CETLs: A COLLABORATIVE LEARNING SYSTEM TO SUPPORT STUDENTS GROUP ACTIVITIES USING THINK-PAIR-SHARE TECHNIQUE

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ABSTRACT

Collaborative learning (CL) is an educational approach for teaching and learning that involves groups of students working together to solve a problem. In many regions, CL has gained attention from a huge population and has been selected as an environment to promote high quality learning via internet in modern education. In order to support the CL approach, a web-based environment called Collaborative Environment for Teaching and Learning Science (CETLs) is developed where the students can interact with each other and their teacher through online. CETLs is designed for learning science subjects. CETLs uses collaborative tools such as e-mail, bulletin board, discussion groups and chatting modules whereby the assessment of the students is integrated using Think-Pair-Share techniques. CETLs is capable of handling tasks such as uploading and downloading notes and assignments, email and chatting. CETLs is implemented using ASP technology and Microsoft Access as a database. The system is developed using object-oriented approach which exploits the Rational Unified Process (RUP) Methodology. CETLs employs three-tier client-server architecture to enable web-based technology that opens the door for remote interaction. The system is tested for its usability by the teachers and students who are the primary users. The data has been gathered and analyzed using Microsoft Excel and SPSS. The result shows that teachers and students agreed using CETLs is an effective and interesting teaching and learning environments. Therefore, this collaborative learning environment can provide a platform for students group activities in their learning process and working together to improve their communication and individual skills.

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LIST OF ABBREVIATIONS

CL	Collaborative Learning
CETLs	Collaborative Environment for Teaching and Learning Science
ICT	Information and Communication Technology
IT	Information Technology
TPS	Think-Pair-Share
MSC	Multi-media Super Corridor
NITC	National Information Technology Council
TV	Television
CD	Compact Disc
CD-ROM	Compact Disc- Read Only Memory
CSCL	Computer-Supported Collaborative Learning
CMC	Computer Mediated Communication
HTML	Hypertext Manipulation Language
CMC	Computer Mediated Communication
CGI	Common Gateway Interface
WEBICL	Web-Based Collaborative Learning System
COVIS	Collaborative Visualization
VLE	Virtual Learning Environment
COMMIT	Collaborative Multi-Media Instructional Toolkit
RUP	Rational Unified Process Model
SDLC	Software Development Life Cycle
OOAD	Object Oriented Analysis Design
SPSS	Statistical Package for Social Science
RAM	Random Access Memory
SVGA	Super Video Graphics Array
IIS	Internet Information Server
IE	Internet Explorer
ASP	Active Server Pages
CSS	Cascading Style Sheets
VB	Visual Basic

SQL	Structured Query Language
GUI	Graphical User Interface
UAT	User Acceptance Testing

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

In the world of technology today, computers and the Internet play an important role in one's daily life. With the continuous emergence of technology and the growth of the Internet it is almost overwhelming. Usage of the Internet as a source of information and as a tool for teaching and learning is widespread in developed countries and particularly in the education field. As such it is a very useful tool as the intermediary or medium for learning. Generally, learning is the process of gaining knowledge or skills through study, experience or teaching. There are various types of learning that have been developed including traditional learning, distance learning, blended learning, web based learning and virtual learning. Besides those types, collaborative learning is a method which requires student and teacher to interact online in groups. Learning as a group can be more effective rather then individual, because in groups student can share ideas, discuss and argue to gain the solution. On the other hand when students study alone there are limited activities. For this research, the collaborative learning system called Collaborative Environment Teaching and Learning Science (CETLs) are developed to support students group activities such as uploading and downloading the notes and assignment, participating in collaborative class and checking emails. All the activities are conducted using Think-Pair-Share technique

1.2 BACKGROUND STUDIES

The development of information and communication technology (ICT) has shown rapid growth in various fields especially in the field of education. In the academic field, the pattern of education has changed widely because of ICT but its implementation towards

virtual learning is still inadequate. Jamaluddin and Hussin (2000) stated that the 'computer and Internet usage, especially for the students and teachers in Malaysia, are still low'. This might indicate that traditional learning is still the best method for both students and teachers. However, this situation is slowly changing. There is growing interest to enhance the field of education in order to be more efficient and thus ICT technology is becoming more applicable to education.

Smith and McGregor (1992) stated that the "Collaborative learning" is an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together. Usually, students are working in groups of two or more, mutually searching for solutions, or meanings, or creating a product. Collaborative learning process is an interactive process between students and teachers through online. It is one of learning strategies to encourage students and teachers communicate with each other in the context of learning process. Students have to help each other by sharing skills and ideas but not compete with their peers. They have to discuss and seek best solutions to solve the problems given by the teacher. Thus, the success of one student can lead to other students being equally successful.

In the learning process, there are two approaches that can be employed during learning activities whether individually or grouping. The individual approach means that students have to learn every thing on their own to gain and set the goal of learning. Grouping on other hand, encourages students to work as a team to obtain their goal. It is a process by which discussion and argument are involved in brainstorming for ideas on a particular subject or task given. Usually every person has their own opinion and ideas. In a group they can share this idea, discuss and argue with it, then select the best solution.

According to Petress (2004.) 'Group study involves sharing of: ideas, personal and collective time management, and task preparation; cooperation amongst group members; collective responsibility both for the group task and for each other's welfare; and a willingness to be an active group participant'. Obviously, if the group approach is organized wisely it will give students more benefits then working alone.

Rosni and NorAishah (2001) said that 'usage of IT equipment is important to ensure that the process of learning becomes more interesting'. Therefore, using the computer as a tool to support a collaborative environment makes the learning process, via the Internet, exciting thereby enabling learners from different locations to interact with one another synchronously (real time) or asynchronously (delayed). For that reason, the Internet and computer can be used as an interactive medium between teachers and students to exchange ideas that will lead to successful learning.

This research focuses on collaborative learning as well as identifying the techniques that can be applied during the collaborative learning process. Many techniques have been engaged in collaborative learning enabling students to learn effectively and quickly. Each technique has its own style and criteria, for example, jigsaw, brainstorming, roundtable and think-pair-share, and can make the collaborative environment more organized and the learning process more interesting.

The intention of this research is to provide the reader with a collaborative learning system using the think-pair share technique (TPS) as applied to secondary school students. The system is provided with a computer mediated communication tool that can support the students' group activity collaboratively.

1.3 PROBLEM STATEMENTS

Improving and enhancing the learning process in education fields is always the primary task of educational organizations. The reason to improve is to make the learning become more effective. This encourages the researcher to find out new approaches to learning in enhancing the learning process for the students. However, in relation to the learning process, there were many problems which are:-

1.3.1 Communication

Communication is the most important thing for teachers and students to ensure that the message transferred from teacher to students is precise and clear. Normally in traditional learning, the teacher acts as the provider and the students as the receivers whereby students tend to hear but later, they will forget. In other words, the learning process involves only one way communication. This prevents the student from participating in any situation that involves learning activities. Communication as understood by Luhmann (1996) is a 'three-fold process where information (as that selected by the communicator), the act of uttering a message and the process of building understanding (as a selection made by the addressee) are combined'. The success of the learning process depends on how well two-way communication between the student and teacher interprets the messages on the course subject.

