Now, my problem is that I not sure whether we need to do our research in general or just focuses on only one type of IA. Can anyone give me some opinions😊? Thnx😊.

**Posted on: Thu, 18 Jan 2007, 1:34:28**
| Post subject: Methods used by IA to retrieve information |
| Post category: Analysis, Resolution |

Dear mwai,
In my opinion, I don't think that we need to focus on the importance of searching process because the question is "How IA support IR" and not "How importance IA to IR". From the articles that I found before, I think if we focus on the method used by IA in searching for a relevant information will be more better. Like a IA may use keyword searching method, agent-based complex query method and so on. Hope to get some opinions from all of you if I get any misunderstanding about mwai ideas. Thnx...
Have a nice day😊😊.

4. Username: soonee, total post: 4

<table>
<thead>
<tr>
<th>Under subject: Assignment 1</th>
<th>mark</th>
</tr>
</thead>
</table>
| **Posted on: Mon, 15 Jan 2007, 4:02:41**
| Post subject: |
| Post category: Clarification |

As I know, the multi-agent and mobile-agent is the type of information agent. But I not sure with the distributed agent.

Is it information agent also a type of information agent😊?
Posted on: Mon, 15 Jan 2007, 4:04:20
Post subject: correction of message
Post category: Questioning

sorry, my question is:
is it information agent is a type of intelligent agent?

Post subject: reply to xuehong
Post category: Questioning, Clarification

dear xue hong, as i know from the article i read, all the agent such as
information agent, mobile agent, user interface agent and so on is the
advance agent of intelligent agent.

Now my question is: for example i choose mobile agent as my topic, can i
choose a journal that talk about more general which is IA system not
mobile agent system? or both also can? anybody who can help me?
thanks...😊

Posted on: Thu, 18 Jan 2007, 4:10:11
Post subject: 
Post category: Evaluative, Broadened

i agree with Jin Sze opinion. We should focos on a problem first, then
found out within the journal, is it the method support IR? Then this will
define the question "How IA support IR".

i disagree with Meng wai opinion. we are not focusing on the process only,
but is focus on the method. this is what i heard from my friend
explanation. thank you!😊

5. Username: Neo , total post: 3

Under subject: Assignment 1

Posted on: Mon, 15 Jan 2007, 13:30:56
Post subject: Mobile Agent
Post category: Questioning, Clarification

Hi guys, I thought i'm the only one that come accross this mobile agent
thing. Anyway from my article, it says that most mobile agent share a
similar architecture consist of at least 3 components: agent servers, agent
interface and agent brokers (service directory).

Any of you got this?

Posted on: Fri, 19 Jan 2007, 15:00:23
Post subject: Windows Search
Post category: Questioning

Hi guys, the search function in Windows is also an intelligent agent? But it
could not adapt to the user behaviour of using the search function.. Is that
still an agent? 😃

Posted on: Tue, 23 Jan 2007, 14:23:54
Post subject: Mobile Agent
Post category: Questioning

So, JinSze ur paper will be done mostly based on Mobile Agent and not
6. Username: waynah_lee, total post: 2

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<th>Under subject: Assignment 1</th>
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<td><strong>Posted on:</strong> Mon, 15 Jan 2007, 16:43:53</td>
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<tr>
<td><strong>Post subject:</strong> Confused!!!</td>
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<tr>
<td><strong>Post category:</strong> Questioning</td>
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Hi everyone!!!
I've come across an journal which talk about distributed intelligent agent and I'm also getting confused whether can we write about the distributed intelligent agent? Will I get out of the scope if I write about the distributed agent? Is distributed intelligent agent same as distributed agent which defined by pooi yee previously?

**Posted on:** Wed, 17 Jan 2007, 4:15:33
**Post subject:** Agree and Questioning
**Post category:** Questioning, Clarification

Dear jin sze,
From what you have post here, I agree with you that they are almost the same. In the journal that I’ve read, I says that data mining is one type of information retrieval and it also explain how intelligent agent technology play a role in the design and development of data analysis and mining systems. So, that mean I just need to focus on intelligent agent on data mining techniques and algorithm?
Please help...😊

7. Username: leejinsze , total post: 6

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<td><strong>Posted on:</strong> Tue, 16 Jan 2007, 1:20:58</td>
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<td><strong>Post subject:</strong> Answering Question</td>
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<td><strong>Post category:</strong> Analysis, Summarizing</td>
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Here are my replies to Pooi Yee's question:

Intelligent Agent (IA)
- In computer science, an intelligent agent (IA) is a software agent that exhibits some form of artificial intelligence that assists the user and will act on their behalf, in performing non-repetitive computer-related tasks. "Intelligent" here implies the ability to adapt and learn.

Mobile Agent
- In computer science, a mobile agent is a composition of computer software and data which is able to migrate (move) from one computer to another autonomously and continue its execution on the destination computer.

- Mobile Agent, namely, is a type of software agent, with the feature of autonomy, social ability, learning, and most important, mobility.

