CHAPTER 1

INTRODUCTION

1.0 Research Overview

Learning is an ongoing and never-ending process. As time goes by, the process has been systematically enhanced in accordance with the rapid flow of technology. Today, learning has been revolutionized from the conventional method that emphasized the use of textbooks and paper-based materials toward computerized, paperless and electronic documenting methods. Looking at the minimum drawbacks together with the positive feedbacks and observations made in studying the new learning process, an intensified method of learning was introduced into the educational system called e-learning. E-learning is a process of acquiring knowledge via the computer, where materials are made available and accessible through the Internet. E-learning requires educators to supplement their knowledge using leading-edge technology to encourage learning and to increase the speed of learning by improving their knowledge in terms of the delivery speed of the subject.

Existing e-learning systems generally rely on traditional approaches which include lecturing, notes, remote distribution and course deliver. With these approaches, it is observed that viewers concentrate too much on viewing the contents by themselves without participating in the improvement of their relationships with a larger community and their individual skills. Such methods seen to be good enough for students but loopholes requiring improvement can still be seen inside the system, especially regarding the assessment process. To
improve and determine absolute e-learning systems, special requirements must be emphasized for the assessment process of e-learning to fulfill the lack of completeness of the system. Theoretically, this research will study and determine the absolute e-learning process, which is seen to have the best approach in improving these shortcomings.

Assessment provides the means of evaluating students’ acquired knowledge. Assessment is a highly dynamic process that involves both synchronous and asynchronous communication between students and instructors. Assessment provides the means for students to evaluate their progress by receiving valuable feedback. In most cases, however, the existing assessments in e-learning rely too much on traditional approaches. These assessments do not allow the use of alternative approaches because they require that everyone undergo the same process. This requirement reduces the ability of students to manipulate their way of thinking, which would also cause educators to become inefficient in handling huge amounts of data concerning human interactions in such a learning environment. To build a model of appraisal, the assessment process will therefore be analyzed via different possible scenarios and different types of assessments. The analysis will identify the main concepts involving the relationships between students, teachers and coordinators by focusing more deeply on each type of assessment, including multiple subjects involved, marking processes, student answers and grading.
For an effective improvement of e-learning assessment, the use of software agent is certainly required. The software agents can be defined in multiple ways depending on the functions and context. Generally, agents are autonomous computational entities capable of sensing (such as acquiring information) and acting (such as producing and sending information) in a medium (such as a Web server) to accomplish a set of designated goals. Agent also refers to a computer system positioned in an environment that autonomously acts on behalf of its user and that has a set of objectives and engages actions to accomplish these objectives. It is undeniable that software agents offer greater flexibility in conducting assessments than traditional approaches. Software agents use a dynamic, adaptable, rich message-based interaction together with a flexible knowledge-based technique to perform easier assessment and to speed-up systems as requirements and technologies rapidly advance. The suites are intended to overcome the weaknesses of current electronic documentation, emphasizing the speed and, accuracy of the system while satisfying users. Software agents can also access the related appraisal together with marking progress and student assessment scores quickly.

Agents are seen to have great potential for attenuating assessment workloads while automatically performing many knowledge-labor-intensive tasks for users. With the ability to perform its own analysis, an agent can detect and localize problems earlier in either the teaching or learning processes, resulting in an absolute and more accurate assessment. The use of agents to manage current e-learning assessments, will make the marking, counter checking and filtering, searching and retrieving of information faster. This
research will therefore concentrate on applying software agents inside e-learning assessments to attain a supreme e-learning system.

The following sections will be subdivided as follows: statement of the problem, research objectives, significance of the research, scope of the research, research methodology and research contributions or target user and dissertation organizations.

1.1 Problem Statement

With the rapid spread of technology around us, it is important to remain on par with its development. Today, more e-learning assessment systems have been created and are available via the intranet and the World Wide Web. However, existing systems are less attractive for assisting students in better understanding lessons. Most of these systems lack sufficient visual assistance (to guide), and there is no coordinator or reminder during the access of the system itself. The challenge of managing e-assessment systems lies in the content delivery to the learners, which varies in format and representation. Existing systems (without a software agent) rely too much on traditional approaches, causing users to impose the same method and undergo the same process along with traditional content-related documentation. A software agent is the best agent for providing a better assessment system with easier access for the student or even the instructors themselves. Due to its autonomy and social ability, the software agent-based approach has been increasingly used in educational environments, and thus, the
number of agents has been designed specifically for educational purposes. From the e-assessment point of view, the benefits of using software agents are especially seen in their ability to coordinate and remind all users that use e-assessment. Therefore, the agent approach is highly effective for improving and developing of e-assessment systems.

1.2 Research Objectives

Within the context of the concerns brought forward in the statement of the problem, this study seeks to consider the following specific objectives:

1. To study an agent-based approach for supporting assessment in e-learning environments.
2. To develop and incorporate software agents into an electronic assessment module.
3. To evaluate the developed module based on the identified parameters.

1.3 Research Significance

The significance of this project is that it develops a web-based e-assessment system using a software agent approach for students, teachers and coordinators to enhance current e-learning systems. One of the most important educational components of the software agent is its ability to assess student’s acquired knowledge. The application of a software agent provides an electronic assessment for students with easier access to a more accurate result obtained by teachers and coordinator. With the use of an informative message prompt,
an assessment with an agent can rapidly access information related to communication issues and related assessments such as answering assessment questions and marking answers. A software can agent also animate the view of contents with its animation tool, which can help students or teachers understand the system better. With the use of an agent, instructors can also quickly view all feedbacks and comments on students’ assessment scores and reports, counter checking and filtering, evaluation types, feedback of students’ progress, analysis of students’ answers, assessment of results and students’ grading, and viewing analysis graphs and mark sheets. Finally, because the software agent can function as a reminder, it can quickly assist with assessment requirements that can sometimes be forgotten by students or instructors when arranging meetings or discussions to improve the assessment or it can post a reminder of any other type of requirement such as conferences or meetings.

1.4 Research Scope

The scope of this research will emphasize the software agent-based approach for supporting e-learning in distributed environments. This approach will be implemented for secondary schools to make simple for the user while keeping a high level of accuracy, providing better management results and fulfilling its mission. To meet the success criteria, software agents work on behalf of a coordinator, and they have the authority to autonomously interact with the system. An agent can access information relate to communication issues, informative messages (announcements and reminders), related assessments (such as a marking system), comments on students’ assessment scores,
evaluation types, feedback of students’ progress, analysis of students’ answers, assessment of results and students’ grading. The agent needs this information to perform its analysis and reach conclusions that may be useful for earlier detection of problems in either the teaching or learning processes. To meet this requirement, the system develops the agent to extend the use of assessment in the current educational system (school). The software agent will also be used in animating the contents of the system, which will make understanding easier for students and teachers. Using a software agent in an assessment system will improve understanding while increasing communication and interaction, and it will, therefore, produce a system that has ease of access, is more efficient and, most importantly, accurately presents the assessed data.

1.5 Research Methodology

Several approaches were implemented in research project to achieve the research objectives. This strategy involves the following steps:

1. Conducting a Literature Review

While conducting the literature review, few existing e-learning systems available in the market had been reviewed to determine the strengths and weaknesses of the systems from the requirement point of view. The current e-learning issues that had been identified will be addressed to propose an agent-based approach for supporting e-learning.
2. **Data Gathering and Analysis**

Because data gathering must be performed to collect sufficient data to produce sets of complete requirements, few data gathering techniques are identified. These techniques are combined and used so that the data gathering techniques can be varied.

3. **Capturing System Requirements**

Because use cases can be used to identify the requirements of a system and because each use case can be examined separately, it has been decided that the use cases will be used to identify the system requirements. For each module of the system, the use cases will be converted into a list of requirements for that module to be implemented successfully.

4. **Design**

In this research project, the conceptual design gives attention to the system’s functions whereas the technical design expresses the form the system will take, including the hardware and software aspects.

5. **System implementation and Testing**

System implementation will elaborate the constructed design and translate it into a form that can be used on a computer system. Testing is concerned with performing a validation of the implementation to determine whether it complies with the original requirements, specifications and designs.
6. **End Product**

A web-based application is produced as a result of the research project development. This application should be able to deploy the system, including executing all steps necessary for users, which in turn include training and providing a user manual with guidelines.

1.6 **Research Contributions / Target User**

The target users of the research system consist of three main parties:

1. **Students**

Students, can use the software agent of the e-learning system to test the online assessment electronically (e-assessment), check their scores or assessment results automatically after answering the questions, view their report cards individually and view a graph analysis for all subjects and assessments from the system.

2. **Teachers**

The task of teachers’ is to create the questions for every assessment of a particular subject. After they have created the questions, they will submit them to the coordinator, who uploads the questions into the system, including posting announcements in the system. Teachers can also monitor students’ assessment progress, check their reports individually for reference, check mark sheets for all students and view a graph analysis for all subjects and assessments. By reviewing all of the reports teachers can predict students’ future results.
3. Coordinators

The coordinator’s main responsibility is to upload all questions given by teachers into the system. Not only can coordinators add, delete, update or display questions; they can also upload all announcements and reminders given by teachers or administers. Based on an analysis of the assessments, the coordinator will provide their headcounts.

1.7 Organizations of the Dissertation

This research is divided into seven chapters.

Chapter 1 is the introduction of the paper, including this section. The first part is an overview of the research. Chapter 1 lays the foundation upon which the research is based, presenting the background of the research, a statement of the problem and the objectives of the research. This chapter also provides the scope, significance and target users of the research, ending with the organization of the research.

Chapter 2 presents a literature review. This chapter reviews, describes and elaborates all of the relevant terminologies related to the thesis title. Chapter 2 also reviews and compares information regarding existing systems, techniques, and models. The review mostly discusses the software agent, e-learning, e-assignments, process architecture and distributed learning. This chapter will highlight sufficient conclusions from the reviewed literature that leads to the system development. Chapter 2 will incorporate an appropriate referencing style and the citation of relevant sources.
Chapter 3 contains the research methodology, which describes the approaches and procedures used during this research to develop guidelines for the newly developed automated tool. This chapter will also discuss a method for an organized approach to problems solving.

Chapter 4 covers the requirement analysis by applying fact-finding techniques, and the following requirement specifications: system overview, user characteristics, project scope, system constraints, use case diagram together with use case description, functional requirements, non-functional requirements and system and hardware requirements.

Chapter 5 elaborates the system design. This chapter includes the system architecture of the related project, the system structure to present all of the modules, a class diagram, a sequence diagram according to the module, the database design and the interface design.

Chapter 6 presents the coding & testing phases. This chapter complements chapters 3, 4 and 5 by presenting the analysis and design phases in a complete system as an attempt to fulfill the research objectives formulated for this research. Chapter 6 includes a screenshot of the system, and it highlight the testing strategies/approaches used to test the system. Therefore, it is crucial to choose the suitable type of test performed and use a proper plan.

Chapter 7 presents an evaluation of and the conclusion to this work, and it provides future system enhancement for automated support development. This chapter reports the results of the users’ evaluation test, the sample size, where and when the evaluation was conducted and the system strength. Chapter 7 also compares the findings of this system with existing systems.
CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Before implementing the development of the system, a literature reviews will be presented on topics related to software agents, e-learning, assessment, e-quizzes, e-tutorials, e-assessments, e-learning technologies, the architecture of software agents and the existing e-learning standards. Most observations were performed in accordance with a development that is ongoing. Thus, the studied information will be derived from electronics media (multimedia presentations, slide presentations, research studies from the Internet and online open information), non-electronic media (mostly from related reference books, notes and journals) and data media. Previous research projects and studies were also taken into account as a reference in to promulgate a new structure, which will result in improvement and enhancement while stressing a better approach and understanding toward a concrete knowledge.

2.1 E-learning

In several sectors of the economy, education and training, in their usual form, show their limits and their insufficiency in responding to the constraints and requirements of the dynamics of the world economy. Technology is changing rapidly in all fields and it is important that companies provide adequate training to improve their employees’ qualifications.
To achieve these requirements, it is necessary to consider other approaches to training, such as the introduction of new multimedia tools, self training and, especially, e-learning, which integrates new technologies and provides tutoring and guidance to learners.

E-learning is an Internet-based instructional program that is distributed to learners electronically using electronic resources, web features (e.g., synchronous, asynchronous, hypermedia and e-searching), course management systems and technological interactive tools such as Web-CT, Moodle or blackboard. E-learning has taken center stage in higher education and is being developed by many national and international colleges, universities, and organizations. Thus, quality in e-learning depends on web-based learning environments designed, developed, and delivered based on several dynamic principals, such as institutional support, course development, teaching/learning, course structure, student support, faculty support and evaluation and assessment.

E-learning refers to an electronic learning environment that uses information and communication technologies (ICTs) as a platform for teaching and learning activities. ‘E-learning involves the use of a computer or electronic device (e.g., a mobile phone) in some way to provide training, educational or learning material’ (Derek Stockley, 2003). Before the creation of e-learning, fully conventional learning methods, such as text books and paper-based materials, were almost exclusively used. The beginning of e-learning was defined as "pedagogy empowered by technology", and it can be accurately called a flow of the learning environment toward a 'digital technology'.
E-learning is learning that is enabled or supported by the use of digital tools. E-learning typically involves a form of interactivity, which may include online interaction between learners and their instructors or peers. E-learning resources are usually accessed via the internet, though other technologies, such as CD-ROM, are also used (Ministry of Education New Zealand, 2004). The functionality of e-learning has drawn much attention in recent years from researchers and practitioners increasing the requirement of its use.

E-learning allows teachers and students to be separated by space and time, thus providing flexibility time and place of learning, communication through informational communicational technologies and cost effectiveness. There are many advantages to using e-learning. Because students do not have to physically attend classes, seminars or training programs, e-learning makes learning available to those who might otherwise be unable to study. E-learning modules can be easily revised, and e-learning software can be automatically updated by connecting to the server. This approach is much faster than the old requirements of retraining professors and reprinting books or manuals. E-learning also allows learners to upgrade their personal skills with a less time-consuming method while avoiding the interruption of career or personal commitments. E-learning also allows for tailoring to individual needs or schedules while allowing employed learners to enhance and reasonably implement their knowledge to increase the efficiency of personal skills, which can also contribute toward the improvement of their company. In addition, e-learning allows learners to become part of a community, class, or cohort of learners with similar needs. These communities can continue to exist in forums after the completing of the course. Finally, e-learning allows for real time
exchanges as well as asynchronous exchanges, thus eliminating time and distance barriers to communication, and it allows the integration of Internet resources.

The effectiveness of a learner’s experience is normally enhanced through student-centered designs. For example, students understand better and gain more information from a text-book that is well organized, has extensive visuals, reflection/interaction points and clear headings. The same concepts are true for online courses. Students learn better through the use of clear headings, limited distractions, visuals, screen-friendly fonts, appropriate white spaces, and web-safe colors, among others. With these observations, we can say that lectures patterned on a student-centered design have a greater impact on students’ understanding than the basic style, which is less attractive and may reduce their interest in learning. ‘Basically, usability is the process of testing (through observation) how students behave with a course—what works, what doesn't, what confuses’ (elearnspace.org). Everyone familiar with how technological developments influence the new e-learning know, how important it is that it be well implemented into the system well. Due to this impact, a more concentrated e-learning system will help organizations gain better results, not only for students but for the instructors as well.
The table below shows differences between traditional learning and e-learning.

**Table 2.1: Differences Between Traditional Learning and E-learning**

<table>
<thead>
<tr>
<th>Traditional Learning</th>
<th>E-learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers and students are together in class, base on a given time and place</td>
<td>Teachers and students, do not always have to be together in class, which</td>
</tr>
<tr>
<td>(according to a timetable).</td>
<td>can be conducted at anytime and any places.</td>
</tr>
<tr>
<td>Students must study in the class and do their homework at home.</td>
<td>Students are not limited to study in the class because e-learning is</td>
</tr>
<tr>
<td></td>
<td>flexible.</td>
</tr>
<tr>
<td>Learning in class cannot be revised easily unless the students make their own effort</td>
<td>Students can extract important materials/notes directly through the</td>
</tr>
<tr>
<td>to take important notes during class for them to revise later.</td>
<td>Internet.</td>
</tr>
<tr>
<td>Students in class often use reprinted books and manuals. This method may sometimes</td>
<td>The Internet makes lessons more interactive because it provides</td>
</tr>
<tr>
<td>put the class in a boring situation.</td>
<td>multimedia features. Students are automatically more attracted to these</td>
</tr>
<tr>
<td></td>
<td>features.</td>
</tr>
<tr>
<td>Transportation to manual classes can incur high travel expenses.</td>
<td>Students can reduce travel expenses.</td>
</tr>
<tr>
<td>Students receive information only from class.</td>
<td>Anytime access to information.</td>
</tr>
<tr>
<td>Students must study face-to-face with their teacher in the classroom.</td>
<td>Learning from various forms of electronic distance technology.</td>
</tr>
<tr>
<td>Classroom learning has becoming less effective compared with electronic methods.</td>
<td>Computer-delivered methods result in more effective learning.</td>
</tr>
</tbody>
</table>

The implementation of e-learning is considered as decentralized approach even though the course materials are managed centrally (Buraga, 2003). E-learning materials can be used with a student’s personal computer, hardware specifications and operating system in accordance with their specificities. Today, learning without additional aid can result in a lack of
information, and it may be unsuitable for the needs of understanding required by students. Topics and objectives are presented in multiple ways, and are expressed in various formats in order to meet today’s trends of knowledge delivery. We may find that learning materials today are more open-ended, including the use of interesting presentation (including text, photos and numbering), audio-visual aids, simulation and other hypermedia files. The tools will help the student to make relations and apply them with their own thinking. Although the use of e-learning is not yet popular, the system has grown to the extent that it is now advancing in parallel with the rapid developments of the binary world of computation. Therefore, e-learning has its own level of categorization, which needs to be stressed so that students can make better decisions concerning they require most.

2.2 Technologies for E-learning

E-learning cannot be separated from the pedagogy that underpins it, or even the technology that enables it. In the present tertiary education institutions now, most of the learning systems come together with the Learning Management System (LMS) and Learning Content Management System (LCMS) which often complement with other technologies.
2.2.1 Learning Management System (LMS)

LMSs, or virtual learning environments have been described as platforms in which online courses or online components of courses are assembled and made available. An LMS usually contains course and administrative tools that create course specifically for enrolled students and their instructors.

Hundreds of LMS applications have been developed since the late 1990s. Most LMSs provide similar e-learning tools for course designers. The following list reasonably represents the basic tools that are available: web pages for presenting course content and notices; links to other Internet sites; discussion or bulletin boards with rich text editing for threaded discussions; chat clients for same-time text-only communication; quizzes (usually multiple choice and other self-marking formats, though open-ended responses can also be captured); grade storage; and student tracking, ranging from login records to individual page views.

There are has a number of features that have yet to appear in commercial LMS packages, such as automatic forwarding of new discussion board posts to a participant’s email, wiki and glossary tools, and student profile features (including automated image association with messages in which- profile images of authors appear next to any message they post). Despite some remarkable differences, LMSs tend to be largely generic. LMSs also tend to lag behind the technical requirements of e-learning innovation. Blogs, for example, are a rapidly maturing e-learning technology (proven pedagogies for their use are
emerging), but they are not yet standard features in LMSs. Institutions often need to look beyond the LMS to make use of particular e-learning approaches.

The following figure is general view an e-learning system.

![Figure 2.1: General View of an E-learning System](image)

A general view of systems, involving the roles and components of e-learning is visualized in Figure 2.1. Several groups are involved, including: authors, learners, administrators and trainers. The authors can be teachers or instructional designers who create e-learning content using with an authority system that allows authors to create course content by storing it inside the LMS, thus making it available for the learner via a run-time system. For larger applications, additional personnel will be required, such content experts, instructional designers, programmers, graphic artists and project managers.

The main core of an e-learning system under the control of an administrator consists of an LMS and an LCMS. An LMS consists of an infrastructure platform that allows the tracking of courses or training
experiences in relation to learners. The LMS allows learners to more easily monitor their own progress, track, and it makes collaboration or scheduling an event. The LMS works also at the curriculum level, assisting with the assemblage of courses into collections, such as academic or training programs. E-learning courses managed by the LMS can be created in parallel with course-authoring tools and delivered with the assistance of an LCMS. The LMS is not limited only to e-learning systems, it can also manage other forms of instruction. The main tasks of the LMS are to manage for learners entire courses, with various curriculums, to present options depending on the learner profile, to track learner needs and preferences and to track course completions and scores. The LMS also has a relational database application designed to track learners, courses, curriculum and scores. The LMS also provides a web-based interface with which faculty and administrators can monitor learner progress through reports of enrollments, completions and grades.

2.2.2 Learning Content Management System (LCMS)

The LCMS consists of an infrastructure designed to create, deliver, manage, and re-use instructional content. The content might be web pages, tests, media, or assembled lessons and other course components. The LCMS deals with content and its assemblies (learning objects, lessons, courses) and how the content is delivered. LCMSs convert information into learning content that makes it available for presentation in various approachable forms depending on the participants and learning objectives. The role of the LCMS is seen more as assisting the LMS to make e-learning more acceptable and better than before.
The LCMS may also provide courses to an LMS that tracks the learner and his/her enrollments.