1.3.2 Teacher Centered Approach

Ordinarily, a teacher has a class of students and is responsible for transferring appropriate knowledge on a given area to the students. The traditional structures and cultures help to perpetuate the teacher-centred approach, where all

the power and responsibility is based with the teacher. The teacher-centered approach relies more on the use of the textbook and lectures from the teacher only. Students usually tend to be passive or inactive during the class, and avoid asking questions with the teacher. Perhaps it is because of shyness and not confidence in themselves. O'Neill and Mcmahon (2005) describes the 'shift in power from the expert teacher to the student learner, driven by a need for a change in the traditional environment where in this 'so-called educational atmosphere, students become passive, apathetic and bored'. So the new approach of learning styles based on the student-centered-approach should be introduced in order to encourage the student be more active and brave to point out their own idea or opinion thus make educational field more competitive.

1.3.3 Time Management

Usually students have to follow the schedule met by the teacher on doing their activities such as assignments and quizzes. But with some reason such as sickness, student fails to come to the class to do their activities which cause them to lose their marks. From a student's point of view, the mark given is very important to them to gain the good results. According to Laferrière and Resta (2007) the flexibility of time and space can be a virtual one in which work is done by individuals who are distributed in place and time. This makes the students manage their time (flexible time) and can organized their activities such as upload/download the assignments and notes without any disturbance.

1.3.4 Less Usage of Computer

Over the years, the pattern of education especially in Malaysia is based on the traditional learning where all the learning process is conducted in the classroom. The learning process is conducted verbally and not supported with any learning aid tools such as computer. The usage of the computer as the learning aid tool are less preferred since some of the teachers are prefer not to use a computer as a medium of learning because it is time consuming and may be a lack of facilities or it appears less interesting. In addition, students do not find it interesting when the teachers does not provide an interactive and conducive environment when using a learning aid tool, thus leading to ineffective communication in the learning process**.** But, according to Hashim (2000), 'ICT development has changed the learning method that was previously used by lecturers. Traditional learning methods need to be supported by multimedia, communication and computer technology to be able to facilitate and support education'. Thus computer technology significant play role to enhance the learning process.

1.3.5 Individual Learning

Usually a bright student loves to study and have no problem to learn individually. But, an average student who has less interest in studying can easily to get bored when they study by themselves. They can learn effectively in groups where by they can have discussions and are able to share the ideas among themselves. According to Dennen and Wieland (2007) the 'learners must interact in some particular ways, engaging with each other and course materials which lead toward negotiation and internalization of knowledge rather than just memorizing of knowledge'. Having group activities frequently in learning process helps students

understand their course subjects. Students can help each other and provide such solutions together.

1.3.6 Textbook-based teaching

Over the years the teaching process is normally conducted through dictation, and is usually textbook-based. According to Taylor (2002), delivery, using traditional methods, generally required one instructor, a text book and whatever additional support materials the instructor was able to gather. Nevertheless, to transfer knowledge from a textbook to the students is a challenging task as the students become bored and believe that knowledge or information does not have value in itself.

The reason above shows that it is better to have the new learning strategies based on the student-centred approach called collaborative learning system that supports the student group activities. The system engages the students and teacher with a new environment that facilitates and supports the activities to accomplish their common goal. The system encourages them to be more thoughtful by contributing their ideas and understanding of the defined problem. Thus, creating a collaborative learning environment, supported with the elements of "*interactivity",* and *"collaborative"* can make the learning process become more interesting and effective. In a collaborative approach, the students take an active role in engaging with studies by constructing their own knowledge through enquiries, as well as participating in the learning process.

1.4 RESEARCH OBJECTIVES

The objectives of this research are:

1. To identify collaborative learning techniques and apply it in a collaborative learning environment framework.
2. To develop a web-based collaborative learning using think-pair-share techniques.
3. To evaluate the usefulness and ease of use of the system.

1.5 RESEARCH SCOPE

The research focuses on collaborative system to support the students' group activities between students and teachers. The groups activities are supported by the system called CETLs. CETLs is designed for learning science subjects and it is integrated using the Think-Pair-Share method. The think-pair-share allows the students to think individually, interact with their partner and share the information with all the students and their teacher. Through the system, the student can conduct their activities such as do assignments, upload and download notes and answer the questions that have been posted by the teacher in the collaborative class. During the students' activities, the student can use collaborative tools including email, bulletin boards, discussion groups and chatting modules. CETLs system manipulates and influences the students to work together and to improve their communication, positive interdependence, leadership, and individual accountability skills. Even though the collaborative learning system is developed for both students and teachers, the research is only focusing on the students and learning parts. Table 1.1 indicates the student's activities and modules involved in CETLs.

Table 1.1: Student's Activities and Modules in CETLs

Student's Activities	Module in CETLs Application
Register and Select Active Class	My Class Management Module
Do the collaborative class based on the Think-Pair-Share technique	My Collaborative Class Module
Upload and download assignment	Active Assignment Module
Download notes	Download Notes Module
Check mail inbox, compose email and add attachment of files	Messaging System Module
Change profile and password	My Profile Module

1.6 RESEARCH CONTRIBUTION

It is important that this research is done in a way to give students experience in a new environment of learning. Today, most schools are provided with personal computers and Internet connections. With the advent of this technology, CETLs will create a new environment (role) for learning, including permitting students to interact with responsive, dynamic environments that support active learning.

Collaborative learning is one of the new learning styles for students to work together with their friends and also their teacher. CETLs is developed using the collaborative technique, Think-Pair-Share (TPS) technique. The TPS allows students to think individually, interact with their partner and share the information with all the students as well as the teacher. This technique helps students to improve and enhance their knowledge by sharing all the information, ideas and skills.

CETLs provide synchronous and asynchronous tools such as electronic mail (email), chat room and bulletin boards. CETLs also allow the students to discuss matters, whether in school or at home. In other words, the technology has shown great value in support of communication and collaboration, including discussion and sharing articles and cooperative work regardless of time and distance.

CETLs also educate the student to be more active and participate during the learning process rather than to be a passive learner. This is because, as students they are required to do group activities and have to solve problems within the time given. This technique encourages the students to be more disciplined and confident since they have to communicate frequently using the system to gain the knowledge. Thus, contribution of ideas and thinking performance can lead the student to work together and to improve their communication and individual skills.

If the schools implement the CETLs, it will be easy to organize student activities such as uploading and downloading the assignment, giving quizzes and giving marks and comments to the students. It also makes the teacher work easier organizing time management since all the work and activities are done in online. For the coordinator, they also have the benefit of monitoring all the students and teacher's activities transparently, since the coordinator has the authority to rule the system.