Application of mobile agents includes:
- Resource availability, discovery, monitoring
| - Information retrieval  
| - Network management  
| - Dynamic software deployment |

**Multi-Agent**
- In computer science, a multi-agent system (MAS) is a system composed of several agents, collectively capable of reaching goals that are difficult to achieve by an individual agent or monolithic system.

- Multi-agent systems are often distributed systems, and distributed systems are platforms to support multi-agent systems.

**Distributed Agent**
- A distributed system is considered to be a collection of independent systems that appear to the users of a system as a single system. Processes and/or data can (or cannot) move from host to host, share information, etc.

- Multi-agent systems are a special kind of distributed application.

**Comment:**
I hope that the information that I search and the summary that I have done can help you better understanding to your question. From my summary, I know that mobile agent is a type of software agent and it can use for information retrieval. Multi-agent and distributed agents are related with each others.

**Posted on: Tue, 16 Jan 2007, 1:24:45**  
**Post subject: Different between information retrieval, information recovery and information filtering?**  
**Post category: Analysis, Questioning**

Hi, friends...

When I still in the process of finding the journal, I found that I always saw this 3 words, but I not really know how to differentiate it.

Here are the definitions that I found and want to share with all of you,

**Information retrieval**
- Information retrieval (IR) is the science of searching for information in documents, searching for documents themselves, searching for metadata which describe documents, or searching within databases, whether relational stand-alone databases or hypertext networked databases such as the Internet or World Wide Web or intranets, for text, sound, images or data.

**Information recovery**
- Information recovery is the process of salvaging data/information from damaged, failed, wrecked or inaccessible primary storage media when it cannot be accessed normally.

**Question:**
Does everyone know what is the different between information retrieval, information recovery and information filtering?

**Posted on: Wed, 17 Jan 2007, 1:16:02**  
**Post subject: Reply: Is distributed intelligent agent same as distributed agent ?**
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<th>Post category: Analysis</th>
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<tr>
<td>Hi..everyone..</td>
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<tr>
<td>Please refer to Way Nah's question...</td>
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<tr>
<td>What is Distributed Intelligent Agents?</td>
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<td>Distributed Intelligent Agents is a agent which runs on different machines but simulation on one machine and learns monotonically, runs with a unique identifier bound to a state that persists over time, across invocations, can make autonomous decisions distinct from user input and also can communicate with other autonomous agents in ways that affect its decision process, and it lives in at most one place at one time.</td>
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<tr>
<td>What is Distributed Agents?</td>
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<td>Distributed Agents is focussed on support for (the development of) large-scale, secure, heterogeneous, agent systems.</td>
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<tr>
<td>Dear Way Nah, in my opinion, I think I agree that distributed intelligent agent is almost same as distributed agent (also mentioned by pooi yee). But the important things that you need to look through your journal to see whether this agent is support for the information retrieval or not? Do you agree with me?</td>
</tr>
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**Posted on: Thu, 18 Jan 2007, 3:56:58**
**Post subject: Focus on how IA support IR...**
**Post category: Evaluative, Broadened**

Hi...

After i heard my friend explanation about our assignment, what i understand is that
(i) Focus any problem that can find from the journal
(ii) Then, from the problem, we need to know how that agent can solve the problem (e.g., how mobile agents solve the problem that related with IR?) That means how IA support IR?

Therefore, i agree with the opinion of jwee ching's statement "Focus on the method used by IA in searching for a relevant information will be more better. Like a IA may use keyword searching method, agent-based complex query method and so on."

Beside, i disagree with the opinion of Meng Wai said that "Do you all think that "How IA is used to support the information retrieval" lies in the importance of searching process?" because the main point is we need to focus the problem of the journal first (what i mentioned in above), not focus in the searching process.

Thanks...

**Posted on: Tue, 23 Jan 2007, 6:23:40**
**Post subject: About Assignment: IA and IR...**
**Post category: Analysis**
Hihi....

Today i had asked Pn. Norjihan some question about our assignment. For the assignment, i focus on mobile agent because mobile agent is one type of the intelligent agent. So, i need to focus on the definition of intelligent agent, definition of mobile agent and how mobile agent is support information retrieval. She said that I also can include the process of the system use in mobile agent. (reply question of Yit Teng). Thank You.

**Posted on: Wed, 24 Jan 2007, 7:04:40**
**Post subject: Answering: Mobile Agent**
**Post category: Analysis, Clarification**

Hi, Neo...

Yes.My assignment will be based on Mobile Agent. I also asked Pn.Norjihan whether i can just found 1 article about intelligent agents only, she said can. So, i will summary definition of intelligent agents from that article. Then, the others i will focus on mobile agent and how mobile agent will support information retrieval. Thanks.

**Posted on: Wed, 24 Jan 2007, 7:04:40**
**Post subject: Answering: Mobile Agent**
**Post category: Analysis, Clarification**

Hi, Neo...