The LCMS consists of a central repository, which is a database where content can be organized, assembled, approved, published, and from where lessons, courses and other learning events can be delivered. Courses in an LCMS are typically created with web-based authoring tools and are viewed with a browser. The LCMS can also launch tests created with testing tools. An LCMS contains the following: **Components**: html pages, XML data, media, test questions; **Learning Object definitions**: use of the above components to accomplish learning objectives; **Lesson and Course definitions**: use of learning objects to accomplish instructional goals; **Templates and style sheets**: to control appearance and delivery; **Framework**: navigation and user interface; and **Metadata**, which concern all of the above.

The key components of the LMS are as follows: **Learning object repository**: a central database in which learning content is stored and managed; **Automated authoring application**: used to create the reusable learning objects that are accessible in the repository; **Dynamic delivery interface**: used to serve up a learning object based on learner profiles, pretests, and user queries and to provide user tracking, links to related sources of information, and multiple assessment types with user feedback; **Administrative application**: used to manage learners’ records, launch e-learning courses from course catalogs, track and report the progress of learners, and provide other basic administrative functions.
2.3 Types of E-learning:

In the context of this research, e-assessment has been chosen for supporting the e-learning system. Decision was made because the existing systems are less attractive for assisting students with understanding the lesson better. Most systems lack sufficient visual assistance (to guide) and have no coordinator or reminders during access of the system. These existing systems (without a software agent) rely too much on the traditional approach, causing users to impose the same methods and undergo the same processes. The use of an agent in this system assessment will, provide easier access for both students and instructors. The agent is also highly effective because it improves the assessment system and is suitable for the development of the e-assessment system.

2.3.1 E-assessment

E-assessment is defined as an end-to-end electronic assessment process where ICT is used for the presentation of assessments and the recording of responses. E-assessment is “the use of electronic processes for registration of candidates to certification and also the end-to-end assessment processes from the perspective of learners, practitioners, school administrators, learning establishments, awarding bodies and members of the general public”.

The advantages of e-assessment include lower long-term costs, instant feedback to students, greater flexibility with respect to location and timing, improved reliability (machine marking is much more reliable than human marking), greater storage efficiency (where ten of thousands of answer scripts can be stored on a server compared to the physical space required for paper
scripts) and enhanced question styles, which incorporate interactivity and multimedia.

E-assessment is also a web-based tool for assessing application skills. When you login into the e-assessment portal, cases are generated by the system, taking your functional area into consideration, and are assigned to your login ID. You have option to either print and answer immediately or later. In the e-assessment, data files and images can be linked to each question and answer. This feature helps the mentors and the students write the cases/answers in a flexible manner.

When online assessment is mentioned, most minds imagine simple, self-marking question techniques such as multiple choices, filling in the blanks, true/false, ordering, matching, multiple answer, and hotspot questions. Unfortunately the additional possibilities afforded by e-learning are seldom considered when discussing online assessment, mainly because they are not in the repertoire of standard online assessment tools. Basic tools that may help e-assessment are as follows:

- **Self-marking assessment tools** – Self-marking refers to true/false, multiple choice and ordering type questions that can be answered in pre-determined ways. Most online assessments make use of these tools, primarily because they are directly in association with the testing of LMS systems and are standard fare of other online assessment systems. Unfortunately, self-marking online assessment tools tend to be built for
the purpose of measuring student performance rather than to provide opportunities for further learning and they are limited to pre-determined feedback. As such, they are largely incompatible with the use of summative assessment for further learning purposes.

- **Simulation-based assessment tools** – Simulations are highly interactive and responsive applications that measure student performance in a simulated environment. Simulative assessments can be highly effective (see, for example, Lapointe and Robert, 2000), but they can be too expensive to purchase. However, a simulation-based assessment tool has been shown to effectively in providing feedback directly based on student input. Simulations are frequently used for teaching, but they can also be effectively used for assessment by requiring students to achieve a certain score, reach a certain minimum level or complete a task within various pre-determined constraints. The real-world context is a vital contribution to skills-based assessment. Simulation-based assessments seem to be largely overlooked by practitioners as an online assessment option.

- **Collaborative and feedback-oriented tools** – E-learning tools such as bulletin boards and document revision provide excellent opportunities for assessment and are worthy of exploration by those wanting to use online tools effectively for assessment purposes. While the automation of marking may be non-existent using these tools, the opportunities for providing feedback to students are maximized because electronic marking (e.g., the comments feature of MS Word) permits increasing levels of feedback at points of relevance. Feedback will be easily given by the participants in shorter time and with quicker access. Bulletin
board discussions, whether pre- or post assessment (or both), maximize the opportunities for learning from assessment tasks. With the exception of simulation-based assessments, online assessment tools are relatively easy to use. Self-marking tools increase efficiency and convenience for instructors and also ensure swift marking. Collaborative and feedback tools, however, increase the validity of assessment (because they measure understanding) and the effectiveness of assessment as a learning tool (providing customized feedback is provided by the instructor).

Thus, there are a variety of online tools that can be used in assessment. Whether these tools are applicable to any particular course depends on the cognitive domain, which needs to be assessed each time. There are three main learning (cognitive) domains (Nichols, 2001), and each is suited to one of the online assessment tool sets:

• **Information (knowledge/comprehension)** – Information is the level of recall. Self marking tools are appropriate here, as students either know something or they do not. Feedback needs to be simple and should guide the students back to the correct answer.

• **Skills (application/analysis)** – Skills are the level of application. Simulation-based tools are appropriate for assessing skills.

• **Understanding (synthesis/evaluation)** – collaborative and feedback-oriented tools are appropriate because understanding is concerned with how well a student knows something instead of whether they know it or not. Feedback needs to be as individualized as the student’s understanding.
2.3.2 E-quiz

E-quiz is a web-based tool that assesses subject knowledge and application skills. This web-based application allows instructors to create and publish quizzes on the Internet. Building an e-quiz is a simple process that can be accomplished in minutes. Users enter a quiz name, quiz schedule and questions, and they are ready to publish the quiz. E-quiz also allows instructors to add explanations and references (e.g., URL links or page numbers) for each question. Students would be able to review this additional information upon the completion of a quiz. If desired, instructors can choose to have the results emailed to them. As an option, users can also print the quiz and a separate answer key directly from their browser. The online quiz corresponds to each module. The e-quiz provides feedback on two levels:

1. For each individual question. In case of a wrong answer to an individual question, the system will immediately provide the right answer and give a brief description explaining the main point. This approach adds to learning rather than just testing knowledge. This method is similar to a hands-on discussion with an expert.

2. Through score cards at the end of the e-quiz. These cards provide a breakdown, by module and topic, of the questions, the right answers and the total percentage marks. The score card helps identify any of the week’s topics that need review.

E-quiz is packed with many features that demonstrate the need to make web-based testing more effective and flexible. E-quiz is designed to generate four types of questions: single response (multiple choice type), multiple response
(check box type), true/false and numerical response. The questions are also classified into three difficulty levels.

Data files and images can also be linked to each question. These features help experts write questions, test students’ knowledge and monitor their skills effectively. E-quiz questions are usually generated randomly by the system. If the same quiz is taken for the second time, a different set of questions will be automatically generated. The database will be updated frequently with new sets of questions. Furthermore, students can review the scores of all papers attempted in the past to assess their learning progress.

2.3.3 E-tutorial

E-tutorial, a term formulated to define the new-age learning technique, has taken the world by storm. Giving contemporary education a razor-sharp connotation, e-tutorials have become a global phenomenon that helps impart a multifaceted perspective to modern learning.

With learning becoming quite customized and convenient in nature, e-tutorial or online learning has become a booming industry worldwide, giving an impetus to both career and study. The easy installation technology process itself has expanded the role of this learning medium, which is clearly seen as a revolutionary innovation vital for knowledge liberation. The medium offers instant solutions when facing imperative issues, such as to acquiring an additional edge for excelling in school and college, facing increasing
competition, acquiring higher scores, avoid problems with travel to classes, clearing doubts regarding any specific subject by the guidance of an expert and gaining conceptual clarity at one's convenience.

E-tutorials have been developed to support learning and to provide a source of supplementary information on both academic course materials and in-school teaching experience. This method is popular and is highly useful for students in the external mode who do not have a professional learning leader on site at their school. In particular, we find that the e-tutorials are extremely useful in pacing students through their studies.

2.4 Software Agent

The American Heritage Dictionary defines an agent as “one that acts or has the power or authority to act… or represent another” or the “means by which something is done or caused; instrument.” The term derives from the present participle of the Latin verb agree which mean to drive, lead, act or do. As in the everyday sense, we expect a software agent to act on behalf of someone to carry out a particular task that has been delegated to it. However because it is tedious to have to spell out every detail, we would like our agents to be able to infer what we mean from what we tell it. Agents can only do this if they “know” something about the context of the request. The best agents, then, would not only need to exercise a particular form of expertise but also take into account the peculiarities of the user and the situation.
A more specific definition of “software agent” that many agent researchers might find acceptable is a software entity which functions continuously and autonomously in a particular environment, often inhabited by other agents and processes (Shoham, 1997). The term software agents originated from the field of artificial intelligence in the 1950s. Research on software agents started to proliferate in the mid-1990s, after several key agent-related papers appeared in the popular computing press followed by several books.

Software agents can be defined in a number of ways depending on the functions and context. A general and widely accepted definition is that software agents are computational autonomous entities capable of sensing (such as acquiring information) and acting (such as producing and sending information) in an environment (such as a Web server) to accomplish a set of designated goals. More experimental research has shown that software agents have great potential to reduce information workloads and to automatically perform many knowledge-labor-intensive tasks for users. For example, these agents, combined with the function of motivation, learning facilitation, collaboration, and so forth, serve as students’ assistants, companions and tutors. Agents assist users in a range of different ways, such as easing the complexity of difficult tasks, performing tasks on the user’s behalf, training or teaching the users and monitoring events and procedures.
Agent technology has been used in educational environments for some time, and a number of agents have been designed specifically for educational purposes. The term ‘agents’ has been used in a variety of fields of computer science and artificial intelligence. The term has been applied in many different situations for different purposes. However, there is no commonly accepted notion of what it is that constitutes an agent. As Shoham (1993) pointed out, the diverse instances of the use of the term “agent” are so numerous that it is almost meaningless without reference to a particular concept of agent.

Many researchers have attempted to address this problem by characterizing agents along certain dimensions. For example, Franklin and Graesser (1997) constructed an agent taxonomy that aimed at identifying the key features of agent systems in relation to different branches of the field. They then classified existing notions of agents within a taxonomic hierarchy. Nwana (1996) classified agents according to three ideal and primary attributes that agents should exhibit: autonomy, cooperation and learning. Autonomy refers to the principle that agents can operate on their own without the need for human guidance. They take initiative instead of acting simply in proactive response to their environments (Wooldridge & Jennings, 1998).

Cooperation refers to the ability to interact with other agents and possibly humans via some communication language, which means they should possess social abilities. Agent learning refers to an agent’s capability of improving its performance over time. Using the three characteristics, Nwana
derived four types of agents in the agent topology: collaborative learning agents, collaborative agents, interface agents and smart agents (Figure 2.2).

Figure 2.2: Agent Topology (Nwana 1996)

“Agents” can be perceived as computing services that human or even other agents can commission to accomplish their tasks. Some services may be simple and others rather complex. A way to determine the best agents services to be implemented is to identify who the actors are in the object of study, which roles they play, and, if possible, what kind of knowledge they use. Thus, when designing such an environment, developers should consider the agents as the integration three kinds of services as stated below:

1. Helping people to perform innovative activities (i.e., educators need to create groups, projects and assessment portfolios; students have to relate the solutions they create to the problems proposed, to negotiate with other students, to collaborate with them, and to criticize or judge their peers' work).

2. Stimulating social behavior within students (i.e., if the system determines that two students are working on similar issues, it can
inform the students and give them information about how to contact each other).

3. Offering educators clear and objective information about the students’ performances (i.e., which students are more creative, who effectively produces what, which students cannot collaborate, which students have to improve their reasoning skills).

2.4.1 Software Agents for Cooperative Learning

A crucial issue for the integration of new information technology in the education system is the enhancement of access to knowledge and culture so that the education system can improve its role of knowledge transfer and citizen training. Information technology can be used for at least three functions developing autonomy and individual learning, removing barriers caused by geographical isolation, thus opening the education system to the external world and facilitating synergy with open resources.

A major issue is the extension of human memory to external memory. Computer technology enables knowledge management and storage. New concepts such as corporate memory or organizational memory are emerging. The education system is certainly a good example of a generator of corporate knowledge that is reused for the benefit of students.

Cooperation via electronic documents is a new activity that will involve new tools. These tools are information-intensive, and they are called software
agents. Traditional writing and reading has become a human-computer interaction. Sometimes documents are designed in such a way that they end up being complex because either the technology does not allow them to be simpler or designers do not have enough knowledge of human factors or the training needed to make designs with simplicity in mind. Software agents should reduce complexity to improve situation awareness, understanding and performance. For this reason, we should keep software agents as small applications (Rappaport, 1995). Software agents assist users to design, produce, manage, access, choose, and interpret documents.

2.5 Architecture of the E-learning Agent-Based System

Software architecture is a high-level development and description of a software system’s design and is often a model of the software’s components (e.g., objects, processes, data repositories, etc.), the externally visible properties of those components, and the relationships among them (Bass, et al., 1998). Software architectures have received considerable attention lately and developers are starting to document software architectures. However, the actual architecture of a software system may drift from the documented architecture if architecture changes are made during software implementation or maintenance and if no similar effort is made to maintain the architecture documents. Although architectural integrity could, in theory, be enforced by a rigorous review process, in practice this is seldom done.
The key functions of the proposed e-learning agent-based architecture are identifying optimal learning conditions through evaluating a user’s behavior and tracking the user’s performance. With this agent-based system, it will also support the rapid development and delivery of educational material; analyzed the personalized needs of an individual automatically and dynamically, allowing agents to communicate with each other and with their environment; and support the interactions between sets of agents that might be geographically dispersed. It also allows multiple agents to collaborate, combining them asynchronously, and it determines which messages other agents can accept and send.

Most e-learning systems are implemented using client/server architecture. Due to the nature of the application, a client/server architecture seems to be a natural fit. In fact, an e-learning system needs a kind of centralized server for course management and authoring, while clients are heavily distributed. The e-learning service or content can be distributed from a server to more clients through a network through the use of relevant architectures, which are the following:

1. Thin client architecture: This is a centralized managed system with applications executed on a server.
2. Proprietary client architecture: This is a stand-alone client application developed to support a specific service.
3. Internet client architecture: This is a Web-, wap-, or I-mode-browser system.
To achieve the functional requirements mentioned above, Figure 2.3 illustrates the architecture proposal that will be applied in this research.

![Figure 2.3: An Agent Server Architecture](image)

With reference to Figure 2.3, this system’s multi-tier client/server architecture consists of four main tiers: client, front-end web server, application server and database server. The client machine connects via the Internet or intranet to run the system through a web browser.

An agent server performs the following main tasks: facilitating the migration of agents’ code, creating and maintaining an execution environment and protection mechanisms for agents, monitoring agents’ actions, allowing the co-existence of and communications between multiple agents, avoiding direct interface between agents, handling agents that are coded by different
programming language interpreters and handling communications with other servers and accessing available services and resources through them.

2.6 Existing E-learning Standards

Many e-learning standards have been established including AICC, IMS, IEEE LTSC, ADRIANE and SCORM. All e-learning technology standards will be discussed briefly in this section. However, this research concentrates on SCORM-based framework as because it demonstrates the function of the supporting agent inside.

2.6.1 AICC

The Aviation Industry CBT (Computer-Based Training) Committee (AICC) is an (Tan, 2006) international association of technology-based training professionals with mission (AICC Press Release, 2001). The AICC develops guidelines for the aviation industry for the development, delivery, and evaluation of CBT and related training technologies. To understand or even operate a SCORM compliant LMS, it is not necessary to understand the AICC. However, this information is presented here for those who develop an interest from the source of the SCORM guidelines. The AICC has developed interoperability standards that enable software vendors to use it across multiple industries, ensuring the reusability and interoperability of online learning. The AICC also coordinates (AICC FAQ, 2005) its efforts with other learning technology standards organizations like IMS, ADL and IEEE LTSC.
2.6.2 IMS

IMS stands for Instructional Management Systems, also known as the IMS Global Learning Consortium Inc. (IMS/GLC). IMS develops and promotes the adoption of open technical specifications (IMS Learning Design Information Model, 2003) for interoperable learning technology. IMS has become a worldwide standard for delivering learning products and services. IMS also includes more than 50 Contributing members, who come from every sector of the global e-learning community.

IMS specifications and related publications are made available to the public without charge. For those in the field of educational technology, it is advisable to be familiar with the IMS project, though such knowledge, it is not required to run SCORM compliant systems. IMS does, however, shed light on the SCORM guidelines and many of their intentions when it was drafted. IMS is mainly known for developing in educational standard cores and as a major force in standard-setting for education.

*Instructional Management Systems (IMS) Learning Design Specification provides a standard XML format for modeling units of learning (Hagen, 2006).*

IMS Specifications (IMS Metadata Specification, 2003) include the IMS Content Packaging Specification, the IMS Learning Resource Meta-data Specification, the IMS Learning Resource Meta-data Specification, the IMS Question and Test Specification, the IMS Reusable Competencies Definition Information Model Specification, the IMS Learner Information Package
Specification, IMS Learning Design, the IMS Accessibility and the IMS Digital Repositories.

The IMS Content Package Specification (Content Packaging Specification, 2006) provides functionality to describe and package learning materials using the XML format in interoperable and distributable packages. The IMS Content Packaging Specification states the description, structure, and location of online learning materials and the definition of content types.

2.6.3 IEEE LTSC

The IEEE "is a non-profit, technical professional association of more than 380,000 individual members in 150 countries" (IEEE, 2003). The IEEE promotes the engineering process of creating, developing, integrating, sharing, and applying knowledge of about electronic and information technologies and sciences for the benefit of humanity and the profession. IEEE Standards is a world leader in the development and dissemination of voluntary, consensus-based industry standards. Within the IEEE, the Learning Technology Standards Committee (LTSC) is chartered by the IEEE Computer Society Standards Activity Board to ‘develop accredited technical standards, recommended practices, and guides for learning technology’ (LTSC, 2003). The LTSC also ‘coordinates formally and informally with other organizations that produce specifications and standards for similar purposes’ (LTSC, 2003). The other organizations include the IMS Consortium and the e-learning standards development body in the ISO/IEC. The LTSC's active membership includes
individuals from small and large private sector organizations, from the US military and military contractors and from governmental organizations and universities of various nationalities. LTSC meetings are held annually in various multiple locations around the world. The LTSC, like the IEEE as a whole, is a respected source of standards especially in the English-speaking world. This e-learning standards body is responsible for having produced the first e-learning standard which is the aforementioned "Learning Object Metadata" standard or "LOM." Despite the prominence and productivity of this group, IEEE e-learning standards are seen as benefiting significantly from the approval that can only be conferred by organizations such as the ISO and IEC, which have official and delegated international representation.

2.6.4 ARIADNE

A European Association open to the World, for Knowledge Sharing and Reuse, E-learning for all, International Cooperation in Teaching, Serving the Learning Citizen. Given that ARIADNE was conceived to foster cooperation in learning it is worth becoming familiar with its goals and approaches. Some Europeans are adopting SCORM (British government) because not as a substitution to ARIADNE but only as an addition to current adoption.
2.6.5 SCORM

SCORM (Sharable Content Object Reference Model) is a standard initiated (Bohl, 2002) by Advanced Distributed Learning (ADL). SCORM is also a collection of standards and specifications adapted from multiple sources to allow for the interoperability, accessibility, and reusability of digital learning materials. The SCORM specifications are becoming increasingly important in ensuring that digital content can be integrated into any learning management system (LMS) software, regardless of its manufacturer. SCORM also opens the door to the creation of "digital repositories," or collections of sharable, reusable online content that educators can search through to find items they can incorporate into their own usage. SCORM has been described as the "first step" on the path to defining a true, shared e-learning architecture. SCORM identifies technical standards that enable web-based learning systems to find, import, share, reuse, and export digital content in a standardized way.

SCORM is a collection of specifications from IMS, AICC, IEEE and ARIADNE. Earlier versions of SCORM, since approximately 2000, permitted learning "objects," such as presentations, tutorials, animations, simulations, and audio or video files, to be shared among various LMS programs. However developers had difficulty in standardizing the components that allowed for the repeatable tracking of student progress and remediation. The developers who put together SCORM 2004 answered that concern by pulling together what is considered to be a complete reference model for creating a reusable learning
object with built-in student remediation functionality. According to its developers, SCORM 2004 Version 3 will improve these standards even further.

For many educators, SCORM is transparent most of the time. For vendors SCORM is familiar because very apparent as they have to incorporate it into their products. How well SCORM works for individuals will depend on how much content they share and reuse with others and how well their online learning systems were engineered.

2.6.5.1 The incorporation of a SCORM-based framework into agent-supported e-learning.

The literature provides several approaches to the application of agent technology for the domain of e-learning. A “pedagogically neutral, content neutral, culturally neutral, platform neutral” framework for the integration of possible architectural components is described below. This framework is intended to be used as an abstract representation of the functionality of certain e-learning artifacts provided or supported by a set of agents. Some of the key features proposed are the following e.g.:

- Adaptable architectural components with extensive (additional) agent support.
- Identification of approaches for agent-based support for e-learning systems.
• Separation and provision of basic and specialized services for reuse and optimization.