Last but not least, this research also highlights the use of software engineering in the field of educational and examined the knowledge to be taught and skills to be acquired from the aspect of software engineering specialization.

1.7 THESIS ORGANIZATION

This thesis will contain seven chapters as outlined below:

1.7.1 Chapter 1

This chapter gives an overview of the thesis, background study, problem statements, research objectives, research scope, research methodology and contributions.

1.7.2 Chapter 2

This chapter provides an overview of Information Communication and Technology (ICT), Internet education, learning, the theory and types of learning, group learning, group composition, group activities, overview of collaborative learning, techniques in collaborative learning, how CL supports students group activities, comparisons between traditional and collaborative learning, the collaborative framework, modes of interaction between student, teacher and contents, computer mediated communication (CMC) tools, research about similar existing systems, comparisons of the system and summary.

1.7.3 Chapter 3

This chapter discusses the collaborative learning approach, proposed techniques (TPS) for the CETLs system, overview of the adjusted CETLs framework, advantages and disadvantages of TPS towards the development of the CETLs and summary.

1.7.4 Chapter 4

This chapter describes about methodology that is used for system development. It also discussed the process in RUP methodology for development of CETLs.

1.7.5 Chapter 5

This chapter outlines the hardware and software requirements of the CETLs, functional requirements, system requirement analysis represented in the use case diagram, non functional requirements and summary.

1.7.6 Chapter 6

This presents the architecture of the system, details of the design, a class diagram, component diagram, and deployment diagram. This chapter also discusses the data dictionary of the database, user interface design of the CETLs and summary.

1.7.7 Chapter 7

This chapter discusses about implementation of the system, system flow consists of the activity of the users in the system, execution of the system from the users point of view, testing, the types of testing, unit testing and user acceptance testing, test cases, analyzing the questionnaire and summary

1.7.8 Chapter 8

The final chapter summarizes the results by reviewing the objectives and examining whether the research achieved them, drawbacks of the system and possible future research.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

The purpose of this chapter is focuses on the analysis and effectiveness into a general perspective of Collaborative Learning. This chapter presents an overview of collaborative learning that includes ICT, Internet education, learning process, theory of learning, collaborating process, model design, techniques and usage of all these components.

2.2 INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

ICT has instituted successful global changes in the field of education. Malaysia is not far behind in this approach. The government and people of Malaysia have realized the significance of ICT. Every year the number of Internet users in Malaysia is increasing and more people are using ICT.

ICT is helping the educational industry to channel the students' attention towards a more pleasurable learning environment by introducing a multimedia mode of education. Malaysia has declared a Vision 2020 Plan for all the industries and has established the "Multi-media Super Corridor (MSC)" near Kuala Lumpur, the capital city. The MSC has developed a "Smart School" prototype with the objective of transforming all schools in Malaysia to adopt the concept of "smart school" by the year 2010. The government is very much committed towards this concept and plans to support it by providing computer laboratories to thousands of schools. The aim of the smart school is to produce versatile citizens who will lead the country in the future.

ICT also creates a high-tech ambiance by providing a new learning package for the students. This allows students to use computers and online methods to learn rather than rely on the traditional black/white board methods.

The Malaysian government's recognition and emphasis on the importance of ICT in the development of the nation resulted in the formation of the National Information Technology Council (NITC) in December 1996. The NITC promotes the use of ICT to produce a value based knowledge society. The NITC formulated the NITC Strategic Agenda to transform Malaysia into an e-world. The NITC Strategic Agenda targets five critical areas including E-Community, E-Public Services, E-Learning, E-Economy and E-Sovereignty. Based on these five areas, seven concepts have been formulated. The seven concepts are e-government concept, multipurpose card concept, e-learning concept, Manufacturers Support Network, World Wide Manufacturing Web, e-marketing concepts, tele-medicine and research and development concept (National IT Council Malaysia, 2001).

2.3 INTERNET IN EDUCATION

Lindbeck and Snower (2000), stated 'computer use is deemed increasingly important in modern societies. Computers and the Internet have introduced dramatic changes to work processes and to the organization of corporate structures over the past decade'.

In the field of education, the Internet has become one of the major sources for students to obtain information easily. The facilities and tools such as search engines,

forums, bulletin boards, electronic mail, and messenger service (chatting) are widely used by students to get information. Each of the tools has its own privileges. Online tools have provided the educator with a variety of ways of communication with their students and for students to communicate with each other. All those working with online instruction agree that interaction is an important aspect to online learning. The quality of technology- based educational materials is determined by how well students can ask questions or discuss materials with other students and how interactivity provides the students with the means of being actively involved in learning activities. Increased interaction improves students' achievement and attitudes toward the learning process. Moreover usage of the Internet creates borderless information repositories for educators and learners alike.

The role of the Internet is not just for transmitting information but as a tool for teaching and learning. Romiszowki and Mason (1996), listed privileges distinctive in the Internet as a teaching and learning tool through which one can educate or learn without the restrictions of time. In addition, the Internet has its own mechanism to achieve hypermedia and information. It also presents a cognitive skill in processing the information and solving problems in a creative way. This can be achieved with technology such as multimedia, and hypermedia using the Internet as the medium of communication.

2.4 LEARNING

Learning is a process of gaining knowledge and skill either formal or informal. People get their formal knowledge in education institute such as school, college and university as a learning process, informal knowledge in other hand can be retrieved through experience in daily basis such as see what other people do and advice, learn from own mistake and watch a TV-knowledge programme (National Graphic as example). People

who involve in formal learning as a learner called student and people who teach the student called teacher, tutor or lecturer. As a student, they have two approaches of studies which are individual study groups study. From those approaches, the student will best study in group rather then individual is undeniable. According to Gerdy (1999), 'learning is enhanced when it is more like a team effort than a solo race. Good learning, like good work, is collaborative and social, not competitive and isolated; sharing one's ideas and responding to others' improves thinking and deepens understanding'. By sharing the idea it provides an opportunity for team members to collaborate and gather information that can improve the solution.

The students can learn more effectively to express an idea, comprehension and can produce good ideas to share with others. It is differ when student study alone without partner, he/she can not have a discussion and argument which is vital in understanding a subject. Individual learner also have a limited idea as compared to group study which they can share their idea and raise an opinion unless he/she do a lot of reading which is time consuming. In fact not all reading material full of information or related to their subject course, if time is crucial matter thus study alone, effect to the student. There is where group effort comes across helping students. It is important for learners to understand the importance of learning and its significance for success, particularly in the academic fields.

2.4.1 THEORY OF LEARNING

The pioneers of dominant theory groups in usage of technology in education are Behaviourism, Cognitive, Constructive and Social Constructiveness. This theory shows every aspect of how the process of learning takes place. Table 2.1, shows the learning theories as mention by Hung *et al*. (1999).