Yes.My assignment will be based on Mobile Agent. I also asked Pn.Norjihan whether i can just found 1 article about intelligent agents only, she said can. So, i will summary definition of intelligent agents from that article. Then, the others i will focus on mobile agent and how mobile agent will support information retrieval. Thanks.

8. Username: xuehong, total post: 2

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<td><strong>Posted on: Tue, 16 Jan 2007, 1:50:52</strong></td>
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<td><strong>Post subject: Answering question for Information retrieval and information filtering.</strong></td>
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<td><strong>Post category: Analysis</strong></td>
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Hi jin sze.This is information that i search from web about the information retrieval and information filtering.

Information filtering is similar to information retrieval. In information retrieval, one views the user actively searching for relevant information in a mass of largely irrelevant information. With information filtering, one views the user as largely passive as mostly relevant information flows past the user.

**Post subject: Is it all are Intelligent agent?**
**Post category: Questioning, Clarification**

I got found some information about intelligent agent, mobile agent,information agent, user interface agent and reactive agent.

-Intelligent Agents are those which contain schedulers, rules, planners etc. Some types of intelligent agents are learning agents, intentional agents,
<table>
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<th>Social agents etc.</th>
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<td>– Mobile Agents are agents which can move around some net-work. They can model a problem involving moving real world entities.</td>
</tr>
<tr>
<td>– Information Agents collect information from various sources and disseminate information to different sources.</td>
</tr>
<tr>
<td>– User Interface Agents directly communicate with the end-user.</td>
</tr>
<tr>
<td>– Reactive Agents or Actors independently respond to events and messages.</td>
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I am confuse about this all agent. Is it this all agent can be use and they are consider as intelligent agent???

9. Username: weiyi, total post: 2

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<td>Post subject: Need to focus on the architecture of the IA?</td>
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<td>Post category: Questioning</td>
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Hi, guys😊. I also find some article about the mobile agent and i also saw the architecture and component that neo mension. But is it that we need to focus so much about the architecture of IA because our title is ‘How IA support IR’. Therefore, some time i also confuse about what should us more focus to?

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<td>Post category: Clarification</td>
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Hi Xue Hong😊
In my opinion and from some of the article that i search, i think that the intelligent agent mobile agent, and information agent also can use but we only need to specify on one agent only. However, the other two i’m not sure whether can use or not because i did not get any article about this two agent.

Gambateh oh!!

10. Username: chuabakleng, total post: 3

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<td>Post subject: Answering</td>
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<td>Post category: Analysis</td>
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Hi, jwee ching.
According to your question, we NEED to SPECIFIC a problem or case and then explain how intelligent agent support intelligent retrieval based on the problem.
Gambateh😊
Hi, pooi yee. Yes, we only need to specific a problem, understand problem scope and explain how IA can support IR to solve the particular problem. Yup, mobile agent is of the examples. This is what I get know from asking Puan Norjihan.

Besides that, I got problems from articles that I found. "With the growing number of the documents available to users and the advance in Internet technology, more robust and reliable document retrieval systems are necessary." By using IA to support IR based on the case, I found three methods of IA able to solve it. They are keyword extraction, capturing the document linguistic structure and capturing the role of the selected keyword. I am not very understand definition and operation for each method very well. Can I know who also got find such methods and more understand on that?

""How mobile agent use in Information Retrieval", something like talk about the function of mobile agent in Information Retrieval." According to your question, i think if you do like that without mention any problem, maybe more general. Maybe cannot support the statement: "How IA support IR" very well.However this is my opinion lah. Can Puan Norjihan give opinion on the Pooi Yee's question?

11. Username: shiah ying, total post: 2

Comparing IR and IF:
-IR is concerned with the collection and organization of texts, filtering is concerned with the distribution of texts to groups or individuals.
-IR is typically concerned with the selection of texts from a relatively static database, filtering is mainly concerned with the selection or elimination of texts from a dynamic data stream.
-IR is concerned with responding to the user's interaction with texts within a single information-seeking episode, filtering is concerned with long-term changes over a series of information-seeking episodes.

As I know, Information retrieval (IR) is the science of searching for information in documents, searching for documents themselves, searching for metadata which describe documents, or searching within databases. Every day, we are presented with enormous amounts of information (via email and newssenet news, for example), only a tiny proportion of which is relevant or important. So, we can characterize the information overload problem by Information Filtering(IF). We need to be able to sort the wheat
from the chaff, and focus on information we need.

Thx.. u all 😊

Post subject: IA and IR  
Post category: Analysis, Questioning

After some explanations from my friends and Puan Norjihan, I got some ideas about our assignment (What is IA and how IA support in IR). Thank you... Before that, I feel quite confusing when learn about IA. Our group also concentrates on mobile agent which is one type of IA. Firstly, I mentioned about the definition of IA, and then mobile agent, some methods that mobile agent support in information retrieval, IR process in mobile agent, conclusion, etc?.

Does there any other ideas or topic that you all want share with us?