• System development implementation aspects of the basic aspects are hidden from the user.

• Improved focus on key elements (e.g., pedagogical issues becomes possible.

• Exchange of application functionality between organizations and interoperability is eased.

• Extensive evaluation capabilities of users and system artifacts.

The framework development is based on the abstract framework of the IMS Global Learning Consortium, Inc. and the SUN Microsystems e-learning Framework. The framework was later refined by several aspects of related architectures and models, such as the Open Knowledge Initiative, the ADL Sharable Content Object Reference Model (SCORM), the IEEE Learning Technology Systems Architecture (LTSA) and the Learning Technology System Architecture of Carnegie Mellon University. Special requirements and advantages evolve from the intended application and integration of agent-based technology. Therefore, it is especially concentrates and focuses on adaptation, autonomous operation, support and flexibility. The novel framework, visualized in Figure 2.4, takes into account the diversity of users involved in the learning processes, in contrast to the functional models of the abstract IMS framework.

In addition to the main groups of learners, authors, trainers and administrators, support is also needed for content experts, instructional
designers, graphic artists and project managers. The requirements for an e-learning system are grouped and depicted by several functional environments. The Presentation Environment (PE) is the basic platform for the integration and display of the other environments. PE is a basic element that is connected to all other environments, including the Administration (AE) and Interaction Environments (IE). Appropriate and specialized access to functionalities for the learner is provided by the Delivery (DE) and Working Environments (WE). Authors, trainers, content experts, instructional designers and graphic artists benefit from the support of the Learning Unit Environment (LUE) and the Content Environment (CE).

![Figure 2.4: A Framework for agent-supported e-learning](image)

To guarantee flexibility, extension and interoperability, the whole framework is structured on three support layers. These layers, according to their specialty provide infrastructural support, common services and e-learning
services. We hereby define a service as a functionality providing entity that, can potentially be used in different environments. The environments are further hierarchically refined as described in the following subsections and fundamental and desirable services are horizontally integrated as provided by the support layers. The specific services can be ordered and used on demand. They environments also provide the basis for connection and data exchange between certain implementations of the proposed framework. This abstraction of common facilities from the classic “LMS only” model has already been proposed.
### 2.6.6 Comparison of Existing E-learning Standards

#### Table 2.2: Comparison of Existing E-learning Standards

<table>
<thead>
<tr>
<th>Function</th>
<th>AICC</th>
<th>IMS</th>
<th>IEEE LSTC</th>
<th>ADRIANE</th>
<th>SCORM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Develops guidelines for the aviation industry regarding in the development, delivery, and evaluation of CBT and related training technologies.</td>
<td>Develops and promotes the adoption of open technical specifications (IMS Learning Design Information Model, 2003) for interoperable learning technology.</td>
<td>Promotes the engineering process of creating, developing, integrating, sharing and applying knowledge about electronic and information technologies and sciences for the benefit of humanity and professions.</td>
<td>Created tools and methodologies for producing, managing and reusing computer-based pedagogical elements and telematics-supported training curricula.</td>
<td>Collection of standards and specifications adapted from multiple sources to allow interoperability, accessibility and reusability of digital learning materials. Also, identifies technical standards that enable web-based learning systems to find, import, reuse, and export digital content in a standardized way.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Definition of Learning Object</th>
<th>AICC</th>
<th>IMS</th>
<th>IEEE LSTC</th>
<th>ADRIANE</th>
<th>SCORM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Authoring tools.</td>
<td>Objects (text, tool, test-item), needed to perform activity.</td>
<td>Any entity, digital or non-digital, that can be used, reused or referenced during technology supported learning (LTSC 2000).</td>
<td>Pedagogical documents.</td>
<td>Content object, normally known as content package. It can be a web-page with java script or it can be a zip file with the necessary SCORM system files.</td>
</tr>
</tbody>
</table>
2.7 Existing E-learning systems

Today, there are numerous e-learning systems and available on the market, such as Moodle, Blackboard and WebCT. All e-learning platforms are useful for schools, universities and colleges. These platforms provide different Web-based educational environments, each with specific features. Nevertheless, because these systems have similar aims, they all share a common underlying feature, which is to deliver learning content through a Web environment. Further information and a basic explanation about Moodle, Blackboard and WebCT will be given as follows.

2.7.1 Moodle

Moodle is a free and open source e-learning software platform, also known as a Course Management System, Learning Management System, or Virtual Learning Environment. Moodle has software package for producing Internet-based courses and web sites. Moodle also functions as a global development project designed to support a social constructionist framework of education. It has a significant user base with 49,256 registered sites with 28,177,443 users in 2,571,855 courses (February, 2009). Moodle is also known as an online, interactive teaching and learning environment that enable educators worldwide to use technology in their classrooms. The learner-centered system is designed to provide educators and students with an easily accessible online course tool. With a social constructionist pedagogy, it can be used for collaborative, activity based learning to create, deliver and manage web-based content for courses, course segments, technology-focused lessons, staff development and more.
critical reflections that encourages interaction with materials, the construction of
materials, and interactions with others about the materials. Moodle also
facilitates and delivers completely online courses asynchronously or with
limited face-to-face interaction, or it can simply be used to augment a current
course. Moodle may also be used for purely static course materials. To optimize
learning, the Course Management System (CMS) design supports a wide variety
of interactive course materials, such as assignments, polls, journals, quizzes, and
much more. By using an open source program, LSU is now part of a large user
community based that continually contributes to the advancement of the system.

Moodle can be installed on any computer that can run PHP, and it can
support SQL-type databases (e.g., MySQL). Moodle can be run on Windows
and Mac operating systems and various types of Linux systems (e.g., Red Hat or
Debian GNU). There are many knowledgeable Moodle Partners that can assist
clients and even host a client’s Moodle site. The word Moodle was originally an
acronym for Modular Object-Oriented Dynamic Learning Environment, which
is mostly useful to programmers and education theorists. Moodle is also a verb
that describes the process of lazily meandering through something, doing things
as they come to mind or an enjoyable tinkering that often leads to insight and
creativity. As such, it applies both to the way Moodle was developed and to the
way a student or teacher might approach studying or teaching an online course.
Anyone who uses Moodle is a Moodler. Figure 2.5 below shows a screen
capture of Moodle.
2.7.2 Blackboard

In 1997, Stephen Gilfus and Dan Cane started a company called CourseInfo LLC. They developed a software product that would power online education and be scalable for wider institutional application. At the same time, Matthew Pittinsky and Michael Chasen formed Blackboard LLC. They were contracted to help lead the formation of the Educause IMS standards group for online education technology. Recognizing the high demand for a sophisticated, easy-to-use, and affordable online education software platform, the two groups merged to form Blackboard Inc., which then developed the Blackboard Learning System.
Blackboard is an easy-to-use online course delivery and management system that is highly flexible. Among Blackboard’s numerous features are a graphical point-and-click interface that allows instructors to incorporate learning materials from word processing, audio and video, spreadsheets, and presentation files without ever learning HTML. The interface can also help create unit descriptions, staff information, assignments, reading lists and links to useful web sites. Educators are also given the opportunity to make important announcements, create interactive tests with instant feedback to students, track student activity and create statistical reports of student grades. Students will be able to work together in small groups and share files with each other through the use of discussion forums. Features for instructors include announcements, content presentation, a calendar, threaded discussions, online quizzes, surveys, grade books, real-time chat and whiteboards using Horizon Wimba Web Conferencing and group pages for student team projects.

The Blackboard Learning System is a Web-based server software platform. This platform’s features include course management, a customizable open architecture, and a scalable design that allows for integration with student information systems and authentication protocols. The platform may be installed on local servers or hosted by Blackboard ASP Solutions. Blackboard’s main purposes are to add online elements inside courses that are traditionally delivered face-to-face and to develop completely online courses with few or no face-to-face conferences. Figure 2.6 shows a screen snapshot of Blackboard.
The Blackboard systems allow several specialists (often called “knowledge sources”) to interact through shared data (posted on the blackboard). *Normally, communication occurs only through the shared data and leads to a form of strong coupling and possibilities of bottlenecks (Gasser et al., 1987; Hayes-Roth, 1988).*

![Screen Shot of Blackboard](image)

Figure 2.6: Screen Shot of Blackboard

2.7.3 WebCT

WebCT was developed at the Department of Computer Science at the University of British Columbia in the mid-1990s. The faculty member in charge of the project, Murray W. Goldberg, had experience building, delivering and studying the success of web-based courses and materials used to supplement existing courses. WebCT, Inc., is now based in Massachusetts.
The official WebCT website is http://www.webct.com. WebCT is a set of Web-based course tools that facilitate on-line learning in a more dynamic fashion. WebCT is convenient because it can be used anytime and anywhere, is secure (password protected) and is becoming more commonly known. WebCT stands for 'World Wide Web Course Tools'. WebCT is not only accessible from its three main sites; it is also accessible from satellite and outreach centers, homes, local libraries or even a cyber-cafés on the other side of the world.

The WebCT provide communication tools and collaborative learning environments that allow communication between tutors and students and between students, through email, discussion, message boards and chat. Study materials can be accessed in various formats, including web pages, Word documents and PowerPoint presentations. These tools make access to resources easier numerous online materials can be obtained from websites, electronic journals and databases. Access to course information is also available, and conduct assessment is made easier.

All WebCT users (designers, graders and students) access WebCT using a web browser (Netscape 2.0 or above). Other than the browser, there is no special software to install. All that is required is that users have access to a network computer (a computer that has a modem or is permanently connected to a network). With computer and browser, the user can access a WebCT server to create and edit a course, to grade a student's work for a course, or to learn (e.g., read notes, take quizzes, perform exercises, communicate with the instructor or
other students). The WebCT server to which the users are connected can be installed by the course developer or by the network administrator at the developer's institution. Currently, the server must run the UNIX operating system (Solaris, SunOS, Irix, FreeBSD, Linux, AIX, HPUX, and others are supported). One WebCT server can be used to develop and serve a large number of courses. Figure 2.7 shows a screen snapshot of WebCT.

![WebCT Screen Shot](image)

**Figure 2.7: Screen Shot of WebCT**
### 2.7.4 Comparison of Moodle, Blackboard and WebCT.

Table 2.3: Details regarding Moodle

<table>
<thead>
<tr>
<th>OVERVIEW</th>
<th>General Appraisal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Open Source, Functionality for teaching. Good support from active community. Keeps up with new tools. Icons are clunky but can be changed.</td>
</tr>
<tr>
<td>Advantages</td>
<td>Half the cost, more functionality, no license restrictions about use, freedom to alter the code to suit individual campus, control over when and what versions to upgrade.</td>
</tr>
<tr>
<td>Philosophy of pedagogy, commerce and support.</td>
<td>Open source philosophy--free development and discussion. Social constructivist theory of learning.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INSTRUCTIONAL TOOLS</th>
<th>Instructional Tools</th>
<th>Three formats--weekly, social, and topics.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>In addition to the standard set of tools, also has Wikis (editable hypertext pages), RSS feeds, Instant Messaging, Choice (immediate cumulative survey questions), Dialogue (one-on-one); crossword puzzles, 3 types of assignment tools, and Workshop (peer assessment).</td>
</tr>
<tr>
<td>Mail</td>
<td>External--one at a time?</td>
<td></td>
</tr>
<tr>
<td>Announcement</td>
<td>HTML Blocks</td>
<td></td>
</tr>
<tr>
<td>File Uploading</td>
<td>Single files, zip files, all web file types.</td>
<td></td>
</tr>
<tr>
<td>Content Sharing</td>
<td>File sharing, SCORM compliant imports; Metacourse allows course copy, tool-by-tool, imports and quiz questions.</td>
<td></td>
</tr>
<tr>
<td>Languages</td>
<td>Faculty can change the</td>
<td></td>
</tr>
<tr>
<td><strong>COURSE MANAGEMENT</strong></td>
<td><strong>Quiz Statistics</strong></td>
<td>Item analysis-facility index, standard deviation, discrimination index, discrimination coefficient.</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Grade book Manipulation</td>
<td>Columns only created by activities, extra column needs assignment, outside activity created and grades put through grade book. Copy/paste to Excel for calculations.</td>
<td></td>
</tr>
<tr>
<td>Reports from Student Tracking</td>
<td>Excellent-Each student shows each page and activity they accessed and when.</td>
<td></td>
</tr>
<tr>
<td>Course content migration from WebCT to another LMS.</td>
<td>Software converter does exist, untested--25% of the course.</td>
<td></td>
</tr>
<tr>
<td>Publisher's</td>
<td>No, except for quiz question imports in 12 different formats.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SOFTWARE ADMINISTRATION</strong></th>
<th><strong>Scalability</strong>--how much work to create a course, populate with students, and archive for each semester</th>
<th>PHP/Apache applications like Moodle scale in that adding users, adds more servers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server hardware, database, and operating system.</td>
<td>MySQL or PostgreSQL, Operating System, Apache or Windows Server (IIS),PHP 4.3.x or PHP 5, Linux</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2.4 : Details regarding Blackboard**

<table>
<thead>
<tr>
<th><strong>OVERVIEW</strong></th>
<th><strong>General Appraisal</strong></th>
<th>Commercial, easy to use, but no support from the company. Is buying WebCT and has 80% market share.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td>Philosophy of pedagogy, commerce and support.</td>
<td>Make as much money as possible as fast as possible and eliminate all competition. Encourage relationships with other vendors and products to</td>
</tr>
<tr>
<td></td>
<td>INSTRUCTIONAL TOOLS</td>
<td>be sold a la carte to universities.</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Instructional Tools</td>
<td>Standard Set discussion boards, chatting, quizzes, surveys, grade books.</td>
<td></td>
</tr>
<tr>
<td>Mail</td>
<td>External</td>
<td></td>
</tr>
<tr>
<td>Announcement</td>
<td>Text Block</td>
<td></td>
</tr>
<tr>
<td>File Uploading</td>
<td>Single files, zip files, all web file types.</td>
<td></td>
</tr>
<tr>
<td>Content Sharing</td>
<td>File sharing, SCORM and IMS Content packaging, imports quiz questions.</td>
<td></td>
</tr>
<tr>
<td>Languages</td>
<td>Expensive language packs.</td>
<td></td>
</tr>
<tr>
<td>COURSE MANAGEMENT</td>
<td>Quiz Statistics</td>
<td></td>
</tr>
<tr>
<td>Grade book</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manipulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reports from Student Tracking.</td>
<td>OK--Each student shows each content module page they accessed and the number of postings.</td>
<td></td>
</tr>
<tr>
<td>Course content migration from WebCT to another LMS.</td>
<td>Software converter--25% of the course.</td>
<td></td>
</tr>
<tr>
<td>Publisher’s</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>SOFTWARE ADMINISTRATION</td>
<td>Scalability--how much work to create course, populate with students, and archive for each semester.</td>
<td>Would probably work as well as WebCT.</td>
</tr>
<tr>
<td>Server hardware, database, and operating system.</td>
<td>SQL Server on Windows, Oracle, and MySQL, Apache or IIS, Linux</td>
<td></td>
</tr>
</tbody>
</table>
Table 2.5 : Details regarding WebCT

<table>
<thead>
<tr>
<th>OVERVIEW</th>
<th>General Appraisal</th>
<th>Commercial, difficult navigation, but familiar to us. Good original functionality but no innovation in instructional tools for the past 5 years.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td>Would not have the extra work of course conversions, changing code, and learning a new product. Supports publisher's e-packs.</td>
<td></td>
</tr>
<tr>
<td>Philosophy of pedagogy, commerce and support.</td>
<td>Make a healthy profit, but give technical and pedagogical support, then sell out.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INSTRUCTIONAL TOOLS</th>
<th>Instructional Tools</th>
<th>Standard Set and Standard set plus image database and Equation Editor. The Content Module is good for interspersing texts and quizzes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mail</td>
<td>Internal or external</td>
<td></td>
</tr>
<tr>
<td>Announcement</td>
<td>Text Blocks</td>
<td></td>
</tr>
<tr>
<td>File Uploading</td>
<td>Single files, zip files, all web file types.</td>
<td></td>
</tr>
<tr>
<td>Content Sharing</td>
<td>File sharing, IMS Import --has bugs, but works for content module and quizzes, imports quiz questions. Vista has Learning Object Manager</td>
<td></td>
</tr>
<tr>
<td>Languages</td>
<td>Expensive language packs--not using.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE MANAGEMENT</th>
<th>Quiz Statistics</th>
<th>Item Analysis-standard deviation, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade book</td>
<td>Add extra columns, may put in calculated formula.</td>
<td></td>
</tr>
<tr>
<td>Manipulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reports from Student Tracking</td>
<td>OK--Each student shows each content module page they accessed and number the of postings.</td>
<td></td>
</tr>
<tr>
<td>Course content migration from WebCT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOFTWARE ADMINISTRATION</td>
<td>Scalability—how much work to create course, populate with students, and archive for each semester.</td>
<td>Works well on Linux with the 5,000 courses we put in now.</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Server hardware, database, and operating system.</td>
<td>Not a relational database (unlike most LMSs). Perl and Apache, Linux. WebCT Vista and upgrades will move to Oracle.</td>
</tr>
</tbody>
</table>

2.7.5 The Weaknessess of Moodle, Blackboard and WebCT compared with the system used in this research.

The existing products, namely, Moodle, Blackboard and WebCT observed to have only one basic requirement for online e-learning, which is too general and are concentrated or specific enough to suit the new wave of current educational power and technology. After a thorough revision was made, various weaknesses were found, thus confirming the previous statement regarding the unspecific ties of the three systems, which that will be compared in the following research.

**Overview of Facilities provided by the system**

Moodle, Blackboard and WebCT are online systems that are widely used around the world, crossing multiple continents. For the purpose of this research, the same platform, that is, a web-based server platform, will be used throughout
simulate the differences between each system and to conclude the required addition in improvising the existing systems. However, the study will only be able to focus on the usage and application of the software agent for assessment, which will concentrate only on its application inside secondary school. Specific marking systems to support the assessment will be used and upgraded accordingly from time to time. This key factor will enable educators to follow their students more closely (based on the assessment results) so as to define potential or suitable courses, create specific designs to tackle student strengths and weaknesses, and to possibly create a better open discussion by giving students an instantaneous feedback in accordance with their assessment. This immediate assessment will also assist educators in finding out how effective their lessons and communications were to what degree their students understood and to what extent did the students were able to apply the key concepts. Compared with the existing systems, quizzes and online exercises are provided but the system still cannot sustain the basic need for students to learn and understand without the requirement of face-to-face discussion with their educators.

The application and use of software agents inside e-assessment substantially, improves a student's confidence in the reliability of the assessment and the comparability of the standards. Students are understandably unwilling to recognize any perceived weaknesses, and those they fail to identify are often forced to their attention by questions they feel incapable of answering.
This agent is designed for assessment, and it can access information related to communication issues and related assessments such as answering the questions of the assessment, marking answers, making comments, assessment scores and reports, counter checking and filtering, providing feedback of students’ progress, analyzing students’ answers, assessing results and students’ grading, and showing analysis graphs and mark sheets. The advantages of using the agent in the system are quicker information retrieval increased speed of use, easier access, greater efficiency and most importantly, accurate of data assessment.

**Overview of Message Information**

The existing systems do not provide enough informative messages. When candidates are busy seeking information and using the system, the appearance of informative messages is sometimes important. Examples of these informative messages are message prompts, posting announcement alerts and reminders for students who failed to have a face-to-face meeting with their teacher. The software agents will therefore work on behalf of the coordinator, and they will have the authority and autonomy to interact with the course web server. The message traffic can thus be reduced because the agent also requires the access of course news and announcements posted by the course coordinator. To meet this purpose, specific web interface courses will be developed and conducted for a coordinator to perform the following basic tasks: are entering and updating course presentation information, posting course news and announcements, uploading message, updating information, and even deleting assessment questions or files.
2.8 Summary

The literatures presented in this chapter helped the author find the currently available approaches to presenting the software agent-based approach for supporting assessment in e-learning environments. The literatures regarding current technologies of e-learning are helpful in determining an enhanced approach for online learners to learn via e-assessment using the software agent approach. To some, the current technologies might not be “the very best” method to assist learning. An agent-based approach is highly effective and suitable for improving the development of e-learning based on a student learning style. Also various levels of difficulty might be a good option to help learners use assessment better.
3.0 Introduction

The research methodology should discuss the problems that were anticipated and explain the steps taken to keep them from occurring. The problems that did occur and the ways their impact was minimized should also be discussed. The research methodology was performed from qualitative point of view to understand why people behave as they do and to be familiar with their level of knowledge and with factors such as their attitudes, beliefs, fears. Several steps were taken in this research project to develop guidelines for the proposed software agent. Figure 3.1 illustrates the flow of the research methodology of this project.
Figure 3.1: Research Methodology Flow
3.1 Research Methodology Description

3.1.1 Literature Review

Certain e-learning systems, software agents and e-assessments that are available on the market were reviewed to determine the current features, strengths and weakness of the system. Several steps were taken to achieve the research objectives. The research began by searching and exploring documents related to the research area. All information was collected from the following sources:

i. Journals and online journals.

ii. Articles from the Internet and books.


iv. Conference proceedings.

v. E-learning websites such as those of universities, schools and colleges.

vi. The main library of University of Malay, which provides much valuable information related to the research.

vii. Software agent websites used in universities, businesses and medical establishments.

viii. References of software agent mailing lists and forum communities.

ix. Books about software agents, especially those authored by Jeffey M. Bradshaw.

x. Books about Designing Distributed Learning Environments With Intelligent Software Agents authored by Fuhua Oscar Lin, ed.
The online database of the Institute of Electrical and Electronic Engineers (IEEE) was the main source used for journals, articles and conference proceedings. The literature review mainly covered the following areas: software agent-based, e-learning, e-assessment, e-quiz, e-tutorial and e-learning technologies; software agent architecture; existing e-learning standards; and existing e-learning systems.