Table 2.1: Learning Theories

Aspect	Behaviourism	Cognitivism	Constructivism	Social Constructivism
Learning Theorist	Skinner	Gagne	Brunner, Piaget	Vygotsky
View of the learning process	The behaviour that produces motivation or movement towards gratification of needs	Learning resulting incorporated input into existing cognitive structures	Knowledge is built by individual	Knowledge is built in social ambience
Learning Definition	Students respond as expected and are accurate. Response and Memorizing	Students can use a principle and concept. Usage of law and Memorizing	Students build and use their own knowledge. Real Situation in solving internal problems and investigation	Students build, share and agree with the social knowledge. Collaborative learning and problem solving
Learning Strategy	Repetition, Step by step and gradually	Deduction: Receive a general principle concept and practice and usage	Induction: Collect the irregular information and build principle concept	Share and exchange information, idea and thinking.
Computer Usage	Training	Tutorial and database	Simulation and induction tools	Generic environment and collaborative

Table 2.1 represents the learning theories and classifies the aspects of the learning process. From the Table 2.1, the theories by Brunner and Piaget and Vytogsky emphasize the concept of learning through collaboration. The Constructivism aspect shows that interaction through the environment can lead to the gathering of meaningful information by the students to construct their knowledge base. This can be done by using simulation and induction tools.

Social Constructivism gives an opportunity for the students to share their knowledge in a social ambiance. The students can build their knowledge and share the information collaboratively by using computer tools and communicate using web-based learning. This approach enables students to share and exchange information, ideas and thinking with other members as well as the instructors.

2.4.2 TYPES OF LEARNING

2.4.2.1 Traditional Learning

Traditional learning or the face to face method has been used in the educational field for a long time. The modes of learner interaction are based on learner-instructor and learner-content. The idea is to provide the information to the students through the instructor during lectures and the provision of printed course materials. Based on Figure 2.1, as mention by Roberts (2003), knowledge is usually transferred in one direction, which is from the instructor to the student. Students are the receivers of information, and the teacher is the distributor. Much of the assessment of the learner is focused on the importance of one right answer. Traditional education is more concerned with preparation for the next grade level and school success

than with helping a student to learn throughout life. Figure 2.1 explains the traditional learning method between the educator (teacher) and students.

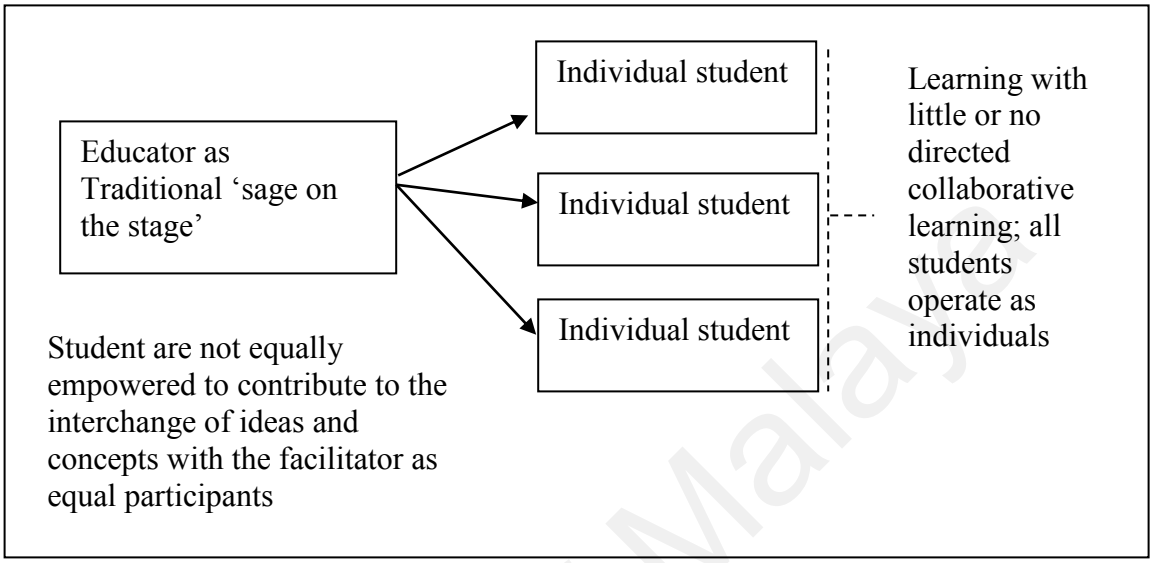


Figure 2.1: Traditional Learning

2.4.2.2 Electronic Learning

According to Rosenberg (2001), E-learning is defined as the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance. E-learning is simply defined as education via the Internet, network, or a standalone computer. It also refers to instruction delivered via electronic media including the Internet, intranets, extranets, satellite broadcast, audio/ video tape, interactive TV and CD-ROM (Govindasamy, 2002). According to E-learning Network (2000), there are four common types of E-learning stated in Figure 2.2 such as:-

2.4.2.2.1 Conventional Type

Conventional learning is the process of one way communication between the students and instructor. Usually, the

process of learning is done in the classroom. This type also uses other electronic device such as Television and Radio.

2.4.2.2.2 Distance Learning

Distance learning is the most common among the three modes of e-learning. The process involves sending physical data to a student. The physical data – course materials including study notes, textbooks, audio cassettes, and video tapes can be sent by post. Basic ICT technologies such as CD-ROM and diskettes can also be used. Communication in these modes of learning can rely on paper-based materials, telephone conversation and also email.

2.4.2.2.3 Web-Based Learning

The web-based learning system focuses on delivering learning materials via the Internet. This environment requires that all study materials are created and stored on the servers. The students are provided with an appropriate user-name and password in order to enable them to access and use all the materials at their own convenience. Email, bulletin boards, forums, chatting and hyperlinks are the characteristics of the web-based system. The web-based system can also be used for collaborative learning.

2.4.2.2.4 Pure Virtual Learning

This type of education is a combination of Distance learning and Web-based learning. In this mode, the students and

instructors rarely come face to face and the students can access online materials. The period of studies and teaching depends on the availability of the students and the instructors. It is an interactive learning by combining all the tools such as video conferencing an interactive videos, emails and chatting tools. This mode also uses CD learning packages.