Thanks!! 😊

12. Username: angiekong84, total post: 1

Under subject: Assignment 1  
mark

Post subject: Reply= Intelligent agent in data mining  
Post category: Acknowledging, Clarification

For what i have searched.

Data Mining Agents-A data mining agent operates in a data warehouse discovering information. A 'data warehouse' brings together information from lots of different sources. 'Data mining' is the process of looking through the data warehouse to find information that you can use to take action, such as ways to increase sales or keep customers who are considering defecting. 'Classification' is one of the most common types of data mining, which finds patterns in information and categorizes them into different classes.

is this helps?

Ohh. i found this article is interesting:
http://en.wikipedia.org/wiki/Software_agent

Attachments:
Description: Data mining framework for training intelligent agent
Accesses: 84
File Size: 67.81 KBytes

13. Username: yit_teng, total post: 3

Under subject: Assignment 1  
mark

Post subject: intelligent agent  
Post category: Broadened, Clarification

Hi..After reading the posted message from you all, I have get a fundamental idea of the intelligent agent. Thanks a lot. But, when try searching the article from database, maybe we can discuss the IA's characteristics and the technologies that are used to relate to the IR.
This is what I’ve found:
There are several technologies that apply in IA, for example: data mining techniques, rule-based reasoning, knowledge-based reasoning techniques and etc. IA integrated with these technologies that help in information retrieval system as well as library management system.
So, what I think is that maybe we can go into detail to discuss how the IA technologies help in IR.
Any idea? Let me know. thanks.

Post subject: IA
Post category: Resources

Here is the link to the intelligent agent providers:

http://www.intelligent-agents.com/

can have a look on those IA that help in information seeking.

Posted on: Thu, 18 Jan 2007, 5:09:31
Post subject: IA that help IR
Post category: Analysis, Clarification

Hi, jinSze,
I’m not sure what do you mean by finding the problem from journal.

But, from my understanding of the question (how IA is used to support the IR), I think we need to highlight the technologies that integrated with IA. Maybe it is correct that we need to find out the ‘problem’, but here actually our ‘problem’ is >> information retrieval. Basically IR is in the sense that searching info from the document, searching from metadata, searching from database, etc.

I think what mwai say is correct. Because a searching process is important in IR. Whenever we need to retrieve the information, we need to search the info, then extract what is the important and relevant info, rearrange the info and display.

Therefore, an intelligent search agent as well as the data mining agent (suggestion from angiekong84) are IA that support in IR.

😄

14. Username: chong_mwai, total post: 2

Under subject: Assignment 1

Post subject: Information searching
Post category: Broadened, Clarification

Hi,

From http://en.wikipedia.org/wiki/Information_retrieval;

Information retrieval (IR) is the science of searching for information in documents, searching for documents themselves, searching for metadata which describe documents, or searching within databases, whether relational stand-alone databases or hypertext networked databases such as the Internet or World Wide Web or intranets, for text, sound, images or data.

In addition to Yit Teng’s comments, I think we should also focus more on
types of intelligent search agents and explain how they perform its search for the information.

Do you all think that "How IA is used to support the information retrieval" lies in the importance of searching process?

Any comments are welcome.


15. Username: Sarah, total post: 1

Under subject: Assignment 1

Posted on: Thu, 18 Jan 2007, 3:35:27
Post subject: looking for pair
Post category: Social

hai, sory ya, i'm just asking anyone who doesn't have a pair yet for assignment 1, you can find me at manorlavender@hotmail.com @ sms me at 0173075057. urgently plz... 😊


16. Username: keanjoo, total post: 1

Under subject: Assignment 1

Posted on: Thu, 18 Jan 2007, 16:56:30
Post subject: Information agent
Post category: Acknowledging

I think information agent is not restricted to internet based only. Microsoft windows also have their Windows Desktop Search which can search emails and files on desktop computers and also across the local network!
17. Username: hidayahkhalid, total post: 1

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<td><strong>Post subject:</strong> assignment 1 -hidayahkhalid &amp; akmasyazwani-</td>
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<td><strong>Post category:</strong> Analysis</td>
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hye,

according to "Intelligent Mobile Agents for Information Retrieval and Knowledge Discovery from Distributed Data and Knowledge Sources" by Yang, Honavar, Miller and Wong: Intelligent agents, mobile agents and multi-agent systems provide an attractive approach to the design of distributed knowledge network tools for information retrieval, information extraction, information assimilation, and knowledge using heterogeneous, distributed data and knowledge sources.

It is clearly stated that an Agent provides a big help or as we can say 'technology' in the field of retrieving information. Many don't realize how this tools really help. As a final year student (most of us), we do know that we will have to face a lot of studying and doing research in order to complete our final year project. For some, how agents help is like a miracle. By doing the research for information retrieval, we can say now, we know how things work behind close doors.

till next time!