3.1.2 Data Gathering

The main goal of the data gathering technique is to collect sufficient, relevant and appropriate data so that a set of complete requirements can be produced. In the data gathering technique, we need to know the goal of the tasks the user normally performs. According to Preece et al. (2002), there are five data-gathering techniques in the requirement study. These techniques are flexible and can be combined and extended in many ways so that the data-gathering technique can be varied and managed to give full leverage to the understanding of different requirements. The techniques are questionnaires, interviews, focus groups and workshops, naturalistic observations and study documentations.

A questionnaire technique was chosen to gather specific data from students and teachers in this research. The data collection included demographic information, satisfaction levels in term of functionality and usability and opinions of the system. Questionnaires are administered on paper, in a structured and semi-structured format. Respondents can choose among a set of forced-
choice or provided responses, including yes/no or scaled responses and questionnaires that are administered in person.

Questionnaires are advantageous for data gathering because they are less time consuming and expensive than other methods, they are easy to use, they can be administered to large groups of individuals and they are effective for assessing program satisfaction. Meanwhile, data entry and analysis are challenging because they are time consuming and it can be difficult to receive the feedback of the completed surveys from stakeholders.

A preliminary survey was distributed to 20 students and 10 teachers at SMK Dato’ Syed Esa, Batu Pahat, Johor in August 2009. The purpose of this survey was to analyze whether the students and teachers were in need of an e-assessment system in their school. The students and teachers participation in the survey had very little experience in online e-assessment before the survey was conducted. The survey respondents were inquired regarding the students and teachers background of e-assessment. Sample questionnaires can be viewed in Appendix B. Figures below summarize responds from some of the preliminary survey questions asked in the survey.

3.1.2.1 Participants Background

Section A of the questionnaire presents the results of the participant background for both the students and teachers.
**Students Background**

Table 3.1 summarizes the result answered by students.

*Table 3.1: Summary of Students Background*

<table>
<thead>
<tr>
<th>No</th>
<th>Questions</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>How frequent do you test yourself?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a.  Never</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>b.  Once in a semester</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>c.  Once in a month</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>d.  Once in a week</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Does the school provide the facilities mentioned below? Please circle at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the appropriate statement.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a.  Provide sufficient computers for students.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>b.  Provide sufficient computers for students to access the internet.</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>c.  Provide wireless Internet Facilities.</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Have you used an e-assessment before this?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a.  Yes</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>b.  No</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>Do you think e-assessment in learning is good for you?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a.  Yes</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>b.  No</td>
<td>0</td>
</tr>
</tbody>
</table>
Based on Question 1, 5 students declared that they made a self-test once in a semester, 12 students declared in once in a week while 3 students declared in once in a week. Based on Question 2, inquires about the facilities provided by the school resulting that 80% students mentioned that the facilities and computers are sufficient to cater students requirement in accessing the internet. This question result was a very good indication for provided the system e-assessment. Based on Question 3, only 8 students have use e-assessment system before Target A System was introduced in the school. So, the remaining 12 students were the first time users of e-assessment. From this question, the result provided a good indication that e-assessment system to be set up for students. This can be additional help for them to using system assessment more easily. Finally, Question 4 all students agreed that the test has helped them to improve their knowledge and making it easier to use.

**Teachers Background**

Table 3.2 summarizes the result answered by teachers.

**Table 3.2: Summary of Teachers Background**

<table>
<thead>
<tr>
<th>No</th>
<th>Questions</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>How many students do you have in a class?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. 20-30 students</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>b. 31-40 students</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>c. 41-50 students</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>d. &gt;50 students</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>How many subjects are you currently teaching?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. 1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>b. 2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>c. 3</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>d. 4</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th>How frequent do you conduct assessment?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Never</td>
<td></td>
</tr>
<tr>
<td>b. Once a month</td>
<td></td>
</tr>
<tr>
<td>c. Once in 3 month</td>
<td></td>
</tr>
<tr>
<td>d. Once in 4 month</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>Have you conducted assessment using computer before?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Yes</td>
<td></td>
</tr>
<tr>
<td>b. No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5</th>
<th>Do you think that e-assessment is helpful?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Yes</td>
<td></td>
</tr>
<tr>
<td>a. No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6</th>
<th>Does your school provide the facilities listed below?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) Computers for students</td>
<td></td>
</tr>
<tr>
<td>( ) Computers with Internet access for students</td>
<td></td>
</tr>
<tr>
<td>( ) Tools to create online tests</td>
<td></td>
</tr>
</tbody>
</table>

Based on Question 1, most of the teachers are responsible for the class of 31-40 students. Question 2 shows that 3 teachers are responsible to teach 2 subjects, 6 teachers have to teach 3 subjects while 1 remaining teacher has to teach 4 subjects. With regards to the frequent conduct of an assessment asked in Question 3, 3 teachers declared that they conducted one assessment in a month.
while 7 teachers did their assessment once in a 4 month. Based on Question 4, 60% teachers have conducted an assessment using a computer system while the remaining 40% of teachers have never involved with computer in assessment system. Based on question 5, majority teachers agreed that e-assessment system is helpful to be used in school. Finally, Question 6 inquires about the facilities provided by the school resulting 80% teachers mentioned that the school provides computers with internet access for students.

As a conclusion, SMK Dato’ Syed Esa students and teachers are ready to use an online assessment in their school. From the preliminary survey distributed also, it can be concluded that, a web-based module easy to build because the computers with internet access has provided.

3.1.3 Capturing System Requirements

In software modeling, it is necessary to first understand what the system is supposed to do. One convenient way of determining the functional requirements for a system is to identify its use cases. Use cases are used during the analysis phase of a project to identify and partition the system’s functionality. This model also serves as the foundation for all other development work. Use cases partition the system into a set of logical, minimally related pieces, each of which describes some ways in which the system will function. There are several advantages to viewing a system in terms of its use cases. These reasons are as follows:
Because there are few connections from one use case to another, each use case can be examined separately. A use case can be understood without having to know all the details of the larger system. In particular, a user can understand the proposed functionality without having to learn about the functionality of other use cases.

- The use cases can be used as the basis for estimating how much time and effort will be needed to design and code the system.

- The system development can be tracked in terms of use cases. That is, managers can follow the progress of each use case as it is designed, coded and tested.

Because use cases can be used to identify the requirements of a system, and because each use case can be examined separately, it has been decided that use cases will be used to capture the system software agent of e-learning. For each module of the system, the use cases will be converted into a list of requirements for that module to be implemented successfully.

3.1.4 Analysis and Design

During the analysis phase, data are collected on available files and decision points and transactions are handled by the present manual system. Interviews, on-site observations and questionnaires were used as tools for system analysis. In the analysis phase, several existing e-learning systems were selected for in-depth study and analysis to identify the advantages and disadvantages of those
systems. In this phase, the software functionality and non-functionality requirements were also analyzed. System analysis also includes the sub-dividing of complex processes involving the entire system, the identification of stored data and manual processes. The results of the analysis phase will be used in next phase which is the design phase.

In general, functional specifications and prototype of the system will be designed in the design phase. It involves the detailed features and operations definition, including data structures and databases, software structure and other documentation (Daniel, 2004). Once system architecture of the project has been designed and verified, it will later be followed by defining and designing the system class diagram. System design is developed properly and well documented so that it can be used on next phase which is coding phase. All procedures and requirements must be analyzed and documented in form of case diagram, sequence diagram and the user interface design.

3.1.5 System Implementation, Testing and Evaluation

System implementation will elaborate the constructed design and translate it into a form that can be used on a computer system. The objective of system implementation is to make sure the new system is available in preparing a set of users. The deployment of the system includes executing all steps necessary to educate users on the new system such as implementing user training and providing user manual’s as guidelines.
The systems implementations used in this research to run the server application is the Apache Xampp component. This application needs to be installed, from a free and open source cross-platform web server package, consisting mainly of the Apache HTTP Server, MySQL database, and interpreters for scripts written in the PHP and Perl programming languages. The database server using (MySQL) controls access on stored data so that multiple users can work with it efficiently. The Apache HTTP Server is an independent platform that can be installed and configured on multiple operating systems. This server is mainly used to execute static and dynamic web pages over the Internet. The static page reads its content off the page itself. Therefore, it does not strictly rely on a web server to show its content. The system also uses the PHP programming language to implement all features previously stated in the analysis phase. PHP is a powerful tool that aims to serve the open source community for the betterment of technology.

System testing is concerned with performing a validation of the implementation, to show if it complies with the original requirements, specifications and design. At this point, all test cases are run to verify the correctness and completeness of the system. A series of system tests need to be performed to ensure that it meets the user’s requirements. Once the coding phase is completed, the system tests are performed. The primary aim of software testing is to examine software modules, software integration, or the entire systems and perform the appropriate corrections of the test’s findings to achieve an acceptable level of software quality. Several types of testing have been performed in this phase, including unit testing, module testing, integration
testing, system testing and security testing. Unit testing has been performed within each module and form involved in the project. Unit testing focuses on logical and functional tests to validate that individual unit of code are working properly. Module testing is a collection of dependent components unit which related components unit. Each module is tested to ensure that the desired functions can run successfully and as expected, and to verify the correctness of the flows of events. However, integration testing was performed during the project to ensure execution in the correct manner. In integration testing, all of the modules are combined and tested as a group. System testing is carried out immediately after the integration testing has been completed. System testing tests the entire system against the functional requirements. Performance testing will be included in the system testing. Security testing ensures that all of the requirements in the access authentication module are implemented correctly.

The purpose of the user evaluation is to gather feedback from the users. Questionnaires are distributed to the users, that is, students and teachers, after the system has been uploaded to the web. The questionnaire focuses on the effectiveness of the Target A System and whether it helped them learn the system better.
3.2 Summary

This chapter discusses the steps taken in conducting the research, including the approaches of the procedures that involved in out the research. Data are gathered from different resources such as electronic journals, articles, reference books, reports and the advice of experienced people investigate subjects such as software agents, e-assessments and e-learning.
CHAPTER 4
REQUIREMENTS ANALYSIS

4.0 Introduction

This chapter looks into the requirements analysis for the Software agent-based approach for supporting e-learning in distributed environments. Requirements analysis is a stage in which all the client requirements are gathered. Requirements analysis is the first technical step in the software process. At this point, a general statement of software scope is refined into a concentrated specification that becomes the foundation for all software engineering activities that follow. Analysis will focus on information, functional and behavioral domains of a problem. It is essential to establish correct requirements and specifications early in the development process to prevent errors in the system.

This chapter elaborates on the system’s requirements which gathered the basis of information provided by users in the form of documents, existing manual system and process specifications and on-site analysis interviews with the end-users. All of these are documented using the use cases that are capable to capture the system functionality from user’s perspective. Based on the list of modules identified in the system, each use case for each module will be converted to list requirements in order to be implemented successfully.
4.1 System Overview

Target A System is an Agent-based approach for supporting assessment in e-learning environments. By fulfilling its mission this system is used for the secondary school. The key players and main actors of the assessment process are students, teacher and Exam Unit teacher who play part as a Coordinator. Student normally will answer assessment in school using traditional method like using a paper but after the development of this system it can assist student in answering every assessment given with a computer. The software agents work on behalf of the teacher and have the authority and autonomy to interact with the course web server. Most of the time, these two actors are geographically and temporally remote from each other, and they use the course website as the online environment for answering assessment. Therefore, the course web server contains a lot of data regarding student’s result, the student’s progress result and assessment analysis.

Software agent can access information related to assessment submission, mark-up progress and student assessment scores. Access information is required in analyzing the conclusions that may be useful for early detection of problems in the assessment process. For this purpose, this system is developed with the agent until to the extent that it can log into the school electronic assessment submission. The agent needs the coordinator’s authorization (user name and password) before logging into the Target A System. The agent can be configured through an agent configuration interface to perform its job on behalf of the coordinator. It can retrieve information of students, result progress of students, grading students percentage point, students ranking in their class,
analysis the result of assessment using graphs, previews report card of the students one by one or overall and send message to students (informative), announcement board, reminder and informative messages with animation.

4.2 General Assumption

The following assumptions have been made in the elicitation of the requirements:

- The users of the Target A System understand well the concept of the system and have read manual given.
- Student and teacher have personal username and password. Students will be answering assessment at the same time with other students. There is no way for more than one user having the same username for using this system.
- The coordinator can upload, update, add and delete questions.
- Student’s record is confidential. They can only check their personal result, while teacher will have the authority to check the result of all students.
- The user on his own must have a web server and database server in his workstation to run the system application as a local host mode.
4.3 User Characteristic

The system’s users here are referred to the students, teachers and coordinator who participated in the Target A System. The user of the system should already know and understand well the concept of using a computer and have a general ideas on how the task is going to be performed. Unit Exam teacher will be working as the coordinator of this system. As a coordinator, they must update the system time by time and check the analysis thoroughly.

4.4 Project Scope

This project is developed using software agent-based for supporting e-learning in distributed environments. The application of software agent provides an electronic assessment for students with the function of easier access towards a more accurate result obtained by teachers and coordinator. The role of agent in this Target A System is the agent can access related assessment such as informative messages (announcement and reminder), marking system, students’ assessment score, evaluation types, feedback of students’ progress, analysis of students’ answer, assessment of result and students’ grading. Software agents also work on behalf of coordinator and have the authority and autonomy to interact with the system.

The system provides informative message prompt (announcement and message) with the use of its animated tools which can make students or teacher understand the system better. So, the active objects in simulations (animation)
are agents. This simulation will give informative message from time to time. Meanwhile, Agent acts on behalf of the coordinator giving reminders for student that is unable to have a face-to-face meeting session with the teacher. It can rapidly assist the assessment requirement that sometimes can be forgotten by students or instructors in arranging meeting or any discussion to improve the assessment or in any case requiring such as conference or meeting.

This system is used by students, teachers and coordinator. The agent needs the students, teachers and coordinator’s authorization (username and password) before logging into the system. Once students have answered the questions, they are able to check their result assessment systematically. Users may also view all their subject progress report. Based on the report displayed, agent will function to change individual marks of student into a grade system. Available marks will be calculated as a whole, then it will be converted into a percentage point of view, and will record the marks achieved by the student. By using this method also, student will be able to know their position or ranking in the class, few seconds after the agents finish with the calculation and conversion of their marks. Within this marking content, agent also functions in stating and displaying comments that are given by the teachers to the overall class.

In the context of eMarksheet, agents will functions as converter, working on changing the mark of each subject into a grading system. Latter, total marks of each individual student will be calculated and converted into a percentage point of view, thus grade and GPP will be calculated. In the end, student’s list will be sorted in accordance with their positioning in the class and also
according to the grade that they received. Agents function in converting or changing the mark of each subject into a graphical point of view. Teachers will therefore be able to analyze the mark of student in an easier manner and this will improve the education as a whole as everything is displayed and viewed simultaneously after each assessment.

4.5 System Constraints

Software agent used in this system has a limited function in performing all goals. Therefore this project will only concentrate on assessment process that considers content-related capabilities and social capabilities, individual assessment process and their results. The assessment contains for all subjects and will be used for Form 1 until Form 3 students.

4.6 Use case Diagram

Use case diagram than can be referred to Appendix A is used to identify the users and functionality of the system. There are three actors which are student, teacher, and coordinator. For each actor, there are few use cases to capture the functional requirement. At first, before users using the system, login is required. Student must sign up to fill up profile. In this system, student can view their profile, vision, announcement, and What Student Do. The main important section/content is that student can conduct online test using computer which is known as e-assessment. After students have completed answering the questions,
the result will be displayed. Based on the result, student will be able to check their progress report and view their analyzed graph.

From the system, teachers are able to view student profile, check the assessment question, view student’s result, mark sheet and graph. All questions are created by teacher and submitted to the coordinator to Upload Question, Add Question, Delete Question, Update Question and Display Question. Graph analysis will be used by the Coordinator in order to perform the head count that will be used for the school. Coordinator has the privilege to manage teachers and student, upload announcement board and change his/her password. Please refer to Appendix A System Analysis for Use Case Diagram and Use Case Description.

4.7 Functional Requirements

Before developing the research, the first idea on conducting e-assessment came during the survey visit to the school, which found out to be that none of the existing system was familiarized enough nor known by all the students. Considering on to improve the ability of the teacher in assessing student progress while reducing their time-consuming effort, this idea of development was discussed between IT’s teacher with the involvement of some actives student. Although it is not an easy work to be started there, but with an advice of some IT professional and lecturers, emphasized on internet notes, example of another system assessment and encyclopedia study, the survey/research began in the required school with its own functional requirement. Functional requirement
is a requirement that describes a function provided by the system. There are 9 modules involved in the functional requirements:

1. Login Module
2. Sign Up Module
3. System View Module
4. e-Assessment Module
5. e-Progress Report Module
7. e-Graph Analysis Module.
8. e-Question Bank Module
9. Head Count Module.
10. Reminder Module.
11. Announcement Board Module.
12. Informative Messages Module.

Below refer to the modules that are used by these 3 actors who are Students, Teachers and Coordinators.

1. Module for students are Student Login Module, Student Sign Up Module, Student System View Module, Student e-Assessment Module, Student e-Progress Report Module, Student e-Graph Analysis Module, Reminder Module, Announcement Board Module and Informative Messages Module.

2. Module for teachers are Teacher Login Module, Teacher System View Module, e-Progress Report Student Module, Mark sheet Student Module,
Student e-Graph Analysis Module, Reminder Module, Announcement Board Module and Informative Messages Module.

3. Module for Coordinators are Coordinator Login Module, e-Question Bank Module, Head count Module, Reminder Module and Announcement Board Module.

4.8 Non-Functional Requirements

a. Maintainability and Expandability

The structure to develop the system shall be easily maintained and can be expanded at any time without affecting the data and information stored.

b. Usability

The system will be developed to satisfy the needs of the different classes of users. The system will be user friendly and easy to navigate. There will also be tools to support different classes of users.

c. Scalability

The system will be configured to allow the addition of web or database servers. It will also be easy to modify the components in order to fix the problem in the system.
d. Performance

As the system will be an online system, it shall provide a response time at a minimum of 3 seconds.

4.9 Summary

This chapter has focused on the design process for Target A System. Apart from it, use cases presented in this chapter guides the author to realize the functional requirements of the system. Next in chapter 5, we will look at the system design of Target A System.
CHAPTER 5
SYSTEM DESIGN

5.0 Introduction

This chapter is intended to look into the design of the software agent of Target A System. The design includes identification and full description of the architectural design which is employed by the system. The chapter will firstly present the architectural design. Then, it will discuss and elaborate the object oriented design of the Target A System. UML sequence and class notations are selected to best describe the design of the Target A System. The sequence diagrams are used to describe most of the system modules. A few of these modules are disclosed in this chapter. Sequence diagrams which are disclosed here structures the main modules in the system as a sequence of interaction. As for the class diagram, it structures the persistent database component which presents the database structure, and discloses the design of all tables, entities, attributes and relationships of the Target A System. It also describes how the Target A System stores data in such a way that shows the interaction between the system and outside entities. In addition, it also summarizes on how the system is divided into smaller portions in highlighting the flow of data among those parts. The last part of this chapter will discusses the user interface (UI) design of key features of the Target A System along with some other key design issues.
5.1 Design Architecture

Since Target A System is a web-based application, it is designed based on client-server architecture. Due to the nature of the application, a client/server architecture seems to be a natural fit. In fact, an e-learning system needs to have a kind of centralized server for course management and authoring, while the clients are heavily distributed. The e-learning service or content can be distributed from a server to more clients through a network through the use of relevant architectures.

Client-server architecture is multi tier architecture which is a software design methodology that uses clients and server components to communicate each other through pre-defined protocols. It happens in which an application is manipulated by multiple discrete software agents. For instance, when a system uses middleware to process data traversing between a user and a database, it makes use of three-tier architecture. The three tier design architecture is the best option here to model the system. That is because in the web development field, three-tier has been always used to reflect websites, electronic commerce applications which are normally built in three tiers. The Target A System’s multi-tier client/server architecture is illustrated in Figure 5.1.

With reference to Figure 5.1, Target A System’s multi-tier client/server architecture consists of four main tiers which are client, front end web server, application server and database server. The client machine is to connect via the internet or intranet to be able to run the Target A System through a web browser. Another three main tiers in the architecture are disclosed below:
1) A front end Web server to display the static content of the Target A System. The Hyper Text Markup Language (HTML) is used here as it is considerably readable by all available browsers in the world. Apache HTTP Server is the web server here to manipulate the hypertext preprocessor language and return static content out of executed dynamic content. The Apache HTTP Server Project is an effort to develop and maintain an open-source HTTP server for modern operating systems including UNIX and Windows NT. The goal of this project is to provide a secure, efficient and extensible server that provides HTTP services in sync with the current HTTP standards.