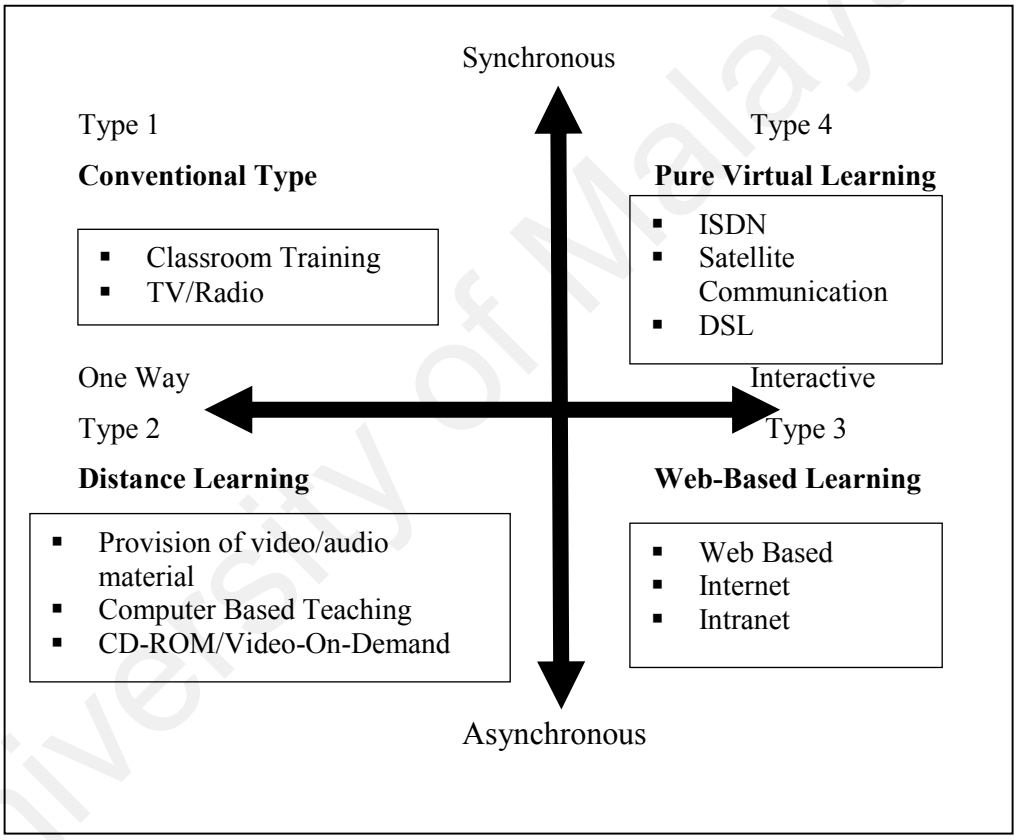


Figure 2.2: Types of E-Learning in Malaysia

2.4.3 GROUP LEARNING

Group learning involves a group of students working together as a team to overcome any situation in a learning process. In this team effort they can share their ideas to solve a given problem. The students can do their activities in such way that they can discuss together, brainstorm the ideas and seek the best solution.

During the learning process, the team members can express own ideas and interpret the knowledge in different ways. This can enhances their level of thinking to be creative and thoughtful. When the students learn in groups, the process of two-way communication will occur. This makes the learning process become more interesting whereby each of the team members in the groups must respond to each other by giving their opinion in order to make the learning process successful. According to Petress (2004) 'studying in groups will enhances the students' social skills and helps the students to bolster their confidence and practice assertiveness'. This can helps especially for a shy student to express the ideas in a group. In the context of collaborative learning, the group learning is more on the student-centered approach that enables the students to build and share the knowledge and indirectly give the learner a more active and more constructive role. One factor that determines the efficiency of collaborative learning is the composition of the group. This factor is defined by several variables- the age and levels of participants, the size of the group and the difference between group members.

2.4.3.1 GROUP COMPOSITON

Although there is only limited research in Computer-Supported Collaborative Learning (CSCL) on the effects of the size of the group, there is a recognition that group size depends on the scope, duration, and complexity of the task. The learning group, however, needs to be small enough to enable students to participate fully and to build group cohesion (Barkley *et al.* 2005). The reason behind this approach is that students are forced to collaborate in order to accomplish a goal because of task demands and the manner in which information necessary for accomplishing the task is

distributed. An elementary method is to distribute expertise among group members in early stages of group formation (Hermann *et al.* 2001). This method implies that only groups in which members exchange their resources or put them together can successfully complete a (learning) task. Therefore, in order to make the process of learning effective and interesting, students must work in a group so that as learners they are exposed to multiple perspectives on issues and tasks which are based on the diverse backgrounds and experiences of the other members of the group. According to Johnson *et al.* (1998), there are three types of groups which are informal, formal and base groups. These will be described in the following section.

2.4.3.1.1 Informal Groups

Informal groups consists of having 'students work together to achieve a joint learning goal in temporary, ad-hoc groups that last from a few minutes to one class period. The concepts of the formal groups are faster whereby the instructor/teacher gives quick instruction to the students and they need to come out with the answer. During the activities, the teacher asks the students questions every 10 to 15 minutes, to discuss what they are learning. The structure of the group is changes every time the new class begins. This is to promote the interdependence skill of each student to be more focused to elaborate the answer. Advantages:-

- Quick responses from students.
- Easy for teacher to check on student performance.

2.4.3.1.2 Formal Groups

This type of group is used to focus students' attention on the material to be learned. Usually, the students work together for one period (e.g one or two week) to achieve the learning goals. Johnson *et al*. (1998) stated that 'the formal learning is students working together, for one class period to several weeks, to complete tasks and assignments'. Here the students are expected to interact with group mates, share ideas and materials, support and encourage each other's academic achievement. The interaction among friends helps to solve the problem through discusses the important point. This formal leaning group is more on the students it self whereby the students encouraged to help each other before the teacher guides them. Advantage:-

- Student –centred approach.
- Independent.

2.4.3.1.3 Base Groups

Base groups are long-term groups with constant membership that support other members in terms of helping and guidance to them for completing their course and assignments. Johnson *et al.* (1998) stated that the 'primary responsibilities of the members are to provide each other with support, encouragement, and assistance in completing assignments, hold each other for striving to learn, and ensure all members are making good academic progress'. Base groups are appropriate when the number of students

in class is large and subject matter is complex. Thus, the base group shall be functioning to helps the students to enhance their performance in academic fields. Advantage:-

- Can help other students to improve learning process.
- Fixed membership

2.4.3.2 GROUP ACTIVITIES

To form a group, at least two people are needed. Working as a group is better then working individually as many activities can be develops when people work in group. The numbers of activities that can be developed depend on how many members participate in the group. In groups, people can have a conversation with each other as one of the activities. In the context of learning, the activity enables students to be successful in examination. There are various possible activities where can be employed when students work as a group.

One of the common activities is discussion. Students can always discuss and argue about any subject in order to get the best solution. Together they can brainstorm their ideas and share with each other. Since their work as a team, they can divide a complex issue into smaller issues that can save time. When gathering information, students are able to retrieve large amounts of information especially there are many member in the group. As a review session, students could conduct a quiz activity in which one of the students can ask questions and others can provide the answer. This is good for memorizing the point and fact. Assignment and presentation

activities also can be done in groups when students are required by their teacher to do such activities as a group. If the group is well organized and every member in the team strives to give their good effort, the team can produces a good result. If some of the member not participate but they can still earn the credit, it makes other member feel not satisfy.