Nur Hidayah Khalid

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18. Username: Rosnita total post: 3

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<td><strong>Posted on:</strong> Wed, 24 Jan 2007, 8:10:46</td>
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<td><strong>Post subject:</strong> Feedback on soonee question..</td>
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<td><strong>Post category:</strong> Clarification</td>
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From my reading to the related website.. information agent is a computational software entity also known as intelligent agent..
For more detail read this..

"An information agent that may access one or multiple, distributed, and heterogeneous information sources available, and pro-actively acquires, mediates, and maintains relevant information on behalf of its user or other agents preferably just-in-time. In other words, information agents are supposed to cope with the difficulties associated with the information overload of the user. This implies their ability to semantically broker information by:
(1) providing a pro-active resource discovery;
(2) resolving the information impedance of information consumers and providers;
(3) offering value-added information services and products to the user or other agents.

Intelligent information agents may be classified according to one or more of the following features:
- Non-cooperative or cooperative information agents, depending on the ability if the agents cooperate with each other for the execution of their
tasks. Several protocols and methods are available for achieving cooperation among autonomous information agents in different scenarios, like hierarchical task delegation, contracting, and decentralized negotiation.

- Adaptive information agents are able to adapt themselves to changes in networks and information environments. Examples of such agents are learning personal assistants on the Web.

- Rational information agents behave utilitarian in an economic sense. They are acting, and may even collaborate together, to increase their own benefits. The main application domains of such kinds of agents are automated trading and electronic commerce in the Internet. Examples include the variety of shop bots, and systems for agent-mediated auctions on the Web.

- Mobile information agents are able to travel autonomously through the Internet. Such agents enable, dynamic load balancing in large-scale networks, reduction of data transfer among information servers, and migration of small business logic within medium-range corporate intranets on demand.

😊Notice me if im wrong..😊😊

**Posted on: Wed, 24 Jan 2007, 8:25:59**
**Post subject: Feedback on soonee question..**
**Post category: Clarification**

From my reading.. information agent is a computational software entity also known as an intelligent agent..😊

**Posted on: Wed, 24 Jan 2007, 8:49:49**
**Post subject: Alamak...sorry..**
**Post category: Clarification, Resources**

Sorry coz posted the same "Feedback to soonee" for 3 times..technical problem..maybe i just want to make soonee more popular..hehehe..By the way,"WorldFlash" is an example of intelligent information agents..

Read this :

What Makes WorldFlash Better Than Other Programs?

Our program employs intelligent agent technologies to bring information you've deemed relevant - directly to your desktop. WorldFlash does not aggregate all the available information and dump it on you without discretion. Instead, the program works as an intelligent web of links that actually recognizes the difference between headlines, stock quotes and weather forecasts. The result is a comprehensive news and information channel. All this is accomplished with minimal bandwidth and CPU requirements. We've included many of the best Internet-based news and information services, and more are on the way.

To get more detail about this please go to http://www.worldflash.com/

Happy day..😊
19. Username: Nurul nadia, total post: 1

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<td><strong>Posted on:</strong> Thu, 25 Jan 2007, 4:57:15</td>
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<td><strong>Post subject:</strong> Assignment 1:IA &amp; IR</td>
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<td><strong>Post category:</strong> Analysis</td>
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Hi, just to share my finding 😊. As we all know, by using IA we can eliminate the problem of information abundances... so by using IA, it can keep track about which information source contains information about which topics. It is also responsible of merging the information from these heterogeneous sources. (Fransiskus Soesianto and Ismail Khalil Ibrahim).

To answer the question of How can IA support IR that need to be identify, which we can focus to what IA can do actually. From what I found in general, the advantages if IA which it can "rapidly" customize a search or retrieval engine query's result, improve the information retrieval performance of a search or retrieval engine based on specified, measurable attributes and relative to the increased cost of adding the agent and will reside with an existing search or retrieval engine. Moreover, intelligent agents may prove to be the needed item in transforming passive search and retrieval engines into active, personal assistants and also can improve the performance of an existing search or retrieval engine.

The agent will learn based on the user's preferences and information content of the queries and documents. So I think this is why IA is been implemented to support the IR. Besides, there are also type of IA that been use in IR such as data mining agents, mobiles agent, etc. This type of IA will emphasize more about what are the flow involve in supporting the IR.

Any comments are welcome..😊😊

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20. Username: mteng84 , total post: 2

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<td><strong>Post subject:</strong> same question</td>
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<td><strong>Post category:</strong> Questioning</td>
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Hi all,
i also very confusing bout the question. as u all said, there are many type of IA, we need to choose 1 type of IA or each article 1 type of IA or we just need to write the general IA which is related to IR? Hope someone can help me to clarify this problem. Thanks alot..😊😊

~~Have a nice day~~😊

| Posted on: Sun, 28 Jan 2007, 15:50:04 |      |
| **Post subject:** opps.. |      |
| **Post category:** Social |      |

oppss.. i jus read the 1st page then already post for the 1st message. after read all the message that you all mention, now i'm quite clear that what should i do now. really thanks for the information.