2) A middle dynamic content processing and generation level Application server, to execute the dynamic part of the Target A System. Personal Home Page (PHP: Hypertext Preprocessor) is a Programming language which is originally intended for generating dynamic web contents. It is responsible to communicate with the front end web server and the back end database server. Hence, PHP is used here as a tool to serve the dynamic content processing. Other languages such as JavaScript and CSS are also used. JavaScript is mainly used for errors handling and CSS is used for the GUI design.

3) A back end database server, including both data sets and the database management system or ADOdb:MySQL software which administrates access to the data of the Target A System. The database serves as a container for the data of the website. All personal details, contacts, profiles, Question Bank and score are to be saved in the database. ADOdb:MySQL software is used to control the database utilization.
To start the process, we put the “ScheduleLife servlet” in the server to accommodate the agent. The servlet will start and initialize execution of the software agent when the server starts and stop the agent when the server shuts down. To facilitate the software agent’s performance in the server, we implemented several Java classes:

- **Schedule Control Class** is the Program code to control the software agent’s life and behavior in carrying out various tasks.
- **Job Listener Class**, which listens to Schedule Control Class, generates an error notification message to report to the system administrator when exceptional events occur.
- **Data Retrieval Class** retrieves all required information at once for the Job Central Processing Class. The information includes students, teachers, the coordinators, assessment, and announcements.
- **Job Central Processing Class**, which is invoked by Schedule Control Class, accepts information provided by Data Retrieval Class. This class
hosts the criteria to generate message alerts to participants, composing messages and sending them to the appropriate recipients when the criteria are met.

The software agent is scheduled to run every day. It sleeps until the current server time meets the scheduled time defined in its configuration file. After it "wakes up," the agent retrieves all necessary data from the system database or from outside sources. In particular, it obtains information about the participants’ (including the course coordinator, teachers, and students) e-mail addresses and their communication preference (when and what types of information). After all information has been prepared, the software agent composes message and sends them to the corresponding participants using the system’s mail server.

5.2 Object Oriented Design

Object-oriented design is typically done after the object-oriented analysis. Therefore, all the object-oriented design diagrams are based on products which have been already identified in the analysis phase. Hence, the products of this chapter include the following activities:

1. Class Diagram
2. Sequence Diagrams
3. User Interface (Page) Design
5.2.1 Class Diagram

In software engineering, the Unified Modeling Language (UML) has been extremely privileged in designing object oriented applications. Class Diagram is known as one of the most commonly used UML model to show all the tables within a system. It is a type of static structure diagram which illustrates the structure of a system by displaying the system's database tables, their entities, attributes, and the relationships between the tables. The class diagram Target A System’s is shown in Figure 5.2.
Figure 5.2: Class Diagram of Target A System
As it is shown in the figure above, the Class Diagram of the Target A System is composed of fourteen (15) tables. The primary key of each table is shown in bold case character and located on the first key at the top position of the table. All other bold case keys within a table represent foreign keys to primary keys from other tables. The descriptions of all tables are as follows:

1) Student table, which stores students profiles that is needed for system login procedures. The site authenticates users in the login page by checking whether or not they are stored in this table.
   ➢ Primary key: Student ID (Studentid)
   ➢ Foreign keys: None

2) Teacher Table, which stores the username and password that is needed for system login procedures. The site authenticates users in the login page by checking whether or not they are stored in this table.
   ➢ Primary key: TeacherID (Teacherid)
   ➢ Foreign keys: None

3) Coordinator Table, which stores the username and password that is needed for system login procedures. The site authenticates users in the login page by checking whether or not they are stored in this table.
   ➢ Primary key: CoordinatorID (Coordinatorid)
   ➢ Foreign keys: None

4) Assessment table, which stores assessment documentation by registered users. The table stores all directory form, class, subject and Assessment type.
 Primary key: Assessment ID (Assessmentid)
  Foreign keys: Student ID (Studentid), Teacher ID (Teacherid), Coordinator ID (Coordinatorid)

5) Form table, which stores all type of form provided in this system.
  Primary key: Form ID (Formid)
  Foreign keys: Assessment ID (Assessmentid)

6) Class table, which stores all classes based on the form provided in this system.
  Primary key: Class ID (Classid)
  Foreign keys: Assessment ID (Assessmentid)

7) Subject table, which stores all subjects based on class and form provided in this system.
  Primary key: Subject ID (Subjectid)
  Foreign keys: Assessment ID (Assessmentid)

8) Question table, which stores all questions provided in this system. The questions will appear when user has selected the form, class, subject and assessment type.
  Primary key: Question ID (Questionid)
  Foreign keys: Assessment ID (Assessmentid)

9) Result Assessment table, which stores the result of questions answered by students. From this table, once students answer the self-selected questions, result will be calculated or marked up automatically for them.
  Primary key: Result Assessment ID (ResultAssessmentid)

1) Foreign keys: Question ID (Questionid)

10) ReportCard table, which stores all important documentations needed in the report card. Based on this report card, student, teacher and coordinator will be able to have a view on it or print it for their references.

   - Primary key: Report Card ID (ReportCardid)
   - Foreign keys: ResultAssessmentid, Studentid, Teacherid and Coordinatorid.

11) MarkSheet table, which stores all important documentations required in the marking sheet. Mark sheet can only be viewed by teacher and coordinator. They may also print it for their references.

   - Primary key: Mark Sheet ID (MarkSheetid)
   - Foreign keys: ResultAssessmentid, Teacherid and Coordinatorid.

12) GraphAnalysis table, which stores data analysis files. The data analysis will be presented on the graph.

   - Primary key: Graph Analysis ID (Graphid)
   - Foreign keys: ResultAssessmentid, Studentid, Teacherid and Coordinatorid.

13) AnnouncementBoard table, which stores announcement details provided by teacher and administer.

   - Primary key: Announcement ID (Announcementid)
   - Foreign keys: Coordinator ID (Coordinatorid)
14) ContactUs table, which stores contact number profiles for this system.

- Primary key: Contact ID (Contactid)
- Foreign keys: None

15) Reminder table, which stores reminder details provided by teacher and administer.

- Primary key: Reminder ID (Reminderid)
- Foreign keys: Coordinator ID (Coordinatorid)

### 5.3 Sequence Diagram

Sequence diagram illustrates the dynamic side of the Target A System. In the following, a few of the Target A System’s sequence diagrams are shown while the remaining of the sequence diagrams can be referred to Appendix A.
5.3.1 **Sequence Diagram for Login to System**

1. Every time a participant login to the system, the system verifies the user information via the username and user password.

2. Client verifies the user to the web server.

3. Web server retrieves the username and password from the database and displays it back to the client.

4. Client display requirement information to the participant.

5. If the entered user information is valid then load content page process is called.

6. If the information entered is not valid, system will therefore request the user to re-enter the username and password.

![Sequence Diagram for Login to System](image)

**Figure 5.3: Sequence Diagram for Login to System**
5.3.2 **Sequence Diagram for Sign Up into the System**

1. Student will have to sign up designated form to register as new user through the sign up interface.

2. Client submits the application information to the web server.

3. Web server stores the registered information in the database.

4. If record is found, the system will request the user to enter another username.

   If user name cannot be found, the system saves the new entered username and Pass word.

5. Student can edit their profile also through the sign up interface.

6. Client will then submits the edited profile information to the web server.

7. Web server confirms the stored application information to the client.

8. Client displays the confirmation status to the student.

9. The Student can view their new profile after it is edited.
Figure 5.4: Sequence Diagram for Sign Up to System
5.3.3 Sequence Diagram for View to System

1. Participant selects a requirement to view through the view interface browser.
2. Client submits the requirement information to the web server.
3. Web server retrieves the requirement information from the database.
4. Web server displays the requirement details to the client.
5. Participant view the requirement details.

![Sequence Diagram for View to System](image)

Figure 5.5: Sequence Diagram for View to System
5.3.4 Sequence Diagram for Answer and Check Result Assessment

1. Students select assessment view through the view assessment interface browser.
2. Client submits the requirement information to the web server.
3. Web server retrieves the requirement information from the database.
4. Web server displays the assessment to the client.
5. Students view questions of assessment.
6. From the selected assessment interface, students answer an assessment.
7. Client submits the student answer to the web server.
8. Web server stored the answer to the databases.
9. Students check the result of assessment through the view of assessment interface browser.
10. Client submits required information to the web server.
11. Web server checks the answer by retrieving required information from the database.
12. Web server displays the result of questions to the client.
13. Students view their results.
Figure 5.6: Sequence Diagram for Answer and Check Result Assessment
5.3.5 Sequence Diagram for Add/Update/Delete Question of Assessment

1. Coordinator add question through the upload assessment interface.
2. Client submits the new questions to the web server.
3. Web server stores the new questions in the database.
4. Web server displays the new question to the client.
5. Coordinator/Participant view the new questions.
6. Coordinator updates the question to the client uploading assessment interface.
7. Client submits the updated questions to the web server.
8. Web server stores the update question in the database.
9. Web server displays the update questions to the client.
10. Coordinator/Participant view the update questions.
11. Participant chooses to delete a requirement through the client by the uploaded assessment interface.
12. Client submits the deleted questions to the web server.
13. Web server confirms the deletion process and updates the list of the requirements in the database.
14. Web server displays the confirmation status to the client.
15. Coordinator/Participant view the delete questions.
Figure 5.7: Sequence Diagram for Add/Update/Delete Question of Assessment
5.3.6 Sequence Diagram for View & Print e-Progress Report

1. Participant selects a requirement to view through the e-Progress Report Interface browser.

2. Client submits the required information to the web server.

3. Web server retrieves the required information from the database.

4. Web server displays the required information to the client.

5. Participant view required information of progress report.

6. Participants print the requirement through the e-Progress Report Interface browser.

7. Client submits the required information to the web server.

8. Web server retrieves the required information from the database.


10. Participant get the e-progress report data printed.
Figure 5.8: Sequence Diagram for View & Print e-Progress Report
5.3.7 **Sequence Diagram for View & Print e-Mark sheet**

1. Teacher/Coordinator selects a requirement to view through the e-Mark sheet Interface browser.

2. Client submits the required information to the web server.

3. Web server retrieves the required information from the database.

4. Web server views the requirement details to the client.

5. Teacher/Coordinator views the required information of the mark sheet.

6. Participants print the requirement through the e-Mark sheet Interface browser.

7. Client submits the required information to the web server.

8. Web server retrieves the required information from the database.

9. Web server prints the required details of e-Mark sheet to the client.

10. Teacher/Coordinator gets the e-progress report data printed.
Figure 5.9: Sequence Diagram for View & Print e-Mark sheet
5.3.8 Sequence Diagram for View & Print e-Graph Analysis

1. Teacher/Coordinator selects a requirement to view through the e-Graph Analysis Interface browser.

2. Client submits the required information to the web server.

3. Web server retrieves the required information from the database.

4. Web server displays the requirement details to the client.

5. Teacher/Coordinator views the required information of the graph analysis.

6. Participants print the requirement through the e-Graph Analysis Interface browser.

7. Client submits the required information to the web server.

8. Web server retrieves the required information from the database.

9. Web server prints the requirement details of e-Graph Analysis to the client.

10. Teacher/Coordinator gets the e-Graph Analysis data printed.
Figure 5.10: Sequence Diagram for View & Print e-Graph Analysis
5.3.9 Sequence Diagram for View Announcement Board

1. Participant selects the announcement to view through the Announcement Board interface browser.

2. Client submits the requirement of announcement to the web server.

3. Web server retrieves the data announcement from the database.

4. Web server displays the announcement details to the client through announcement board.

5. Participant view the announcement details.

Figure 5.11: Sequence Diagram for View Announcement Board
5.3.10 Sequence Diagram for Add/Update/Delete Announcement Board

1. Coordinator add announcement through the upload announcement board interface.

2. Client submits the new announcements to the web server.

3. Web server stores the new announcements in the database.

4. Web server displays the new announcements to the client.

5. Coordinator/ Participant view the new announcements.

6. Coordinator updates the announcements to the client by the upload announcements board interface.

7. Client submits the updated announcements to the web server.

8. Web server stores the update announcements in the database.

9. Web server displays the update announcements to the client.

10. Coordinator/ Participant view the update announcements.

11. Participant chooses to delete a requirement through the client by the uploaded announcement board interface.

12. Client submits the deleted announcements to the web server.

13. Web server confirms the deletion process and updates the list of the requirements in the database.

14. Web server displays the confirmation status to the client.

15. Coordinator/ Participant view the delete announcements.
Figure 5.12: Sequence Diagram for Add/Update/Delete Announcement Board
5.3.11 Sequence Diagram for View Reminder

1. Students/teachers login to the system, the system verifies the user information such as user name and password.

2. Agent will show reminder to the students who fail in assessment test automatically after student login and reminder for teacher after login. This reminder function will give alert and can avoid student or teacher from forgetting important things. (example session face-to-face sessions meeting).

3. Web server retrieves the data reminder from the database.

4. Web server displays the reminder details to the client through announcement board.

5. Students/teachers view the announcement details.

![Sequence Diagram for View Reminder](image)

Figure 5.13: Sequence Diagram for View Reminder
5.3.12 Sequence Diagram for Add/Update/Delete Reminder

1. Coordinator add reminder through the upload reminder interface.

2. Client submits the new reminder to the web server.

3. Web server stores the new reminder in the database.

4. Web server displays the new reminder to the client.

5. Coordinator/ Participant view the new reminder.

6. Coordinator updates the reminder to the client by the upload reminder interface.

7. Client submits the updated reminder to the web server

8. Web server stores the update reminder in the database.

9. Web server displays the update reminder to the client.

10. Coordinator/ Participant view the update reminder.

11. Participant chooses to delete a requirement through the client by the uploaded reminder interface.

12. Client submits the deleted reminder to the web server.

13. Web server confirms the deletion process and updates the list of the reminder in the database.

14. Web server displays the confirmation status to the client.

15. Coordinator/ Participant view the delete reminder.
Figure 5.14: Sequence Diagram for Add/Update/Delete Reminder
5.3.13 Sequence Diagram for Informative Messages

1. Participant selects the requirement/animation of agent to be viewed through any interface browser.
2. Client submits the requirement/animation of agent to the web server.
3. Web server retrieves the data requirement/animation of agent from the database.
4. Web server displays the informative messages to the client through interface.
5. Participant view the informative messages.

![Sequence Diagram for View Informative Messages](image)

Figure 5.15: Sequence Diagram for View Informative Messages
5.4 The User Interface (UI) Design of key pages

This section discusses the page layout design of some key pages of the Target A System. The page layout design here represents the final blueprints of the Target A System pages which are used for the implementation and execution phase. There are no CSS or colors applied into the page design of the blue prints. Because it is meant for the purpose of facilitating the developer to produce more accurate HTML colored page design which applies CSS into the layout. This section is considered as an important prerequisite criterion for the execution and implementation phase of the Target A System since it is completely used to produce the real screenshots of the Target A System. The blue prints of all key pages of the Target A System are presented here except the visualization pages since they are dynamically changed from a shape to another. Therefore, the visualization pages can be shown in the implementation and execution phase.
5.4.1 Login Page

The login page is where the user (coordinators, teachers and students) keys in the username and the password to get into the site home page. Students, teachers, coordinators have their own login information with a designated password, which can be changed in future in when necessary. The extension that the agent will offer is the ability to log into the research system (assessment). Figure 5.11 shows the website login page.

![Login Page Diagram](image-url)
5.4.2 Sign Up Page

The Sign Up page is where students register their information into the system. The data input includes name, IC, address, gender, age, email, username, password and password confirmation. Once student has done inserting their full information, they will have to click the ‘create account’ button. Data input by student are saved. If student click cancel button, data input will be emptied again. Figure 5.12 shows the sign up page.

![Sign Up Page Layout](image-url)
### 5.4.3 Student Home Page

Student home pages are created with graphical user interface. The arrangement of the home page is balanced and easy to understand. All pages can be accessed just by clicking the button on the left and above of the home page. The active objects/animation in simulations are agents. This simulation will give informative message from time to time. Another participant homepage have a same design with student homepage. Figure 5.13 shows the student home page.
5.4.4 Reminders For Students That Failed to Have a Face-to-face Sessions Meeting.

The software agent has to access course presentation information including the schedule of face-to-face sessions. Agent acts as on behalf of the coordinator giving reminders for student that are unable to have face-to-face meeting sessions with the teacher.
5.4.5 Student Announcement Board

The agent also needs to access course news and announcements posted by course coordinator. Web interface course will be developed and conducted for coordinator in order to post more course news and announcements from time to time.

![Diagram of Student Home Page Layout]
5.4.6 Student View Assessment

This page does only provide information of eAssessment using in this system.

Figure 5.21 shows student view assessment layout.
5.4.7 Student Choose Assessment

These pages are opened before students answer the questions of assessment. The student must click the button of eAssessment. Under the form provided, simulations agents give an informative message to select the form, class, subject also and assessment. After the form is completed, the student must click submit button. So the questions of assessment are opened to be answered. Figure 5.22 shows student choose assessment layout.
5.4.8 Student Answer Assessment

From the assessment chosen by the student, the answer must be completed before they submit with the button. All questions are objective, thus student will just need to click the suitable answer for all questions to complete the assessment.
5.4.9 Student Result Assessment

This page shows the result of students automatically after the answer submitted. The result is shown with their score and level of answer. Agent will generate the mark of questions to score (percentage) and level (A, B, C, D or E). From this page, the student will get their result faster and easier.

![Diagram of Student Result Assessment Layout]
5.4.10 Coordinator Upload Assessment

The main coordinator’s tasks are to upload, update and delete the questions. So, this page can be accessed only by the coordinator. First the coordinator must select the file to be uploaded and later to select the place of the question to be uploaded or replaced. The software agents will work on behalf of coordinator and have the authority and autonomy to interact with the course web server. The course web will be interfaced for the coordinator to perform the following tasks. Coordinator just have to selects the file to be uploaded and click the submit button. Review button is always available in order to double check list of files that have been uploaded. All information is stored inside the server’s database, which will be assessed by software agents in order to perform its duties. Figure 5.25 shows the layout of coordinator upload assessment.
5.4.11 Coordinator Update Assessment

The software agents also work on behalf of coordinator and have the authority and autonomy to interact with the course web server. The course web is interfaced for the coordinator to perform the following tasks. Coordinator must select the file to update and after that select to review the question. On completion of reviewing and updating the submit button will be clicked, thus the questions are updated. All the information is stored in the server’s database, which software agent can access to perform its duties. Figure 5.26 shows the layout of coordinator update assessment.

![Coordinator Update Assessment Layout](image-url)
5.4.12 Coordinator Delete Assessment

The software agents also work on behalf of coordinator and have the authority and autonomy to interact with the course web server. The course web interfaced for the coordinator to perform the following tasks. Coordinator must select the file to delete and after that review the question. Once reviewing and deletion done, the submit button will be clicked. Then, questions are deleted. All information is stored in the server’s database, which software agent can access to perform its duties. Figure 5.27 shows the layout of coordinator delete assessment.
5.4.13 Teacher and Coordinator View eProgress Report

This page shows that eProgress Report is divided by 3 main reports, which are eReportCard Individual, eMarksheet and eGraph Analysis. Only teacher and coordinator are able to view this page for their references. Students can only view their own or individual report card and will not be able to see others.
5.4.14 Teacher and Coordinator Choose eReportCard Individual

In order to check and print student individual result, teacher or coordinator must select the Form forwarded by the Class and Assessment.
5.4.15 Report of eReportCard Individual

Once the View button is clicked, a report card will appear which shows the individual result of all students. Base on report displayed, agent will function to change individual marks of student into a grade system. Available marks will be calculated as a whole, then it will be converted into a percentage point of view, and will record the marks achieved by student. By this method also, student will be able to know their position or ranking in the class simply within a few seconds after the agents finish with the calculation and conversion of their marks. Within this marking context, the agent also functions in stating and displaying comments that given by teachers to the overall class. Based on this report, teacher or coordinator may print this page as their reference.

<table>
<thead>
<tr>
<th>No</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Mark</th>
<th>Grade</th>
</tr>
</thead>
</table>

Register Subject :
Result :
Score :
Percentage :
Place in the Class :

Form Teacher

Signature of Form Teacher  Signature of Principle  Signature Of Guardian
5.4.16 Teacher and Coordinator Choose eMarksheet

For checking and printing an eMarksheet of student, teacher or coordinator must select Form continued/forwarded by the Class and Assessment.
5.5.17 Report of eMarksheet

Once the View Mark sheet button is clicked, the mark sheet will appear which shows the result of all students. In the context of eMarksheet, agents will function as converter, working on changing the mark of each subject into a grading system. Latter, total marks for each individual student will be calculated and converted into a percentage point of view, thus grade and GPP will be calculated. In the end, the student will be constructed/shuffled in accordance with their positioning in the class, according also to the grade that they received. From this report, teacher or coordinator can print it as their references.
Figure 5.32: Marksheet Print of eSheet Layout

<table>
<thead>
<tr>
<th>SCHOOL :</th>
<th>FORM :</th>
<th>FORM TEACHER :</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NAME</td>
<td>SUBJECT</td>
</tr>
</tbody>
</table>

DATA
5.4.18 Teacher and Coordinator Choose eGraph Analysis

For checking and printing of an eGraph Analysis of student, teacher or coordinator must select Form submitted by Class and Assessment.
5.4.19 Report of eGraph Analysis

Once the View Graph button is clicked, the graph analysis will appear which shows the result subjects for all students based on assessment. Teachers and coordinator will be able to view this graph analysis on each subject result obtained by the student, according to the Assessment conducted from time to time. Here, Agents functions in converting or changing the mark of each subject into a graphical point of view. Teachers will therefore be able to analysis the mark of student in an easier manner, and this will help the education as the whole to improve faster as everything is displayed and viewed simultaneously after each assessment. Figure 5.34, teacher or coordinator can also print it as their reference.