2.5 COLLABORATIVE LEARNING

Collaborative learning (CL) is an environment where the interaction centred by a group of students with teacher as a facilitator to guide them towards achieving a common goal. Unlike traditional learning that practicing one way communication where only the teacher actively giving a speech while student passively listen and busy making notes. Collaborative learning urge students to be independent and responsible for their own learning not just rely on teacher input. Discussion, argument, sharing ideas and information among students are the main ingredients in CL. Teacher as facilitators also take part in contributing an idea and opinion to support students learning.

2.5.1 Theory

'In particular, collaborative or group learning refers to instructional methods that encourage students to work together on academic tasks. Collaborative learning is fundamentally different from the traditional "direct-transfer" or "one-way knowledge transmission" model in which the instructor is the only source of knowledge or skills' (Harasim, 1990).

According to Harasim, collaborative learning refers to instructional methods that support the students while working together on academic tasks and also a way of direction for the student and teacher to cooperate in getting and delivering

information. Collaboration between a learner and their peers is done through the sharing of doubts, questions, and comments so that the learning process is complemented. This interaction of peer relationships makes the process of learning more achievable where the students can learn new things, share ideas and skills. The main purpose of collaborative learning is to let the students discuss with each other and get more knowledge through friends or group members. It is useless for students if the package simply delivers and lets students memorize. Dillenbourg P. (1999) collaboration concerns four aspects of learning:-

i. A ***situation*** can be characterised as more or less collaborative (e.g. collaboration is more likely to occur between people with a similar status than between a boss and their employee, between a teacher and a student.)

ii. The ***interactions*** which do take place between the group members can be more or less collaborative (e.g. negotiation has a stronger collaborative flavour than giving instructions).

iii. Some learning ***mechanisms*** are more intrinsically collaborative (e.g. grounding has a stronger collaborative flavour than induction).

iv. Concerns the ***effects*** of collaborative learning.

Initially, collaborative learning brings advantages to the students and teachers. For the students, it makes them more responsible and able to think creatively which may lead in good decisions making. It also provides a better education support and cultivates new ideas within a conducive learning

environment. Figure 2.3 as proposed by Roberts (2003) shows the interaction between educator (teacher) and the students.

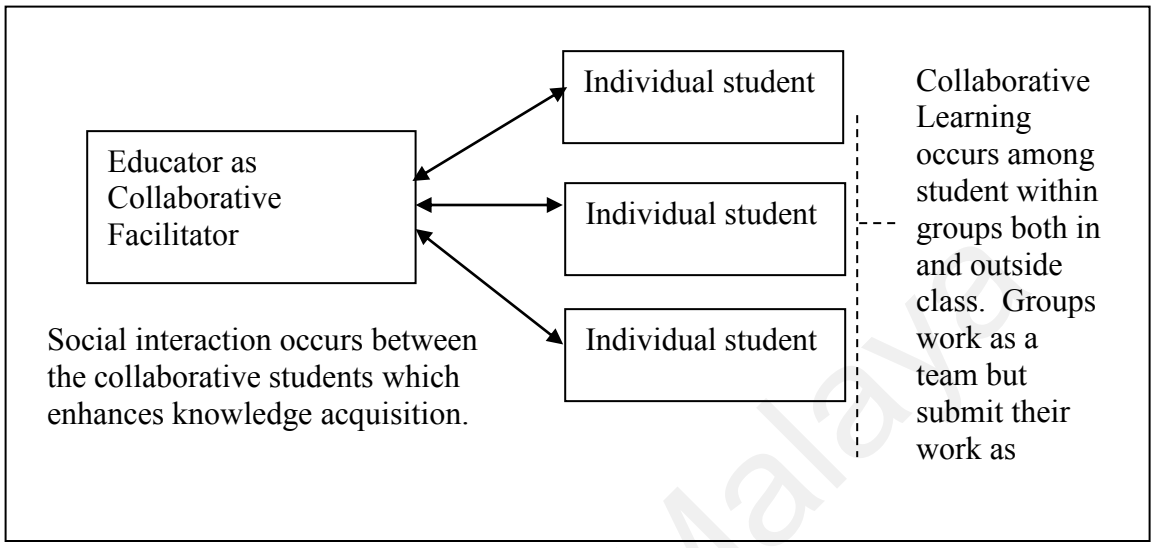


Figure 2.3: Collaborative Learning

2.5.2 Overview

CL needs a good platform to be operated in order to be effective. ICT has been recognized as the most practical platform for CL. Carlos *et al.* (2000) stated, 'Collaborative learning supported through computers seems to be very promising, since advances in computational technology enable the widespread use of tools such as bulletin boards, chats, whiteboards, and video-conferences'. Through ICT with dedicated software, students and teacher may communicate each other as a learning process via online to meet the objective of gaining knowledge in a virtual class. There are two modes in communication online namely as:

- Synchronous as a real time interaction such as chatting, messaging and video conferencing.
- Asynchronous as off line interaction such as forum, email and delayed telecast

Since the learning process executes virtually and a teacher may not be present, student may not be able to participate and use the collaborative tools as expected. Student may ignore other student and worst still they did not participate at all. As such it is so importance for teacher or administrator to monitor student's activities. For that reason, collaborative profile has proposed to monitor student whether he or she is an active participant or not. Carlos *et al.* (2000) stated, 'In order to support study groups in this environment, the definition of learner collaboration profile is proposed'. Students are required to fill in their personal information data in the profile during registration so that administrator is able to locate the student, to record student personal information and organize student activities. Figure 2.4 show the collaborative learning environment according to Carlos *et al.* (2000).