😊
21. Username: syakirah, total post: 1

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<tr>
<td>Posted on: Thu, 08 Feb 2007, 7:08:21</td>
<td></td>
</tr>
<tr>
<td>Post subject: Information filtering</td>
<td></td>
</tr>
<tr>
<td>Post category: Analysis</td>
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</tbody>
</table>

One of the purpose of using intelligent agent to support information retrieval is the usage of filtering agent.

Filtering was needed on the search results from Internet search engines. Intelligent filtering is meant use of artificial intelligence (AI) methods to enhance filtering.

This can be done in different ways, one is:

AI software can be used to derive attributes for documents, which are then used for filtering, it can be used to derive filtering rules, or it can be used for the filtering process itself. With the machine learning approach, the filter will take as input information from the user about which documents the user likes, and will then look at these messages and try to derive common characteristics of them to be used in future filtering.

If an AI method is used to derive filtering rules, it might be valuable if these rules are specified in a way which a human can understand and trust.

This is how intelligent agent support information retrieval.

---

22. Username: sharanizian, total post: 1

<table>
<thead>
<tr>
<th>Under subject: Assignment 1</th>
<th>mark</th>
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</thead>
<tbody>
<tr>
<td>Posted on: Thu, 08 Feb 2007, 7:56:18</td>
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<tr>
<td>Post subject: what makes an agent intelligent...</td>
<td></td>
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<tr>
<td>Post category: Summarizing</td>
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</tbody>
</table>

From my reading of white paper on Intelligent Software Agents, Reticular Systems states that software constructions must meet several criteria in order to be considered an agent. They must be autonomous--free to, and able to execute without user intervention. Additionally, they must be able to communicate with other software or human agents and must have the ability to perceive and monitor the environment in which they reside.

Researchers in the field have different views as to what makes an agent intelligent. Most agree though that to be intelligent, agents must include the ability to operate in real-time and communicate using natural language. Along with this, they must be able to learn from their environment and be capable of adaptive goal-oriented behavior. In other words, intelligent agents need to work together on a user-specified problem when told to do so and must be able to do this successfully in a dynamic environment. Importantly, the agent must communicate to the user, in a language he or she understands, that the task has been successfully completed or that it has been otherwise terminated.

Current trends and applications using agent!!!
Automate search processes are the future of search engines. With agent technology, a user might run a search and instruct the search engine's agent to alert the user when new indexed items are added to the database. This effectively takes a static system and makes it a more dynamic, user-driven information resource.

There are other applications though which also lend themselves to execution by intelligent agents. For instance, agents can automate some of the more mundane tasks we perform hundreds of times a day. E-mail is an excellent example of where agents can automate work in an everyday environment. Intelligent agents can learn to prioritize, delete, forward, sort, and archive mail messages on behalf of the user. By monitoring how the user interacts with e-mail, the agent can learn how to handle similar mail in the future.

---

23. Username: nur jannah kamarol zaman, total post: 1

**Under subject: search for articles**

Posted on: Thu, 25 Jan 2007, 4:20:52  
Post subject:  
Post category: Acknowledging  
You can also search for intelligent agent article in www.intelligentagent.com, so good luck!

---

24. Username: shikin_abhamid, total post: 1

**Under subject: search for articles**

Posted on: Fri, 12 Jan 2007, 10:10:37  
Post subject: search for articles  
Post category: Resources  

You can find articles here ~> http://portal.acm.org

---

25. Username: Nur Hanani Jamaluddin, total post: 1

**Under subject: search for articles**

Posted on: Fri, 19 Jan 2007, 3:07:31  
Post subject: search 4 d articLe  
Post category: Clarification  

Ya aLL Lso can Search d ArticLe Or jouRnaL At thiz webSiTe  

http://proquest.umi.com  

Good LucK

---

26. Username: sitiaisyahamir, total post: 1

**Under subject: search for articles**

Posted on: Thu, 08 Feb 2007, 4:17:15  
Post subject: first esaiment  
Post category: Resources  

you can also get your details for the assingment at www.doaj.org  
good luck k!!!
Sample file for ID W2 that was sent to IS educators for evaluation purpose

1. Username: Sitiaisyah, total posts: 2

<table>
<thead>
<tr>
<th>Under subject: PROJECT</th>
<th>Under subject: COPs</th>
<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
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<tr>
<td>Posted on: Tue, 16 Jan 2007, 3:50:01</td>
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<tr>
<td>Post subject:</td>
<td></td>
<td>Post subject: I knew Better Now...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post category: Social</td>
<td></td>
<td>Post category: Acknowledging, Social</td>
<td></td>
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</tr>
</tbody>
</table>

Pn.Suraya...
Thanks for the update of this forum..
I give you my word, I'll try my very best to fulfill your requirement for the project group. I won't disappoint you...😊😊