Figure 5.34: eGraph Analysis
5.5 Structure Chart

Figure 5.35: Structure Chart of Target A System
5.6 Target A System Design Issues

There are three issues which concern the design of the Target A System. The following subsections briefly present these design issues.

5.6.1 Target A System Session Control

For anybody to participate in the Target A System sessions, he or she must login first using his username and password. This will help the owner in order to have a secure password and at the same time coordinators are able to know the number of members who is currently logged in and the number of their participation in the Target A session.

5.6.2 Security, Privacy and Anonymity of Target A System

The entire participant’s personal information is confidentially treated and kept. That is why the coordinator must be honest and able to keep all the group’s secret including that of the members.

Member’s information is stored in the database and only the username of the member is going to be displayed in association with his/her message so that the member can be identified and replied accordingly.
5.6.3 Accountability and Information Sharing

Sharing information in one of the specialties of Target A System as it allows members to distribute, send and share information among themselves. However, members must be accountable for all what they share and send as they can easily be identified by their username. Moreover, this does not imply that the discussion and information sharing is abandoned randomly without keeping a close watch on them.

5.7 Summary

This chapter has focused and shown the simplicity of the applications in the design process for Target A System, such as the architectural design, the ER diagram to identify the database, the activity diagram to identify the main flow for the whole system, the object oriented sequence diagrams and Storyboard written for the subsystems clearly projected the interface design of Target A System. Design issues were lastly discussed at the end of the chapter. The next chapter will concentrate on representing the implementation and execution of the Target A System.
6.0 Introduction

This chapter describes the implementation and execution process of the Target A System. The first section will describe the development of the environment. After that, this chapter will be presenting the details of the implementation process. The execution procedures describe how projects are initiated and customized also how participants are being created in all available means such as through the registration or invitation modules. Important screenshots taken during the development will be incorporated to demonstrate the implementation process. The visualizations of the Target A System are also present. This chapter will also provides the graphical user interface (GUI) of the implemented Target A System in order to show how the real pages of all previously analyzed modules appear.

6.1 Implementation Tools

The Target A System development is divided into six distinct stages via various tools, as summarized in Table 6.1 below.
Table 6.1: Development tools

<table>
<thead>
<tr>
<th>No</th>
<th>Development Stage</th>
<th>Development Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Storyboard Writing</td>
<td>Microsoft Power Point 2007</td>
</tr>
<tr>
<td>2</td>
<td>Storyboard Review</td>
<td>Microsoft Words 2007</td>
</tr>
<tr>
<td>3</td>
<td>Graphic elements creation</td>
<td>Adobe Photoshop CS2</td>
</tr>
<tr>
<td>4</td>
<td>Multimedia lesson development</td>
<td>Flash 8</td>
</tr>
<tr>
<td>5</td>
<td>Web-based system development</td>
<td>- XAMMP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Dreamweaver MX 2004 &amp; PHP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- MySQL using PHPMyAdmin</td>
</tr>
<tr>
<td>6</td>
<td>System Integration and uploading to</td>
<td>Internet connection</td>
</tr>
<tr>
<td></td>
<td>server</td>
<td></td>
</tr>
</tbody>
</table>

6.2 Implementation Environment

The main goals of this section are to make sure that the system meets all gathered and stated requirements in the initial stages of the Target A System life cycle and to ensure system success. The system can only run on windows operating systems. The system is based on multi-user web-based technology which runs on two compatible servers which are front-end and back end server. The front-end server is the well known as Apache web-server and the back-end server known as the MySQL database server. The application is developed using multiple set of tools that are combined each other, serving one purpose. The main tool used in the development process is PHP. Other tools such as the Hyper Text Markup Language (HTML), Cascading Style Sheet (CSS) and JavaScript are also used. The following sub section discusses about the technologies used to develop the Target A System.
6.2.1 The World Wide Web

This Target A System runs on the World Wide Web (WWW) and has reserved the domain name (http://www.targetA.com) in the Internet which is the implementation of the World Wide Web. It is a worldwide collection of network that links together with millions of businesses, government agencies, educational institutions as well as people. The World Wide Web is primarily used as a medium to collect, distribute and share data and worldwide information worldwide. In order to facilitate that the Target A System has been developed to sustain these advantages as well.

6.2.2 Xampp

Xampp is a free and open source cross-platform web server package, consisting mainly of the Apache HTTP Server, MySQL database, and interpreters for scripts written in the PHP and Perl programming languages. The program is released under the terms of the GNU General Public License and acts as a free web server capable of serving dynamic pages. XAMPP is available for Microsoft Windows, Linux, Solaris, and Mac OS X, and is mainly used for web development projects.

Officially, XAMPP's designers intended to use it for only as a development tool to allow website designers and programmers to test their work on their own computers without any access to the Internet. In order to make this as easy as possible, many important security features are disabled by default. In practice, however, XAMPP is sometimes used to actually serve the web pages
on the World Wide Web. A special tool is provided to password-protect the most important parts of the package. XAMPP also provides support for creating and manipulating databases in MySQL and SQLite among others.

6.2.3 MySQL Database Server

The Target A System is a web-based application with dynamic information creation, sharing and storing capabilities. A database allows users to remotely store, search, sort, retrieve and manipulate data. The Target A System uses the MySQL database as a container to store all data processed by the system. The database server (MySQL) controls access to the data it stores so that multiple users can work with it efficiently. This method is called concurrent database manipulation. It allows fast access to the data it stores and provides solid authentication procedures to validate authorized users against any type of data access.

6.2.4 Apache HTTP Web-Server

According to Apache organization, the Apache HTTP Server Project is an effort to develop and maintain an open-source HTTP server for modern operating systems including UNIX and Windows NT. The goal of this project is to provide a secure, efficient and extensible server that provides HTTP services in sync with the current HTTP standards. Apache has been the most popular web server on the Internet since April 1996 (http://httpd.apache.org/). The Apache HTIP Server
is an independent platform which can be installed and configured on multiple operating systems. It is mainly used to execute static and dynamic web pages over the internet. The static page reads its content of the page itself. Therefore, it does not severely rely on a web server to show its content for examples such as pages with HTML file extensions like “home.html”. On the other side, the dynamic page needs a web server to be able to display its content as the content of the dynamic page is taken from a database that the page is connected to. The web server handles the connection between the dynamic page and the database which holds the content of the dynamic page. The examples of dynamic page are those pages with PHP file extension. PHP files best work with MYSQL database. The Apache executes the PHP file requests and turns them to the browser into web pages. The next two sections highlight the PHP and HTML files in brief.

The Target A system is a web-based application as mentioned earlier, which makes use of the Apache web server features to do the job of manipulating the content of Target A system pages. The PHP is also considered as a programming language tool which is used as a language interface between the Apache and the MYSQL web server.

6.2.5 PHP

The Target A System uses PHP programming language to implement all features previously stated in the analysis phase. PHP is a powerful tool aims to serve the open source community to the betterment and towards a lot of improvement on.
technology. PHP is highly taking the advantage of being an open source tool where millions of worldwide developers write codes every hour making it borderless and extremely helpful. PHP code is everywhere on the planet. PHP is a server-side scripting language intended specially for developing dynamic web contents.

Browsers such as Firefox and Internet Explorer are considered as a displaying tool that is used to display HTML. Browsers read static pages such as HTML files. They do not simply read files written in un-interpreted languages such as the PHP files. Therefore, the PHP file codes are interpreted first at the web server which converts those PHP files into HTML pages that the browser can display and users can read. PHP has many supporting advantages over other scripting languages for the reasons why it has been selected as the de-facto programming language for this application. These advantages include the following:

- Platform independent, where it can run on many different operating systems such as Linux, Windows, etc.
- Database independent, where it can be connected to many different types of database containers and versions
- High Performance.
- Readymade class libraries for many ordinary web features;
- Cost free;
- Easy to use and to understand;
- Portability and reliability.
- Support Availability.
6.2.6 Hypertext Markup Language (HTML)

HTML on the other side is a hypertext markup language that any World Wide Web page is merely made of. The browser display functionality itself as it is totally dependent on HTML in many aspects. First, the browser does only display what HTML has sent over the web server after processing such a dynamic language like PHP. Second, all different available dynamic programming languages are mainly executed in the web server to produce HTML pages that can be displayed by the browser on the client machine. Therefore, it is the language that can be executed and read by all web browsers. World Wide Web contents that can be seen by internet browser are actually made of HTML pages. Third, the layout and design structure of a web page document are defined by HTML codes using multiple sets of tags and attributes. For instance, displaying a table in a web browser can be done using the following HTML tags: (<table></table>). At last, since HTML is read by all browsers, the Target A system structures the basic layout and designs of all of its webpage documents using HTML.

6.2.7 JavaScript

JavaScript is a programming language commonly used for client-side web development. It is a powerful, daily updated, prototype-based programming language with premium class functions. JavaScript is used by many programming languages and can easily be built into web browsers to allow user interactivity with the website. In fact, this is the primary use of JavaScript which
is to allow writing codes (e.g.: Functions & Classes) which can be embedded in HTML web document as well as included in it to interact with the user through manipulating the Document Object Model (DOM) of the HTML page. The examples of such usage are as follows:

1. Opening a new pop up window that is completely controlled by setting the window size, position, and all other attributes. New pop-up window can be used as an error handling for HTM forms.

2. Validation of HTML input values of the web form to ensure that they are safe values before they are sent over or submitted to the database server.

3. Changing colors as the mouse pointer moves over buttons or links. This effect is normally used to draw the user's attention to the location of the mouse cursor or where the user is pointing at.

Therefore, JavaScript can be used to directly manipulate forms and images within HTML web document. JavaScript runs locally on the user’s machine. Therefore, it can respond to user actions faster than any other programming languages such as PHP and ASP, where they respond to user’s action through a remote server causing little delay for processing these actions. Hence, using JavaScript in an application would make it feels more responsive and thus it is used in the Target A system.
6.2.8 Cascading Style Sheets (CSS)

Cascading Style Sheets (CSS) can be simply defined as a simple mechanism for creating style (e.g. fonts, colors, spacing) to HTML Web documents. In web development generally, it can be defined as a style sheet language which is used to describe the presentation layout of a web document written in a markup language such as HTML, XHTML. The Target A system uses CSS to style the layout design of all the web pages and to define the color, fonts and all other attributes of all web documents of the system.

6.2.9 Web Browser

According to northeastwebdesign.com (2001), a web browser is a software application which allows a user to interact with text, images, audios, videos and any other information which are typically located on a Web page at a Web site on the World Wide Web or a local area network. Text and images on a Web page document may contain hyperlinks to Web pages within the same website or other different Web sites. Web browsers enable a user to access content of websites by traversing their directing hyperlinks. Web browsers format HTML tags and attributes for layout display. Therefore, the appearance of a Web page may differ from browser to another.

Web browsers are mostly used with HTTP user agent type. They are typically used to access the World Wide Web by communicating with Web servers using the HTTP protocol to fetch web pages. However, they can also be
used to access information content provided by Web servers in private networks or file systems.

The most currently web browsers in use are the Microsoft Internet Explorer and the open source Mozilla Firefox. The Target A system fully supports the use of Mozilla Firefox in the first place. Internet Explorer 6.0 and above as well as other browsers such as, Opera and Safari are also supported by the application. However, there are slight differences in the website CSS layout appearances among them especially in the visualization module.

6.2.10 Ajax

Ajax as it is called now or AJAX with all letters in caps case as it was used to be called when it was first invented, which is an abbreviation of the term (Asynchronous JavaScript and XML). It is defined as a group of interconnected web development techniques which is used to produce interactive web applications or rich Internet applications. Ajax powers web applications up to processing data from the server asynchronously behind the scene without interfering with the HTML layout display or the behavior of the processed page. It is intended to make web pages feel more responsive by exchanging data with the server in the background, so that the entire web page does not have to reload each time the user triggers a query or submit a change. This technique has led to an increment of the interactive animations on web pages because animation typically takes high load on the server, causing a slower response due to its size.
It is obviously remarkable that the smaller the size of web page, the faster the loading will be then it is sent through the browser to be displayed. Hence, using Ajax to retrieve a web page data can save on the server side load’s consumption. Ajax uses the XML HttpRequest object to retrieve a web page data from the server. There are other ways to retrieve a web page data from the server by the use of Remote Scripting languages in browsers that do not support the Ajax defaulted object.

The Target A system uses Ajax in the visualization module to retrieve data asynchronously in a dynamic manner. Ajax was implemented only in the visualization module because there are quite a number of math calculations and images rendering to display in a web page that may go for thousands of stakeholder negotiations. The use of this technique allows making multiple calls to the server without refreshing the web documents.

6.3 System Implementation

In order to make the whole concept clear, there is a need of clarification view on the design, specification and the layout of the project. Thus, this section is therefore dedicated to give a better and clearer view on the project in hand by presenting the GUI of the real project followed by a detailed explanation of each step. It explains the sequence of the project process beginning from login page up to the visualization page, thereby creating conducive atmosphere for the user to comprehend and understand the nature of the process of the project and explaining the usage of software agent in this system.
6.3.1 Login Page

The agent needs the coordinator’s, teachers and students authorization (username and password) before logging into the system. Students, teachers, coordinators have their own login information with a designated password which can be changed in future when necessary. The extension that the agent will offer is the ability to log into the research system (assessment) which can interact with the system itself in order to obtain necessary information and filter the information and then send e-mails to course coordinator to report its findings.

![Login Page](image)

**Figure 6.1: Login Page**
6.3.2 Sign Up Page

As for the new users of the system, a registration space is created for them (below the sign up page column). The data required to be filled in including name, ic (identification number), address, gender, age, email, username, password and confirm password. Once student completed inserting their full information, they will have to click the ‘create account’ button. The data filled in by the student are saved. If student click cancel button, data input will be emptied again. Figure 6.2 shows the sign up page.

![Sign Up Page](image_url)

Figure 6.2: Sign Up Page
6.3.3 Student Home Page

After logging in, the user homepage will appear and the member will face by three main features here. On the left side of the page, there are the total number of the projects (groups) that are currently active, while on top right of the right hand side, there is a banner of the system. On the centre right hand side of the figure is a space content of system. The active objects in simulations (animation) are the agents. This simulation will give informative message from time to time. Figure 6.3 shows the student home page.

![Figure 6.3: Student Home Page](image-url)
6.3.4 Reminders for Students that Failed to Have a Face-to-face Sessions Meeting.

The software agent has to access course presentation information including the schedule of face-to-face sessions. Agent acts as on behalf of the coordinator giving reminders for students that are unable to have a face-to-face meeting sessions with the teacher.

Figure 6.4: Reminders for Students that Failed to Have a Face-to-face Sessions Meeting
6.3.5 Student Announcement Board

The agent also needs to access course news and announcements posted by course coordinator. Web interface course will be developed and conducted for coordinator in order to post more course news and announcements from time to time.

Figure 6.5: Student Announcement Board
6.3.6 Student View Assessment

This page does only provide information of eAssessment used in this system.

Figure 6.6 shows student view assessment.

![Student View Assessment](image)

*Figure 6.6: Student View Assessment*
6.3.7 **Student Choose Assessment**

These pages must be opened by the student before answering assessment questions. The student therefore must click the eAssessment button. Simulations Agents give a message to select the form, class, subject also and assessment. After the form has been filled correctly, student must click the submit button. So the questions of assessment are opened to be answered. Figure 6.7 shows student choose assessment.

![Student Choose Assessment](image)

**Figure 6.7: Student Choose Assessment**
6.3.8 Student Answer Assessment

From the assessment chosen by the student, the answer must be completed before they submit the button. Since all questions are objective, student only need to click the suitable answer for all questions to complete the assessment.

Figure 6.8: Student Answer Assessment
6.3.9 Student Result Assessment

This page shows an automatic result of student once all assessment questions that answered has been submitted. Agent will generate the mark of questions to give the score (percentage) and level (A, B, C, D or E). From this page, the student will be able to get their result faster and easier.

Figure 6.9: Student Result Assessment
6.3.10 Coordinator Upload Assessment

Shows the procedures of uploading/adding/replacing new questions, whereby the coordinator is required to set the questions given by teachers and upload it into the system. The software agents will work on behalf of coordinator and have the authority and autonomy to interact with the course web server. The course web will be interfaced for the coordinator to perform the following tasks. Coordinator just have to select files to be uploaded and click the submit button. Review button is available to check files that have been uploaded. All the information is stored in the server’s database which will be assessed by software agent in order to perform its duties.

Figure 6.10: Coordinator Upload Assessment
6.3.11 Coordinator Update Assessment

The software agents also work on behalf of coordinator and have the authority and autonomy to interact with the course web server. The course web is interfaced for the coordinator to perform the following tasks. Coordinator must select the file to be updated and after that review the question. After reviewing and updating have been done, submit button must be clicked so that questions will be updated. All the information is stored in the server’s database which software agent can access to perform its duties. Figure 6.11 shows the coordinator update assessment.

Figure 6.11: Coordinator Update Assessment
6.3.12 Coordinator Delete Assessment

The software agents also work on behalf of coordinator and have the authority and autonomy to interact with the course web server. The course web interfaced with the coordinator to perform the following tasks. Coordinator must select the file to be deleted and after that review the question. After completing with reviewing and deletion process, submit button has to be clicked so the questions will be erased/deleted. All information is stored in the server’s database which software agent can access to perform its duties. Figure 6.12 shows the coordinator delete assessment.

![Figure 6.12: Coordinator Delete Assessment](image-url)
6.3.13 Teacher and Coordinator View eProgress Report

This page show eProgress Report which is divided to 3 main reports, that which are Individual eReportCard, eMarksheet and eGraph Analysis. Only teacher and coordinator can view this page for their references. Students can only view their individual report card and not other students.

Figure 6.13: Teacher and Coordinator View eProgress Report
6.3.14 Teacher and Coordinator Choose eReportCard Individual

In order to check and print individual result of student, teacher or coordinator must select the Form followed with Class and Assessment.

Figure 6.14: Teacher and Coordinator Choose eReportCard Individual
6.3.15 Report of eReportCard Individual

Once the button View button is clicked, a report card will appear which shows the individual result for each student. Base on report displayed, agent will functions to change individual marks of student into a grade system. Available marks will be calculated as a whole, then it will be converted into a percentage point of view, and the marks achieved by student will be recorded. By using this method, student will be able to know their position or rank in the class simply within a few seconds after the agents finish with the calculation and conversion of their marks. Within this marking content, agent also functions in stating and displaying comments that are given by teachers to the overall class. From this report teacher or coordinator can print it when required as their references.
Exam Slip

SMK DATO' SYED ESA
BATU PAHAT
ASSESSMENT 1
Feb-09

FATIN BINTI MOAZ

NAME : FATIN BINTI MOAZ
IC NO : 940121015848
GENDER : FEMALE
FORM : 2 RKA1
RACE : MALAY

<table>
<thead>
<tr>
<th>No</th>
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<tbody>
<tr>
<td>1</td>
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<tr>
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<td>B</td>
</tr>
<tr>
<td>9</td>
<td>19</td>
<td>MORAL</td>
<td>87</td>
<td>A</td>
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</table>

Register Subject : 9
Result : 4A 4B 1C
Score : 700
Percentage : 85.50%
Place in the Class : 2/31

Teacher's Comment : Good

Teacher Signature  Principle Signature  Guardian Signature

(                     )  (                     )  (                     )

Figure 6.15: Printed Report of eReportCard Individual
6.3.16 Teacher and Coordinator Choose eMarksheet

In order to check and print the eMarksheet of student, teacher or coordinator must select Form continued with Class and Assessment.