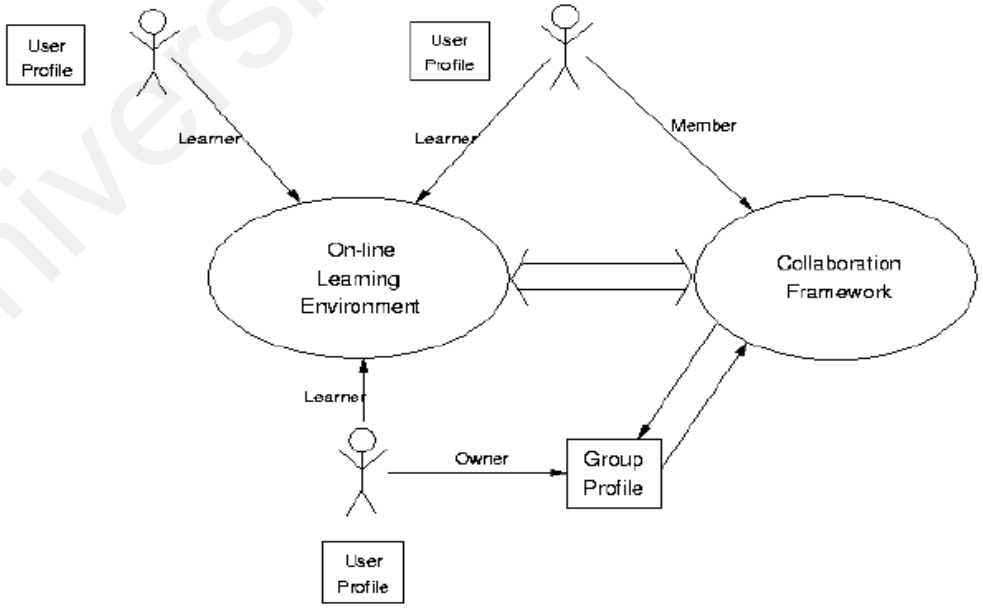


Figure 2.4: Overview of a Learning Environment with Collaboration

'Usually, collaborative learning environments emphasize Computer-Mediated Communication (CMC), with tools to integrate email, bulletin boards, whiteboard and chat rooms into HTML pages'. (Collins-Brown, 1999). Collaborative learner use collaborative tools to interact with peers, teacher and administrator. There are varies of collaborative tools designed for users, such as forum, email and chatting which the selection of those tools depending on requirements. In this context, groups have to be previously assigned to work together, and the environment administrator must create the corresponding of the e-groups. It is assumed that the group will work together to achieve a common understanding from this community of learners.

According to Baharuddin (2000), 'an online learning session will provide an interactive environment between students and teacher, control information and also give response and feedback to the input given'. This indicated that collaborative learning should provide a manageable environment to control and organize user activities. Despite users may not require a specific time and location to participate in collaborative learning since the communication will be in asynchronous mode, their activities are still manageable to be monitor. Thus the concerns about user participation no longer exist, even the learning process in a virtual environment.

2.5.3 Process

The process for collaborative learning in the literature mostly aims to describe the activity-chain of collaborative learning activities or serve as a basis for the design of computer support for the activities of collaborative learning.

According to Kienle (2006), the process of the computer supported collaborative learning introduced here includes four steps:-

1. The first step is be initiated by the moderator. The moderator will prepare the task and offer the workspace for the students and teacher to do their activities in a collaborative class. The task is to prepare the groups, course structure and add any learning contents into the system. The moderator can be either a teacher or coordinator.

2. Secondly, the participants who are the teacher and students will work on their own material. For the teacher, the process of elaborating, editing and exporting the material and knowledge will be the primary task. These activities involved navigating, copying and searching.

3. Thirdly, the students do their activities that have been instructed by the teacher. The students will interact with the teacher to work with the learning materials (e.g. annotating or linking) that been uploaded by the teacher.

4. Fourthly, the teacher and students can collaborate by discussion and negotiation. The students will ask questions to the teacher. The teacher will discuss and come out with solution.

These steps rely on the participants' collaboration but should also be supported by the system's functionality. Figure 2.5 shows the process of collaborative learning described with the semi-formal modelling method SeeMe.

The goal of SeeMe is to include contingencies of human action and communication in a modelling method (Herrmann *et al.* 2004).

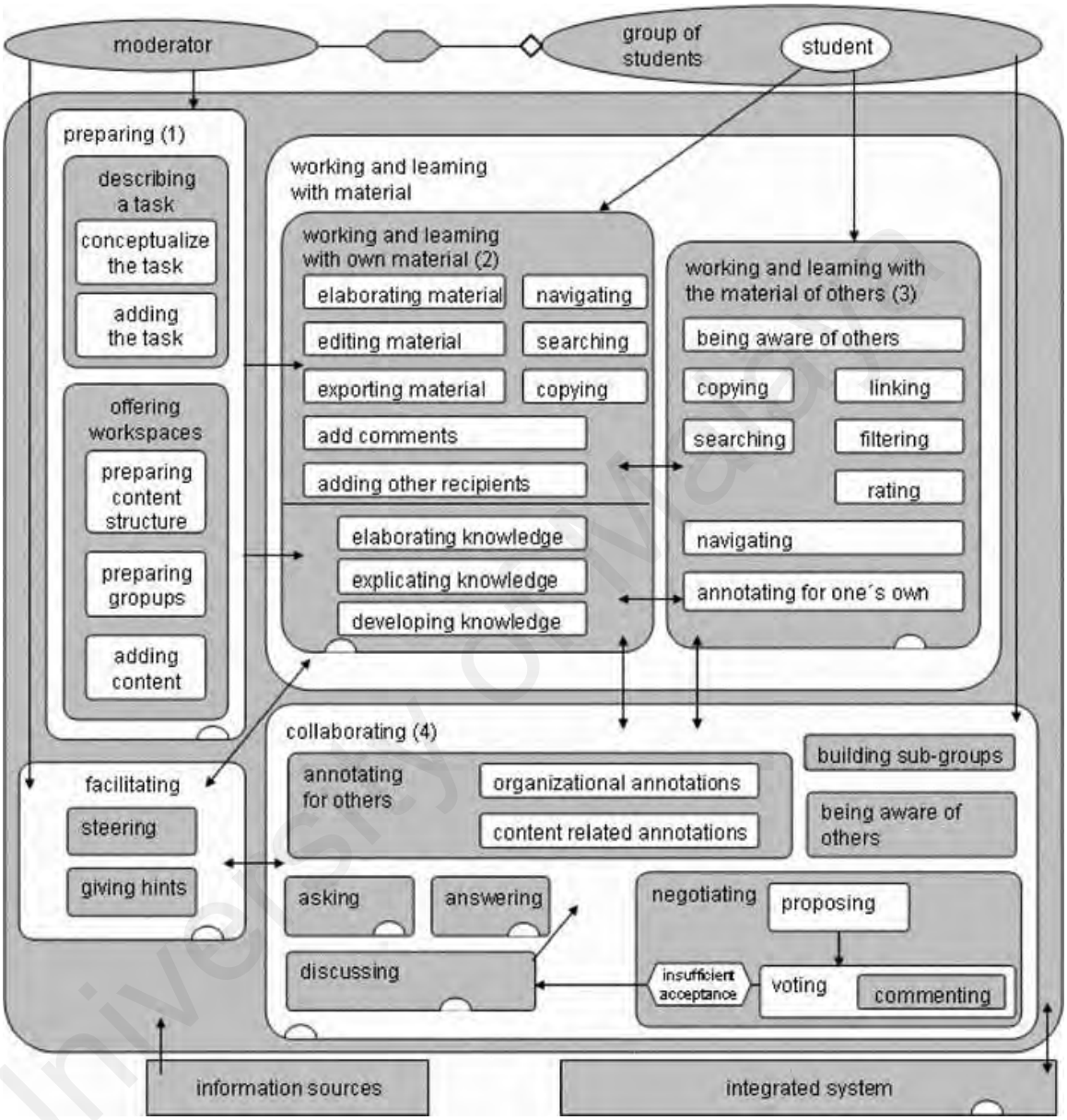


Figure 2.5: The Process of Collaborative Learning

2.5.4 Techniques

Many techniques can be applied in a collaborative learning environment to help the students learn effectively and more quickly. These techniques are designed systematically for students to interact together with their teacher and peers. These

techniques enhance the learning process making it more effective and interesting. For the purpose of this research, there are five important techniques which are discussed.