Heheh madey, don't have much time to read it???
Same here laa, but we just have to manage our time...
em, Just to let everyone know that I am using these jurnal:
1) Data Mining as Driven by Knowledge Management in Higher Education by Jing Luan, Ph.D., ITMC
2) Using Data Mining Techniques for Knowledge Management: An Empirical Study by K. Vladimir

so, just in case any of u guys are referencing to the same articles, please let me know k
Em, after reading through the articles I really have a better understanding of data mining application in KM... before this, it's all blur je.
so, for all of u guys... do start reading and try to understand the concept of data mining in KM
Pn.Suraya has thought me a good lesson yesterday...
Thanks Pn.Suraya... really appreciate your concern!!!
<table>
<thead>
<tr>
<th>Under subject: PROJECT</th>
<th>Under subject: COPs</th>
<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
<th>mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puan Suraya, thanx 4 ur guidance....</td>
<td>Hmmmm &quot;great name&quot; huh????????? hmmmm i'm not gud in giving names ler. Oooopzzzzz sorrie 😕 Hei guyyyyyyyy, if anyone of u knowz any &quot;cool&quot; name for our CoPs, Hurry Up..... WMES3318 Students BOLEH!!! Hehe 😊 Bye</td>
<td>Hei thanx 4 help sitiaisyah 😊 Hei guyy..... hope it will help u all too 😊</td>
<td>Hi... Have anyone started with the assignment????? If yes, pizzz help me..... The question asked us to describe the decision rules approaches, rite????? It means howz the decisions rules are being implemented in an organization using KM model huh???????? Hurry Up!!!! Haha 😊 Thank You!!!!!</td>
<td>😊</td>
</tr>
</tbody>
</table>
3. Username: Sitifaridah, Total posts = 1

<table>
<thead>
<tr>
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<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
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<tr>
<td><strong>Posted on:</strong> Tue, 16 Jan 2007, 5:46:38</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td><strong>Post subject:</strong> Correction for the project title...</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td><strong>Post category:</strong> Clarification</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td>I'm the member of WAVE group wanna make a correction of our project title that is &quot;EXXON MOBIL&quot; not exxon mobile.tq! 😊</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>mark</strong></td>
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4. Username: Theventhira Kumar, Total posts = 3

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<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
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<tbody>
<tr>
<td><strong>Posted on:</strong> Tue, 16 Jan 2007, 11:04:53</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>mark</strong></td>
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<tr>
<td><strong>Post subject:</strong> group</td>
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<td><strong>Post subject:</strong> -</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>mark</strong></td>
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<tr>
<td><strong>Post category:</strong> Clarification</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td>Puan Suraya, There is error in our group name...it suppose to be 'infamouz'....tanx!!!!! kumar</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td><strong>Posted on:</strong> Wed, 17 Jan 2007, 18:43:13</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td><strong>Post subject:</strong> assign1</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td><strong>Post category:</strong> Questioning</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td>Hi there all!!!!!! how do u all get the articles, journals, e-books from????? is there ne related website where we can find all the material for our assignment ????? if got juz help me out n others too!!!!! even in UM library very little material and some even kenot be download!!!!! kumar</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td><strong>Posted on:</strong> Tue, 16 Jan 2007, 5:25:13</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>Posted on:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td><strong>Post subject:</strong> Assignment 1_WMES3318</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>Post subject:</strong> -</td>
<td><strong>mark</strong></td>
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<tr>
<td><strong>Post category:</strong> Clarification</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>mark</strong></td>
</tr>
<tr>
<td>Hi everyone there!!!!!!! So for the assignment 1, we should find out any related field that applies data mining technology izzit....is anyone did the data mining technology part??? What type of technologies that you all did for ur assignment....plz let me know so i'll get the clear picture on how to tackle the question....tanx😊 Kumar</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>Post category:</strong> -</td>
<td><strong>mark</strong></td>
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</tbody>
</table>
5. Username: Siva Balan, Total posts = 1

<table>
<thead>
<tr>
<th>Under subject: PROJECT</th>
<th>Under subject: COPs</th>
<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
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</table>

Posted on: Tue, 16 Jan 2007, 18:35:14
Post subject: KM Portal???
Post category: Questioning

how 2 differenciate between KM Portals n normal web sites???

VA-SI

6. Username: Nur Hanani Jamaluddin, Total posts = 2

<table>
<thead>
<tr>
<th>Under subject: PROJECT</th>
<th>Under subject: COPs</th>
<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
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Posted on: Thu, 18 Jan 2007, 3:31:36
Post subject: CyBercoP
Post category: Clarification

how about "CyBercoP"
ehehehehehehehe

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<thead>
<tr>
<th>Under subject: PROJECT</th>
<th>Under subject: COPs</th>
<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
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</table>