Figure 6.16: Teacher and Coordinator Choose eMarksheet
6.3.17 Report of eMarksheet

Once the View Mark sheet button is clicked, the mark sheet will appear which shows the result of all students. In the context of eMarksheet, agents will be functioning as a converter, working on changing the mark of each subject into a grading system. Latter, total marks for each student will be calculated and converted into a percentage point of view, thus grade and GPP will be calculated. In the end, the student will be sorted in accordance to their position in the class and also to the grade that they received. Based on this report, teacher or coordinator can also print it as their references, when required to do so.
<table>
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<td>A</td>
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<td>B</td>
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<td>B</td>
<td>79</td>
<td>B</td>
<td>66</td>
<td>95</td>
<td>A</td>
<td>67</td>
<td>66</td>
</tr>
<tr>
<td>6</td>
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<td>56</td>
<td>C</td>
<td>65</td>
<td>B</td>
<td>64</td>
<td>C</td>
<td>58</td>
<td>C</td>
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<td>A</td>
<td>66</td>
<td>66</td>
</tr>
<tr>
<td>7</td>
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<td>50</td>
<td>C</td>
<td>89</td>
<td>A</td>
<td>66</td>
<td>B</td>
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<td>67</td>
<td>B</td>
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<td>B</td>
<td>86</td>
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<td>77</td>
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<td>98</td>
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<td>89</td>
<td>A</td>
<td>45</td>
<td>D</td>
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<td>95</td>
<td>87</td>
</tr>
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<td>10</td>
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<td>77</td>
<td>B</td>
<td>80</td>
<td>A</td>
<td>79</td>
<td>B</td>
<td>80</td>
<td>A</td>
<td>77</td>
<td>80</td>
<td>A</td>
<td>46</td>
<td>90</td>
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<tr>
<td>11</td>
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<td>D</td>
<td>77</td>
<td>B</td>
<td>64</td>
<td>C</td>
<td>80</td>
<td>A</td>
<td>65</td>
<td>B</td>
<td>89</td>
</tr>
<tr>
<td>12</td>
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<td>67</td>
<td>B</td>
<td>67</td>
<td>B</td>
<td>58</td>
<td>C</td>
<td>95</td>
<td>A</td>
<td>67</td>
<td>90</td>
<td>A</td>
<td>46</td>
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<td>A</td>
<td>79</td>
<td>B</td>
<td>45</td>
<td>D</td>
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<td>58</td>
<td>65</td>
</tr>
<tr>
<td>14</td>
<td>MUHAMMAD NAJIB BIN ABU BAKAR</td>
<td>58</td>
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<td>B</td>
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<td>D</td>
<td>67</td>
<td>B</td>
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<td>B</td>
<td>87</td>
<td>56</td>
</tr>
<tr>
<td>15</td>
<td>JAUHARI BIN MOHD SUJUD</td>
<td>60</td>
<td>C</td>
<td>67</td>
<td>B</td>
<td>98</td>
<td>A</td>
<td>89</td>
<td>A</td>
<td>60</td>
<td>56</td>
<td>C</td>
<td>67</td>
<td>60</td>
</tr>
<tr>
<td>16</td>
<td>MUHAMMAD YUNOS BIN JURIMI</td>
<td>64</td>
<td>C</td>
<td>56</td>
<td>C</td>
<td>66</td>
<td>B</td>
<td>56</td>
<td>C</td>
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<td>56</td>
<td>C</td>
<td>65</td>
<td>80</td>
</tr>
<tr>
<td>17</td>
<td>FATIN SYAKIRAH BINTI</td>
<td>92</td>
<td>A</td>
<td>86</td>
<td>A</td>
<td>46</td>
<td>D</td>
<td>95</td>
<td>A</td>
<td>92</td>
<td>95</td>
<td>A</td>
<td>80</td>
<td>45</td>
</tr>
<tr>
<td>18</td>
<td>UMA ISMA BIN SAMIAN</td>
<td>79</td>
<td>B</td>
<td>89</td>
<td>A</td>
<td>80</td>
<td>A</td>
<td>46</td>
<td>D</td>
<td>79</td>
<td>46</td>
<td>D</td>
<td>95</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>Roll No</td>
<td>Subject 1</td>
<td>Grade</td>
<td>Subject 2</td>
<td>Grade</td>
<td>Subject 3</td>
<td>Grade</td>
<td>Subject 4</td>
<td>Grade</td>
<td>Subject 5</td>
<td>Grade</td>
<td>Subject 6</td>
<td>Grade</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------</td>
<td>---------</td>
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<td>-------</td>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>19</td>
<td>MOHAMAD FAISA BIN MOHD MUSA</td>
<td>45</td>
<td>D</td>
<td>78</td>
<td>B</td>
<td>95</td>
<td>A</td>
<td>98</td>
<td>A</td>
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<td>D</td>
<td>80</td>
<td>A</td>
<td>65</td>
</tr>
<tr>
<td>20</td>
<td>MUHAMAD SYARIFUDDIN BIN M. SAH</td>
<td>46</td>
<td>D</td>
<td>95</td>
<td>A</td>
<td>80</td>
<td>A</td>
<td>66</td>
<td>B</td>
<td>46</td>
<td>D</td>
<td>98</td>
<td>A</td>
<td>64</td>
</tr>
<tr>
<td>21</td>
<td>MUHAMAD MUKMININ BIN ROSLAN</td>
<td>66</td>
<td>B</td>
<td>66</td>
<td>B</td>
<td>56</td>
<td>C</td>
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<td>B</td>
<td>66</td>
<td>B</td>
<td>65</td>
<td>B</td>
<td>98</td>
</tr>
<tr>
<td>22</td>
<td>MUHAMMAD FILDANIS FITRI BIN ASMUNI</td>
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<td>A</td>
<td>64</td>
<td>C</td>
<td>91</td>
<td>A</td>
<td>80</td>
<td>A</td>
<td>89</td>
<td>A</td>
<td>58</td>
<td>C</td>
<td>56</td>
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<tr>
<td>23</td>
<td>ZA’IM FIKRI BIN MESKAM</td>
<td>80</td>
<td>A</td>
<td>98</td>
<td>A</td>
<td>90</td>
<td>A</td>
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<td>B</td>
<td>80</td>
<td>A</td>
<td>66</td>
<td>B</td>
<td>45</td>
</tr>
<tr>
<td>24</td>
<td>MUHD FAIZAL BIN IBRAHIM</td>
<td>45</td>
<td>D</td>
<td>46</td>
<td>D</td>
<td>35</td>
<td>E</td>
<td>87</td>
<td>A</td>
<td>45</td>
<td>D</td>
<td>87</td>
<td>A</td>
<td>89</td>
</tr>
<tr>
<td>25</td>
<td>MUHAMMAD IZUDDIN BIN ZULKIFLI</td>
<td>95</td>
<td>A</td>
<td>45</td>
<td>D</td>
<td>39</td>
<td>E</td>
<td>91</td>
<td>A</td>
<td>95</td>
<td>A</td>
<td>TH</td>
<td>E</td>
<td>90</td>
</tr>
</tbody>
</table>

Figure 6.17: Mark sheet Print of eMarksheet
6.3.18 Teacher and Coordinator Choose eGraph Analysis

In order to check and print the eGraph Analysis of student, teacher or coordinator must select the Form continued with Class and Assessment.

Figure 6.18: Teacher and Coordinator Choose eGraph Analysis
6.3.19 Report of eGraph Analysis

Once the View Graph button is clicked, the graph analysis will appear which shows the result for each subjects of all the students based on assessment. Teachers and coordinator will be able to view this graph analysis on the result for each subject result obtained by the student, according to the Assessment conducted from time to time. Here, Agents’ functions are converting or changing the mark of each subject into a graphical point of view. Teachers will therefore be able to analyse the mark of student in an easier manner, and this will help to improve the education system as a whole as everything will be displayed and viewed simultaneously after each assessment. By viewing the statistics, students can reflect it with their effort in the assessment towards improving their self-regulation. With this graph also, teacher or coordinator may print it as their reference when required.

![Graph Analysis by Subjects](image)

Figure 6.19: Graph Analysis Report Print
6.4 Coding

Coding is a process of translating program logic into particular commands that facilitates the computer system to perform the execution. An algorithm is a finite instruction for performing a computation or for solving a problem. Therefore, some of the important functions of the system will be discussed in this chapter together with the algorithm, coding and the description for each selected function.

6.4.1 Animation and Informative Messages Interface

Figure 6.20: Animation and Informative Messages Interface

Target A System as in Figure 6.20 has active objects in simulations (animation) are call agents. This simulation will give informative message for more interactive.
<select id='select'
onChange="agentReact(this.value,document.getElementById('informative').value)"
>&lt;?
$sql = "SELECT * FROM agent";
$result = $db-&gt;query ($sql);
$num_rows = $result-&gt;num_rows;
while ($fetch=$result-&gt;fetch_array())
{
    $name = $fetch['name'];
    $folder = $fetch['folder'];
    echo "&lt;option value='$folder'&gt;".$name."&lt;/option&gt;";
    if ($name == $character) echo " selected";
    echo ">$name&lt;/option>";
}
?
</select>
6.4.2 For View Agent in Target A System

This section is meant for displaying the key functions of the Target A system using Agent for view page.

```html
<script type="text/javascript" src="scriptaculous/prototype.js"></script>
<script type='text/javascript' src='js/prototip.js'></script>
<script language='javascript' src='jscript/agent.js'></script>

<link rel="stylesheet" type="text/css" href="css/prototip.css" />

<div id='agent' class="toolTipElement"></div>

<script language="javascript">
new Draggable('agent');
</script>

<!--
new Tip('agent', {
    title: "<? echo $agent_title ?>",
    style: 'protogrey',
    closeButton: true,
    showOn: 'mousemove',
    hideOn: { element: '.close', event: 'click' },
    hideAfter: true,
    width: '250px',
    stem: { position: 'bottomLeft', width: 14, height: 20 },
    hook: { target: 'topRight', tip: 'bottomLeft' }
});
-->
6.4.3 Agent Character as Assistant (Emotion)

This section is meant for displaying the agent character as assistant in Target A system.

```php
<?
session_start();
include ('dbconfig.inc');

if (isset($_GET['agent']))
{
    $agent = $_GET['agent'];
    $sql = "UPDATE user SET agent='$agent' WHERE userId = " . $_SESSION['username'] . "";
    $result = $db->query ($sql);
```
$_SESSION['agent'] = $agent;

echo "<center>"

echo "<img src='images/aesthetica/128x128/process_accept.png' height='128'><br /><br />

echo "Agent saved as your default assistant!<br /><br/>

else
{

$character = $_SESSION['agent'];

?</script>

<h2>Agent Library</h2>

<center>
<b>Select elearningsa:</b>
<select id='selectelearninsa' onChange="agentReact(this.value,document.getElementById('behavior').value)"

<?

$url = "SELECT * FROM agent";
$result = $db->query($url);
$num_rows = $result->num_rows;
while ($fetch=$result->fetch_array())