Posted on: Mon, 15 Jan 2007, 7:32:16
Post subject: About D' assignment
Post category: Synthesis

i think wut we need 2 do is to discuss about the approach that can be use in the knowleDge management model..the approach that are related to this topic,erm like for example Techno-centric,Organisational,Ecological and Combinatory,Bdw, this is my OpiniON,,i guess its cOrrect ehehE
<table>
<thead>
<tr>
<th>Under subject: PROJECT</th>
<th>Under subject: COPs Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
<th>mark</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Post subject: just reply...</td>
<td>Post subject: WMES3318 Assignment 1-hv to submit next week!!!</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Post category: Social</td>
<td>Post category: Questioning, Synthesis</td>
<td></td>
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<tr>
<td></td>
<td>great name??!hahahaha maybe some kind of 'high tech' name...</td>
<td>hmmm i also don't know how to do this assignment...</td>
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<td></td>
<td>still dun hv any idea... how about FUTUOS-FUTUre of practice cOmmunitieS...hehehehe...</td>
<td>but maybe we hv to find any field/company/software that use KM as their approaches..</td>
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<td>such as e-Learning... how KM and e-Learning are used to help to become a learning organization...</td>
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<td>rmhmm think so.....if wrong, don't blame me okey</td>
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<td>madey</td>
<td></td>
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<td></td>
<td>Post subject: FUTUOS</td>
<td>Post subject: ASSIGNMENT 1</td>
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<td></td>
<td>Post category: Social</td>
<td>Post category: Questioning</td>
<td></td>
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<tr>
<td></td>
<td>futuos-phew... chose-way to pronounce...hehehehe</td>
<td>puan, as i c u before,hmm can i combine the input/data that i get from 3 journals together? still confuse about the flow...coz one article got KPI, the other one got CoPs... Dun hv much time to read...hehehehe</td>
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8. Username: Nur Jannah Kamarol Zaman, Total posts = 1

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<th>Under subject: COPs</th>
<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
<th>mark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Post subject: Post category: Clarification</td>
<td>puan, can i do the summary for each journals that i get? means that i did nit combine all the journals into 1 report. if i hav 3 journals, i will do 3 introduction, 3 summary and 3 conclusion. can i do it like that?</td>
<td>-</td>
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</table>

9. Username: Krishnaraj, Total posts = 1

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<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Posted on: Mon, 22 Jan 2007, 19:53:57 Post subject: HI guys n girls..... Post category: Resources</td>
<td>just wanna drop by... Wanna know Where did knowledge management came from? go to this page.... <a href="http://www.research.ibm.com/journal/sj/404/prusak.html">http://www.research.ibm.com/journal/sj/404/prusak.html</a></td>
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10. Username: Wentze, Total posts = 1

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<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
<th>Mark</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Posted on: Mon, 15 Jan 2007, 5:26:50 Post subject: Reply and questioning Post category: Questioning, Synthesis</td>
<td>i think the desicion rules approaches that v hv to find must related to the KM model..mayb can find the impact of the desicion rules approaches to the KM model.. Have anyone can gv me some idea to find more references about this topic? cz what i found is not really related to the topic 🙁 DateFormatter 🔹</td>
<td>-</td>
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</table>
11. Username: fatin, Total posts = 1

<table>
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<tr>
<th>Under subject: PROJECT</th>
<th>Under subject: COPs</th>
<th>Under subject: Assignment 1 matter</th>
<th>Under subject: start discuss about assignment 1 WMES3318</th>
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<tr>
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<td>-</td>
<td>Posted on: Tue, 23 Jan 2007, 2:53:22</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Post subject: hey guys!</td>
<td>-</td>
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<td></td>
<td></td>
<td>Post category: Social</td>
<td>-</td>
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<tr>
<td></td>
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<td></td>
<td>after class tday, i think we all hv more understand to do</td>
<td>-</td>
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<td></td>
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<td></td>
<td>de' assignmnt aite?? 😊😊😊</td>
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<td>-VeRoNiQu3-</td>
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12. Ashikin_Ibrahim, Total posts = 1

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<th>Under subject: start discuss about assignment 1 WMES3318</th>
<th>Mark</th>
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<tbody>
<tr>
<td>-</td>
<td>-</td>
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<td>Posted on: Tue, 23 Jan 2007, 2:54:53</td>
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<td></td>
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<td>Post subject: blur</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Post category: Questioning</td>
<td>-</td>
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<td></td>
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<td></td>
<td>siti aisyah, before this u already ask lecture either we can still use the article if the article didn't have the Decision Rules Approaches.? so how? can we still use that kind of article? just focus on the application of data mining technology... 😁</td>
<td></td>
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<td>ciqeane</td>
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13. Fahimy Kamaruddin, Total posts = 1

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<td>-</td>
<td>Posted on: Wed, 24 Jan 2007, 14:06:16</td>
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<td></td>
<td></td>
<td></td>
<td>Post subject: Approach for assignment 1</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Post category: Analysis</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Case studies regarding knowledge management would be the best source for this assignment. anyone agrees/disagree?</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Act speaks louder than words...</td>
<td>-</td>
</tr>
</tbody>
</table>
Publication Resulting From This Research


12. Mee Chin Wee and Zaitun A. B., Evaluation of a Model for Assessing Students’