```php
{name = $fetch['name'];
$folder = $fetch['folder'];
echo "<option value='$folder"; if ($folder == $character) echo " selected";
echo ">$name</option>";
}
</select>
<input type='button' value='Set as my assistant'
onClick="Modalbox.show('agentlibrary.php?agent='+document.getElementById('selectelelearninsa').value, {title: 'Setting Agent', width: 600})" />
<br />
<input id='behavior' name='behavior' type='hidden' value='normal' />
<br />
<b>Animation:</b><br />
<table border='0' width='400'>
<tr><td width='400' colspan='2' align='center'><input type='button' value='Normal Behavior'
onClick="document.getElementById('behavior').value='normal';agentReact(document.getElementById('selectelelearninsa').value,document.getElementById('behavior').value)" />
</td></tr>
<tr><td width='200' align='center'><input type='button' value='Everything is OK'
onClick="document.getElementById('behavior').value='ok';agentReact(document.getElementById('selectelelearninsa').value,document.getElementById('behavior').value)" />
</td></tr>
<tr><td width='200' align='center'><input type='button' value='Things are good'
onClick="document.getElementById('behavior').value='good';agentReact(document.getElementById('selectelelearninsa').value,document.getElementById('behavior').value)" />
</td></tr>
```
<tr>
<td width='200' align='center'><input type='button' value='I am sad' onClick="document.getElementById('behavior').value='sad';agentReact(document.getElementById('selectelearningsa').value,document.getElementById('behavior').value)" /></td>
</tr>

<tr>
<td width='200' align='center'><input type='button' value='Thinking..' onClick="document.getElementById('behavior').value='think';agentReact(document.getElementById('selectelearninsa').value,document.getElementById('behavior').value)" /></td>
</tr>

<tr>
<td width='200' align='center'><input type='button' value='Informative' onClick="document.getElementById('behavior').value='info';agentReact(document.getElementById('selectelearninsa').value,document.getElementById('behavior').value)" /></td>
</tr>

<tr>
<td width='200' align='center'><input type='button' value='Welcome' onClick="document.getElementById('behavior').value='welcome';agentReact(document.getElementById('selectelearninsa').value,document.getElementById('behavior').value)" /></td>
</tr>

</table>

<?
}
6.5 Implementation Process

This section describes the Target A System uploading process and the overall navigation within the completed system.

6.5.1 Uploading Process

Since this system involves a database to store the students and marking information – i.e the students Login ID/Password and survey results, MySQL is used to configure the connection. There are two phases involved in uploading the files to the web:

a) uploading files to localhost via xampp

b) uploading files to remote server (www.101stuffs.com)

Firstly, all completed files are uploaded to the local-host to test their functionality whether they are working properly in the web-based environment or not. After testing the page hyperlink and the connection to databases when everything works properly then they are now ready to be uploaded to the remote server.

A server space at www.101stuffs.com was rented to locate the Target A System for testing purposes. Table 4.4 summarizes some important configuration made during the process of uploading the files to remote server:
### Table 6.2: Configurations to Remote Server

<table>
<thead>
<tr>
<th>No</th>
<th>Procedure</th>
<th>Description / Screenshots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Uploading files:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) By using ftp</td>
<td>Files were uploaded using WS_FTP LE. Folders on the left side of the screen are local folders (in PC), while folders on the right side is the folder uploaded to the remote server.</td>
</tr>
<tr>
<td></td>
<td>b) By using Xampp for Windows</td>
<td>The Xampp interface is used to upload files and database configuration (phpMyAdmin) by remote server.</td>
</tr>
<tr>
<td>2</td>
<td>Database configuration using</td>
<td></td>
</tr>
</tbody>
</table>
6.6 Summary

This chapter has focused on the implementation of Target A System. All aspects ranging from non-technical and technical have been discussed in this chapter. This includes the software and hardware requirements. The graphical user interface (GUI) of key pages in the Target A system has been enormously described the development tools, development environment, database involved as well as the system integration process. From the Target A System, the agent has actively participated in accomplishing tasks, rather than serving a passive tool as practiced in today’s applications. Next, Chapter 7 will describe the testing and evaluation process for Target A System.
CHAPTER 7
SYSTEM TESTING AND EVALUATION

7.0 Introduction

This chapter describes the Target A system involving the testing and evaluation. Firstly, it will describe the testing phase that has been executed on the system. Secondly, description of procedures that involved during user evaluation will be discussed. After that, the result of the effectiveness of evaluation survey that has been conducted will also be analysed. This will include graphs and statistics, as well as the analysis and interpretations.

7.1 System Testing

Testing is a critical phase of software quality assurance in a software development life cycle. The objective is to execute a program with the intention to discover errors, evaluate the system’s abilities and most importantly to determine whether it complies according to its requirements and functional specifications.

There are five stages in the testing phase of Target A System which are unit testing, module testing, integration testing, system testing and security testing.
7.1.1 Unit Testing

The primary purpose of conducting a system test is to detect software failure before the system goes alive. Unit testing is defined as a development procedure where programmers create tests as they develop the software. This stage of testing verifies each component functions correctly with proper input and output expected based on the component designs and requirements. In Target A System, unit testing is done before files are uploaded to the local host. During the development of Target A System, there were several steps being carried out which were:

- Code review which intended to examine the correctness of program codes by reading line by line and attempt to spot algorithm, data and syntax faults.
- Performed a test to each button and link to ensure that it will function as required.
- Developed test cases to show the input is properly processed to expected output.
- Boundary conditions were tested to make sure the functions run at boundaries established for limiting process.
- Tested all errors handling paths.
- Database including tables, indexes and connection.
The exit criterion for this milestone is code-completed. All functionality, logical and physical components of the application were completed and made available for module testing.

Table 7.1 illustrates some important unit testing done in Target A System creation.

**Table 7.1: Unit Testing**

<table>
<thead>
<tr>
<th>No</th>
<th>Test Descriptions</th>
<th>Problem (if any)</th>
<th>Solution (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Database Connection Test</td>
<td>Unable to connect to database when login.</td>
<td>Recheck index.php file uploaded. Recheck host name, userID &amp; password.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pop up windows</td>
<td>Close button does not working properly</td>
<td>Recheck button setup in .fla file</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Logical Error</td>
<td>Problem: Student’s level generated from score is wrong.</td>
<td>Check and modify the related if...else statement in resultassessment.php file.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Print Report</td>
<td>Printer does not working properly.</td>
<td>Check the setup of printer and cable.</td>
</tr>
</tbody>
</table>
7.1.2 Module Testing

A module is a collection of dependent components unit which encapsulates related components unit. Testing can be carried out on every module that have been defined in the requirement phase. Each module was tested to ensure that the desired functions can run successfully as expected and also to verify the correctness of the flows of events. Figure 7.1 illustrates a sample of a Test Plan for the access authentication module.
# TEST PLAN CONTROL FORM

**Project:** Target A System  
**System:** Access Authentication Module  
**Test type:** Unit / Module / Integration / System  
**Cycle No.:** 1  
**Tester:** Hairul Barriah Mohsin  
**Start Date:** 3 Mac 2010  
**End Date:** 3 Mac 2010

<table>
<thead>
<tr>
<th>No.</th>
<th>Test Scenario</th>
<th>Expected Result</th>
<th>Actual Result</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Enter valid username &amp; password</td>
<td>Session created, Login successfully</td>
<td>Same as expected</td>
<td>32-bit session ID seeded using username, password and micro time</td>
</tr>
<tr>
<td>2.</td>
<td>Enter invalid username &amp; password</td>
<td>Error Message</td>
<td>Same as expected</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Leave both username &amp; password field blank</td>
<td>Error Message</td>
<td>Same as expected</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Leave blank for username field</td>
<td>Error Message</td>
<td>Same as expected</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Leave blank for password field</td>
<td>Error Message</td>
<td>Same as expected</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Check POST VALUE for http connection</td>
<td>32-bit scrambled value</td>
<td>Same as expected</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Check POST VALUE for https connection</td>
<td>128-bit scrambled values</td>
<td>Same as expected</td>
<td></td>
</tr>
</tbody>
</table>
| 8.  | Logout function                                  | -Redirect to main page  
 -Unregistered Session ID  
 -Destroy Session ID | Redirection successful but Session failed to destroy. | Check session ID variables |
7.1.3 Integration Testing

The integration testing of the Target A System can be viewed from an incremental perspective, whereby the test starts from the main page of Target A System and moves down to the lowest level of the functions, which is view and print graph analysis by using this approach, the software is built piece-by-piece and tested little-by-little as shown in Figure 7.2. For the Target A System, this test is also used to ensure that all modules are connected and linked according to the requirements in order to discover errors associated with the interface.

![Incremental Testing in Target A System](image)

*Figure 7.2: Incremental Testing in Target A System*
7.1.4 System Testing

System testing in Target A System involves testing against integrated hardware and software system in order to verify that the system meets the specified requirements as described in the requirement specifications. It also, involves a series of different tests designed to fully exercise the system to uncover its limitation and measure its capabilities. The Target A System testing takes place at a higher level whereby the testing focuses on behavior rather than functional structure.

7.1.5 Security Testing

The agent needs the coordinator’s, teachers and students authorization (username and password) before logging into the system. Students, teachers, coordinators have their own login information with a designated password, which can be changed in the future when necessary. The security testing is to verify that the protection mechanism built into the system will protect it from improper access. During the security testing, access authentication module is tested aggressively for any possible access. Security testing ensures that the system always verifies and authenticates all the accesses and requests made by the authorized user. In addition, when the user purposely types a URL without logging-in, system will block this unauthorized access as stated. The security testing ensures that all requirements in access authentication module are implemented correctly.
7.2 Testing Process

Each type of the testing stage in the PSP.NET uses the testing process as illustrated in Figure 7.3.

![Testing Process Diagram]

Figure 7.3: Testing Process in Target A System

As shown in Figure 7.3, all of the test cases are documented in Test Plans which are derived from Target A System requirements and functional specifications. Based on the experimental material, each of the test cases is developed and the expected results are written first. Then, the Target A System application is executed and tested with all of these sample data. The test outputs are compared with the expected outputs. If there is any differences exists
between the test outputs and the expected outputs, the program code will be checked to discover bugs.

7.3 User Evaluation

Target A System provided questionnaires for students. These questionnaires are divided into three sections covering the student’s opinions and functionalities, the student’s satisfaction with the usability of the systems and suggestions for enhancements. For teachers, the questionnaires cover the teacher’s opinions and functionalities, the teacher’s satisfaction with the usability of the systems and suggestions for future enhancements or improvements. Please refer to Appendix C for samples of the questionnaires are used in this system.

The purpose of user evaluation is to gather some feedback from the users, in this case the secondary school students and teachers. Questionnaires were distributed to 20 students and 10 teachers from SMK Dato’ Syed Esa. The survey questionnaires were distributed to the students after the system has been uploaded within a month into the web. The questionnaire focuses on the effectiveness of Target A System – whether Target A System has helped them to learn the system better or not.
a) **Questionnaire Format**

Questionnaires were distributed to 20 students and 10 teachers using the Target A System. All participants responded well to questionnaires. Sample questionnaires can be viewed in Appendix C.

b) **Test Data Analysis**

i) **Summary Results**

Based on questionnaires presented in Appendix C, the results of the survey are collected and represented in this section.

### 7.3.1 Functionality

Section A of the questionnaire represents the result of the system functionality for both the students and teachers.

**Students Result**

These results are shown in Table 7.2.

**Table 7.2: Summary of Functionality (Students)**

<table>
<thead>
<tr>
<th>No</th>
<th>Questions</th>
<th>Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The system allows the students to take e-assessment.</td>
<td><img src="chart.png" alt="Chart" /></td>
</tr>
</tbody>
</table>

[![Chart](chart.png)](chart.png)
40% of students thought that the systems are very useful and 35% are useful. This is a good indication for future use of the system assessment in the school.

2. The animated contents assist a lot for a better understanding.

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Useful</td>
<td>65%</td>
</tr>
<tr>
<td>Useful</td>
<td>30%</td>
</tr>
<tr>
<td>Not Useful</td>
<td>0%</td>
</tr>
<tr>
<td>Not Sure</td>
<td>5%</td>
</tr>
</tbody>
</table>

65% of students believed that animated contents assist a lot for better understanding of the system is very useful and 30% are useful. So, this is also a good indication for this system and shows a positive impact for the system to be used in the future.

3. The reminder will give alert and can avoid student from forgetting important things. (example session face-to-face sessions meeting).

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Useful</td>
<td>70%</td>
</tr>
<tr>
<td>Useful</td>
<td>25%</td>
</tr>
<tr>
<td>Not Useful</td>
<td>0%</td>
</tr>
<tr>
<td>Not Sure</td>
<td>5%</td>
</tr>
</tbody>
</table>

70% of students believed the reminder will give alert are very useful and 26% are useful. So, this is also a good indication for this system give reminder for students.
4. Informative messages will help student to have more attention and can give a good guidance for a better understanding.

65% students agreed that informative messages are very useful and 30% are useful. So this is a good indication for this system.

5. Announcement board can help students to participate faster main required and alert of new course item.

Overall 95% students agreed that announcement board are very useful and useful.

6. The system displays students’ result immediately after the student has answered, then converts it into grading and percentage point of view.

All students strongly satisfied that such system that displays student’s result then converts it into grading and percentage point is very useful while the remaining claimed it to be
The system displays report card individual with comment on. 60% of students agreed that the individual report card displayed on the system is very useful and 30% agreed that it is useful. So, this is another good indication as the provided system is going to be useful and can help students to get their individual report card easier.

The system allows students to view their history of result. 50% of the students agreed that the system allowing them to view their results history is very useful and 35% of the students agreed that it is useful. Therefore, this feature can be used and can be improvised for the future assessment system.
40% of the students agreed that the analysis graphs displayed by the system is very useful and another 40% more agreed that it is useful. This is another good indication that the impact of e-assessment system is going to be positive.

<table>
<thead>
<tr>
<th></th>
<th>Analysis Graphs displays system.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="chart_image" alt="Chart showing analysis graphs usefulness" /></td>
</tr>
</tbody>
</table>

From the students system functionality result, it can be concluded that 75% students agreed the system allows the students to take e-assessment. 65% of students believed that animated contents assist a lot for better understanding of the system is very useful and 30% are useful. The reminder will give alert and can avoid student from forgetting important things. So from this question, 70% of students believed the reminder will give alert are very useful and 26% are useful. 65% students agreed that informative messages are very useful and 30% are useful. Announcement board can help students to participate faster main required and alert of new course item. Overall 95% students give answered agreed that announcement board are very useful and useful. All students strongly satisfied that such system that displays student’s result then converts it into grading and percentage point is very useful while the remaining claimed it to be useful. 60% of students agreed that the individual report card displayed on the system is very useful and 30% agreed that it is useful. So, this is another good
indication as the provided system is going to be useful and can help students to get their individual report card easier. 50% of the students agreed that the system allowing them to view their results history is very useful and 35% of the students agreed that it is useful. Therefore, this feature can be used and can be improvised for the future assessment system. 40% of the students agreed that the analysis graphs displayed by the system is very useful and another 40% more agreed that it is useful. This is another good indication that the impact of e-assessment system is going to be positive.

**Teachers Result**

These results are shown in Table 7.3.

**Table 7.3: Summary of Functionality (Teachers)**

<table>
<thead>
<tr>
<th>No</th>
<th>Questions</th>
<th>Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>System allowing teacher to create question based on a module.</td>
<td>40% of teachers agreed that the system allowing teacher to create question based on a module is very useful and 30% agreed that it is useful.</td>
</tr>
<tr>
<td></td>
<td>The system allows teachers to check students’ individual results, subject by subject and review analysis, thus predict students’ upcoming result.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="chart1.png" alt="Bar Chart" /> <strong>Basically, majority of the teachers (90%) agreed that the provided system and facilities is useful/very useful. The remaining 10% of teachers that do not agree might not get used with the system and believed to have not surveyed the system properly.</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>System allowing teacher to set the total of questions per assessment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="chart2.png" alt="Bar Chart" /> <strong>80% of the teachers agreed that the system that allows teachers to set the total of questions per assessment is very useful/ useful. Remaining 20% of teachers thought that it is not useful and not sure.</strong></td>
<td></td>
</tr>
</tbody>
</table>
Easy access system for teachers to print report card of the students either individually or for overall results.

<table>
<thead>
<tr>
<th>Very Useful</th>
<th>Useful</th>
<th>Not Useful</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>70%</td>
<td>30%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

All teachers strongly satisfied that such system that has an easy printing access for them is very useful.

System that able to show analysis graph based on assessments or subjects.

<table>
<thead>
<tr>
<th>Very Useful</th>
<th>Useful</th>
<th>Not Useful</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>40%</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

90% of teachers agreed that analysis graph display in the system are useful while the remaining 10% claimed that they were not sure, possibly because they did not explore the overall system.

From the teachers system functionality result, 40% of teachers agreed that the system allowing teacher to create question based on a module is very useful and 30% agreed that it is useful. Majority of the teachers (90%) agreed that the provided system and facilities is useful/very useful. The remaining 10% of teachers that do not agree might not get used with the system and believed to have not surveyed the system properly. 80% of the teachers agreed that the
system that allows teachers to set the total of questions per assessment is very useful. Remaining 20% of teachers thought that it is not useful and not sure. All teachers strongly satisfied that such system that has an easy printing access for them is very useful. 90% of teachers agreed that analysis graph display in the system are useful while the remaining 10% claimed that they were not sure, possibly because they did not explore the overall system
7.3.2 Ease of Use

Section C of the questionnaire represents the results of the ease of use for the system, conducted on students and teachers. The ease of use questionnaire is designed based on the Software Usability Measurement Inventory (SUMI) (Drs. Erik P.W.M, 1998).

Students Result

These results are shown in Table 7.4.

Table 7.4: Summary of Usability (Students)

<table>
<thead>
<tr>
<th>No</th>
<th>Questions</th>
<th>Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The system can be used with minimal guidance or no guidance.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>75% of students agreed that the system can be used with minimal guidance or no guidance. Another 10% were undecided and 15% disagreed.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The purpose of the system can be easily understood.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>75% of students believed that Target A System is very easy to</td>
<td></td>
</tr>
</tbody>
</table>


use and to be understood as it responds accurately at the right time. Students were convinced that spending time on this particular system is enjoyable and it becomes easier and easier as the time passes.

3 Students’ performance can be viewed easily.

75% of students agreed that the easy and viewable performance system will provide a better conclusion for them.

4 The user interface is attractive & easy to navigate

80% of students believed that the user interface of the system is attractive and easy to navigate. 10% were undecided while another 10% disagreed with user interface attractiveness.

From the students’ ease of use result, 75% of students agreed that the system can be used with minimal guidance or no guidance. Another 10% were undecided and 15% disagreed. 75% of students believed that Target A System is very easy to use and to be understood as it responds accurately at the right time. Students
were convinced that spending time on this particular system is enjoyable and it becomes easier and easier as the time passes. 75% of students agreed that the easy and viewable performance system will provide a better conclusion for them. 80% of students believed that the user interface of the system is attractive and easy to navigate. 10% were undecided while another 10% disagreed with user interface attractiveness.

**Teachers Result**

These results are shown in Table 7.5.

*Table 7.5: Summary of Ease of Use (Teachers)*

<table>
<thead>
<tr>
<th>No</th>
<th>Questions</th>
<th>Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The system can be used with minimal guidance or no guidance.</td>
<td>90% of teachers agreed that the system can be used with minimal guidance or no guidance. Another 10% are undecided.</td>
</tr>
<tr>
<td>2</td>
<td>The objective of the system can be easily understood.</td>
<td></td>
</tr>
</tbody>
</table>
90% of teachers believed that Target A System is very easy to use and it responds accurately at the right time.

3  The system reduces burden of marking papers.  

Majority of the teachers agreed that the system reduces the burden of marking papers and another 10% did not agree.

4  Students’ performance can be viewed easily.  

80% of the teachers agreed the student’s performance can be viewed easily by using the system.

5  The interface is attractive and interactive.  

80% of teachers believed that the user interface of the system is attractive and easy to navigate. 10% were undecided the user interface and another 10% disagreed with user interface.
From the teachers’ ease of use result, 90% of teachers agreed that the system can be used with minimal guidance or no guidance. Another 10% are undecided. 90% of teachers believed that Target A System is very easy to use and it responds accurately at the right time. Majority of the teachers agreed that the system reduces the burden of marking papers and another 10% did not agree. 80% of the teachers agreed the student’s performance can be viewed easily by using the system. 80% of teachers believed that the user interface of the system is attractive and easy to navigate. 10% were undecided the user interface and another 10% disagreed with user interface.

ii) Summary on Open-Ended Questionnaire

Section D of the questionnaire captured user’s responses towards three open-ended questionnaires.

Students Responses

These results are shown in Table 7.6.

**Table 7.6: Summary of Open-Ended Question (Students)**

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>List down your comments and suggestions for future improvements of Target A System.</td>
<td>1. I would like to see the exam materials for the past years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Notes and examples of questions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Quizzes/word games. Those are fun.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. More exercise and answers please.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Online forum -- will be helpful if more</td>
</tr>
</tbody>
</table>
|   | Things I like the most about Target A System is | 1. The system has animation guidance.  
|   |                                               | 2. The system has announcement board also reminder.  
|   |                                               | 3. The system shows the result after answer questions. It also shows percent, score and grade.  
|   |                                               | 4. Student can view report individually and graph analysis by subjects.  
|   |                                               | 5. The system easy to navigate and understand.  
|   | Limitation of Target A System                | 1. Assessment questions can sometimes be difficult.  
|   |                                               | 2. Not enough exercises and examples.  

From the open-ended questionnaires above, student’s comments and suggestions for future improvements of Target A System are they would like to see the exam materials for the past years, notes and examples of questions, quizzes/word games those are fun, more exercise and answers and also online forum. From students view, Target A System advantages are the system has animation guidance, announcement board, reminder, shows the result after answer questions, shows percent, score and grade, can view report individually and graph analysis by subjects and also the system easy to navigate and understand. The system limitations from students view are assessment questions can sometimes be difficult and not enough exercises and examples.
**Teachers Responses**

These results are shown in Table 7.7.

**Table 7.7: Summary of Open-Ended Question (Teachers)**

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
</table>
| 1   | List down your comments and suggestions for future improvements of Target A System. | 1. I would like to see the materials for the past years examinations.  
3. More quizzes/word games. Those are fun.  
4. More exercise and answers please.  
5. Show graph analysis based on subjects, students, class, year and more.  
6. Online forum teachers and students -- will be helpful if more students participate.  
7. Chatting side teachers with students. |
| 2   | Things I like the most about Target A System is                           | 1. The system shows the result after answer questions. It shows percent, score and grade.  
2. Teacher can view and print report individually and give comment on the system.  
3. Teacher can view and print mark sheet of students. |
<table>
<thead>
<tr>
<th></th>
<th>Limitation of Target A System</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1. Not enough exercises and examples.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Not have reminder using email to students to alert an assessment due date.</td>
<td></td>
</tr>
</tbody>
</table>

From the open-ended questionnaires above, teachers’ comments and suggestions for future improvements of Target A System are they would like to see the materials for the past years examinations, more exercises and examples, more quizzes/word games those are fun, more exercise and answers, show graph analysis based on subjects, students, class and year, online forum teachers and students for attract more students participate and also but not least chatting side teachers with students. From teachers view, Target A System advantages are the system shows the result after answer questions also shows percent, score and grade, can view and print report individually, mark sheet of students and graph analysis and also the reminder has good usage students who are failed on the assessment because the system show reminders to have face-to-face sessions meeting with teacher. The system limitations from teachers view are not enough
exercises and examples and not have reminder using email to students to alert an assessment due date.

7.4 **Comparison Agent with Non-Agent Systems.**

There are two overviews for comparing agent and non-agents system. The first overview is made based on facilities where non-agent systems have only one basic requirement for online e-learning, which is too general and are not concentrated or specific enough to suit the new waves of current educational power and technology. Even though the agent and non-agent system are using the same platform that is web-based server platform, agent system has more stability. However, the study will be able to focus only on the usage and application of software agent for assessment, which will concentrate only on its application inside secondary school. Specific marking systems to support the assessment will be used and upgraded accordingly from time to time. This key factor will enable educators to recognize their students in a closer manner (based on the assessment result) so as to define the potential or suitable course, specific design to tackle student strength and weaknesses, and possibly create a better open discussion by giving the student an instantaneous feedback in accordance with their assessment. This immediate assessment will also assist educators in order to find out how effective was their lesson and communications, until what level has their student understood and to what extent did their student was able to apply the key concepts. Compared to the agent system, quiz and online exercises are provided but still the system cannot sustain the basic needs for the
students to understand without having to have a face-to-face discussion with their educators.

With the application and the use of the agent inside e-assessment, it will severely improve student’s confidence level in reliability of assessment and comparability of standards. Students are able to perceive their weaknesses by analyzing their result and for those who have failed to identify the weaknesses will question themselves about their incapability for future improvement.

This agent is designed for an assessment and can access information related to a communication issues and related assessment such as answering the question of assessment, marking answers, commenting on, students’ assessment scores and reports, counter checking and filtering, evaluation types, feedback of students’ progress, analyzing of students’ answer, assessment of result and students’ grades, showing analysis graph and mark sheet. The advantages of using the agent in the system are the retrieval of information becomes faster, the speed of use is increased, the access is easier and becomes more efficient and the most important fact is the data assessment is more accurate.

The second overview is based on informative messages which unfold the fact that the existing systems do not provide enough informative messages. When candidates were busy on working out to seek information and using the system, the appearance of informative message sometimes is important.
especially when it doesn’t correspond at all to their study and research. Examples of those informative messages are normally; message prompt, post announcement alert and reminders for the student that failed to have a face-to-face sessions meeting with the teacher. The software agents will therefore work on behalf of coordinator and have the authority and autonomy to interact with the course web server. The traffic of the message thus can be reduced because the agent also requires the accessing course news and announcements posted by the course coordinator. To meet this purpose, specific web interface course will be developed and conducted for a coordinator in order to perform the following basic tasks which are entering and updating course presentation information, posting course news and announcements, uploading message, updating information, or even to delete assessment questions or files.

7.5 Summary

As to sum up, positive impacts have mostly gathered from the feedback of questionnaires even though it was just using basic fundamentals of e-assessment system. Prior to the real development of e-assessment, testing done indicates that many things can be done in order to improvise the prototype of Target A System. The unit testing has helped the author to identify logical fallacies. On the other hand, the user evaluation helps the author to gauge feedback from the actual users on how they want the web based module to be presented.
CHAPTER 8
CONCLUSION

8.0 Introduction

Upon completing the testing of Target A System prototype, this chapter discusses the conclusion and future work of Target A System. It is very significant to evaluate the implementation of the developed prototype to identify the research contributions, the strengths and limitations of the prototype as well as the objective achieved. This chapter will therefore suggest and promote some future enhancements that can be done to improve and further enhance the Target A System.

8.1 Research Contributions

This research is concerned on designing an Agent-based for supporting assessment learning module that can help the Secondary School of SMK Dato’ Syed Esa. An Agent-based contribution towards the students can be seen as follows:

- It provides online assessment or answering an assessment using computer.
- Easier access for student towards a more accurate result obtained by teachers and coordinator.
- It provides an individual report card with comment from teacher and their places in the class and grading.
- It helps students to view their subject progress report via analysis graph.
• It provides announcement board and reminders alert for students.

An Agent-based contribution towards the teachers can be seen as follows:

• It helps the teacher to view student profile.

• It helps the teacher marking questions paper, check student assessment result.

• It provides assessment report such as individual report, mark sheet report and analysis graph on every subject.

• It is an easy way for students and teacher to have a face-to-face session.

An Agent-based contributions towards the coordinators can be seen as follows:

• Coordinator work on behalf of the software agent, interacting with teacher and students.

• It helps coordinator to upload, delete and update assessment questions.

• It helps to update the system.

• It helps coordinator get a more accurate result.

8.2 Strengths of Target A System

Various assessments of e-learning systems can be found in the internet. However, there is no dedicated assessment system using an Agent-based approach. Therefore, the following are the distinguishable strengths of Target A System:
- The software agents will therefore work on behalf of coordinator and have the authority and autonomy to interact with the course web server.

- This agent can access information related to a communication issues, informative messages and related assessment such as marking system, commented on, students’ assessment scores, evaluation types, feedback of students’ progress, analysis of students’ answer, assessment of result and students’ grading.

- User friendly interface and easy to use.

8.3 Limitations of Target A System

Despite various strengths presented earlier, Target A System does have its limitations. The following are the limitations found:

- It focuses on two important topics: software agent and electronic assessment.

- Students can only view their individual report not others but teachers can view all of students’ report.

8.4 Objectives Achieves

Target A System has three main objectives as discussed in Chapter 1. The objectives of this research have been successfully achieved based on:

i) **Objective #1: To study an agent-based approach for supporting assessment in e-learning environments.**
While drafting the design document (storyboard), the author has suggested and studied various ways of presenting an Agent-based for supporting assessment online system. Software agents will work on behalf of coordinator and have the authority and autonomy to interact with the system. So, what the agent will do is that the agent can access information related to a communication issues, informative messages and related assessment such as marking system, commented on, students’ assessment scores, evaluation types, feedback of students’ progress, analysis of students’ answer, assessment of result and students’ grading. For that, research objective#1 has been achieved.

ii) **Objective #2: To develop and incorporate software agent into electronic assessment module.**

The application of software agent is to provide an electronic assessment for students with the function of easier access towards a more accurate result obtained by teachers and coordinator. The software agent is also designed for an assessment using computer with extra features of answering the question of assessment, marking the answers, providing assessment reports, showing analysis graph and grading. For that, research objective#2 has been achieved.

iii) **Objective #3: To evaluate the developed module based on the identified parameters.**

Students and teacher have been tested in using the Target A System. From the user acceptance testing discussed in Chapter 7, impressively, 75% of the students thought the system assessment is very useful. From the open-ended question, the students and teachers demanded on
attaching more functions such as past year exam materials, notes and examples of questions, quizzes and online forum. This indicates that, even with the basic starter conducted on them, they are really impressed by the system as they gave a lot of positive responses. If these feedbacks are to take place in the future, it will certainly help students and teachers in using the system with full excitement. Hence, the third research objective has also successfully been achieved.

8.5 Future Enhancements

Unit testing and user acceptance testing done indicates that Target A System needs to undergo some enhancement to ensure a better functionality and usability. The following are some suggestions collected from the testing:

1. To add material and notes in the system.
   - Currently, this system does not include online material and notes. In future, Target A System can be enhanced by including the subjects materials and supplementary teaching notes so that the students can benefit most from it.

2. To add online forum discussion.
   - Currently, this system does not have online forum discussion. In future, Target A System will be enhanced by adding online discussion forums to provide students with a convenient place to ask questions and receive answers from teaching staff and also between the teaching staff and the coordinator.
3. To add reminder using email to students to alert an assessment due date.

- In future, Target A System can be enhanced by using an email in reminding or informing students on the due of the assessment that will be due (warning and alert). For example, it might send a reminder to students five days before the due date of an assessment.

8.6 Summary

From this research, the following conclusions are drawn.

Chapter 1 mentioned the objectives of this research. The first objective mentioned is to study an agent-based approach for supporting assessment in e-learning environments. An agent-based approach found from current and previous literatures presented in Chapter 2 were useful during the design phase of the prototype.

The second objective mentioned is to develop and incorporate software agent into electronic assessment module and the third objective is to evaluate the developed module based on the identified parameters. Hence, Chapter 3 explored out the requirement analysis of this agent-based approach of assessment module while Chapter 4 reported the implementation process of this prototype and chapter 5 explained about the system design of the system. Meanwhile, Chapter 6 discussed about the implementation of system. From this research, it can be concluded that both of these objectives have been achieved. Chapter 7 tabulated the testing and evaluation been done towards Target A
System. Overall, about 75% of the students thought the Target A System are useful. Meanwhile, about 90% of the teachers agreed that the system facilities are very useful. In addition to that, result from the test suggested that 75% of the students and 90% of the teacher believed that the Target A System is very easy to use and it responds accurately at the right time.

Section 8.5 describes the future enhancements that can be done to expand the functionality and usability of Target A System. Therefore, continuous improvements are the key to successfully build an ultimate enhancement of system.

There was vast amount of knowledge gained throughout the Target A System development. These include the following:

1. Knowledge in reviewing literatures

2. Knowledge in designing an Agent-based approach for supporting assessment in e-learning environments:
   a. Studying on software agent-based, e-assessment, architecture of software agent and etc.

3. Knowledge in research data analysis.
Last but not least, the knowledge gained through the computer science courses like an Agent-based, assessment online and Software Testing were literally put into practice.
REFERENCES