2.5.4.1 Jigsaw

It is a "Divide and Conquer" technique. The class is divided into the same number of groups, and identify one member from each team. One part of the reading will be given to each team so that they can digest and prepare to explain to their team. Then the students are rearranged so that each team has someone who has read one of the self-contained parts, and each student will be taught their part of the reading to the rest of the team. Table 2.2 list the advantages and disadvantages of the Jigsaw technique.

Table 2.2: Advantages and Disadvantages of Jigsaw Technique

Advantages	Disadvantages
- Builds a depth of knowledge.	- Students must be trained in this method of learning.
- Discloses a student's own understanding and resolves.	- Requires an equal number of groups.

2.5.4.2 Round table/Brainstorming

The tutor asks a question using audio collaboration or text chat. Furthermore the tutor can write the question and upload it to the presentation table as a document. The learners can answer the questions using audio or text chat. The learners can use the brainstorming tool in order to write and attach their ideas. Table 2.3 list the advantage and disadvantage of the Round table/Brainstorming technique.

Table 2.3: Advantages and Disadvantages of Round table/Brainstorming Technique

Advantages	Disadvantages
- Have brainstorming tool.	- Cannot share application.

2.5.4.3 Pairs Check

Discussion is done in pairs on a set of exercises. Two members of the pair work together with the first member working on a problem while the second member coaches and vice versa. Afterwards they can check the answer with another pair. Finally all problems and inconsistencies can be resolved. This process is repeated for subsequent exercises. Table 2.4 list the advantages and disadvantage of the Pairs Check technique.

Table 2.4: Advantages and Disadvantages of Pairs Check Technique

Advantages	Disadvantages
- Quick learning.	- Process can be repeated again and again.
- Two way interaction.	- Complex.

2.5.4.4 Pairs Annotations

Students pair up to review or learn same article, chapter or content area and exchange double-entry journals for reading and reflection. Students discuss key points and look for divergent and convergent thinking and ideas. Together students prepare a composite annotation that

summarizes the article, chapter, or concept. Table 2.5 list the advantages and disadvantages of the Pairs Annotations technique.

Table 2.5: Advantage and Disadvantage of Pairs Annotations Technique

Advantages	Disadvantages
- Quick learning.	- Beginner student feel difficult to use the annotations.
- Highlight the important point.	- Complex.

2.5.4.5 Think – Pair – Share

Think-Pair-Share is when the students are studying and sharing the knowledge in pairs. The tutor poses a question or problem as a file on the presentation table or using audio/text chat. Students think about each question, pair off and discuss the question with a classmate, and share their answers with the class. Table 2.6 list the advantages and disadvantages of the of Think-Pair-Share technique.

Table 2.6: Advantages and Disadvantages of Think-Pair-Share Technique

Advantages	Disadvantages
- Students can work independently in 'think' stage - Students can share/enhance their thinking when discussing with other partner	- The duration for think-pair-share is too short. - Students must be trained in this method of learning.
- Share the knowledge to the public.	- Discussion only happens between two learners.

2.5.5 How CL Support Students Group Activities

Encouraging group activities for students are vital in CL due to it is student-centred approach. If student have lack participation, the purpose of CL can not be achieved. There is where collaborative tools play an important role to support student's group activities. Since collaborative tools are varies, introducing a suitable tools are necessary to meet a specific requirement.

By using appropriate tools, CL can support student group activities by introducing a discussion session where student able to brainstorm and make an argument to produce a solution for particular subject. This session benefit student to be more active hence activate their intelligent thinking. Forum session encourage students to raise their opinion, share ideas and information as suggestions and supplements towards the learning process. Apart from that, this session will also enhance student's knowledge. According to Yokomoto and Ware (1997) 'group quizzes can be used to promote discussion and peer teaching by structuring them so that students are given a minute or two to discuss the quiz before attempting a solution'. Apparently, introducing group quizzes is practical to support student group activities, this approach required students as a group strive to find the answer by support each other sharing their knowledge and idea.

2.5.6 Comparisons Between Traditional and Collaborative Learning

The table below shows the comparisons between collaborative learning and traditional learning done by (Theroux, 2000).

Table 2.7: Comparisons between Traditional and Collaborative learning

Traditional Learning	**Collaborative Learning**
A teacher centred environment	A student centred environment
The teacher is in control.	Students are in control of their own learning.
Power and responsibility are primarily teacher centred.	Power and responsibility are primarily student centred.
The teacher is the instructor and decision maker.	The teacher is a facilitator and guide. The students are the decision makers.
The learning experience is often competitive in nature. The competition is usually between students. Students resent others using their ideas.	Learning may be cooperative, collaborative or independent. Students work together to reach a common goal. Students willingly help each other sharing/exchanging skills and ideas. Students compete with their own previous performance, not against peers
Series of smaller teacher defined tasks organized within separate subject disciplines.	Authentic, interdisciplinary projects and problems
Learning takes place in the classroom.	Learning extends beyond the classroom.
The content is most important.	The way information is processed and used is most important.
Students master knowledge through drill and practice.	Students evaluate, make decisions and are responsible for their own learning. Students master knowledge by constructing it.
Content is not necessarily learned in context.	Content is learned in a relevant context.

Table 2.7 shows the differences between traditional learning and collaborative learning. In traditional learning, students learn in class using face-to-face communication where they can receive a quick prompt response. Traditional learning is more teacher-centered where all the instruction and content are based on the teacher. Collaborative learning is a student-centered approach that requires students to collaborate and participate virtually in forums or through emails using text to communicate. The learning process becomes more interesting with support from the computer technology. The students can evaluate, make decisions and are responsible for their own learning and master knowledge by constructing it.

2.6 COLLABORATIVE FRAMEWORK

In order to develop a collaborative learning system, the framework or the backbone of the system must be defined. There are a number of frameworks from which the skeleton of the development of process can be chosen. Details of the frameworks are given below:

2.6.1 System Process Framework

This framework is designed by Dimitracopoulou (2005), for secondary schools. Figure 2.6 show that the process of learning collaboratively must consider four fundamental considerations.

i. A vision of all agents and cognitive systems involved in collaboration learning settings

ii. A complete view of the necessary tools and functions supporting collaborative learning.

iii. A vision of a mixed category of collaborative learning system.

iv. A vision of the control of the collaborative process as distributed to all the Agents

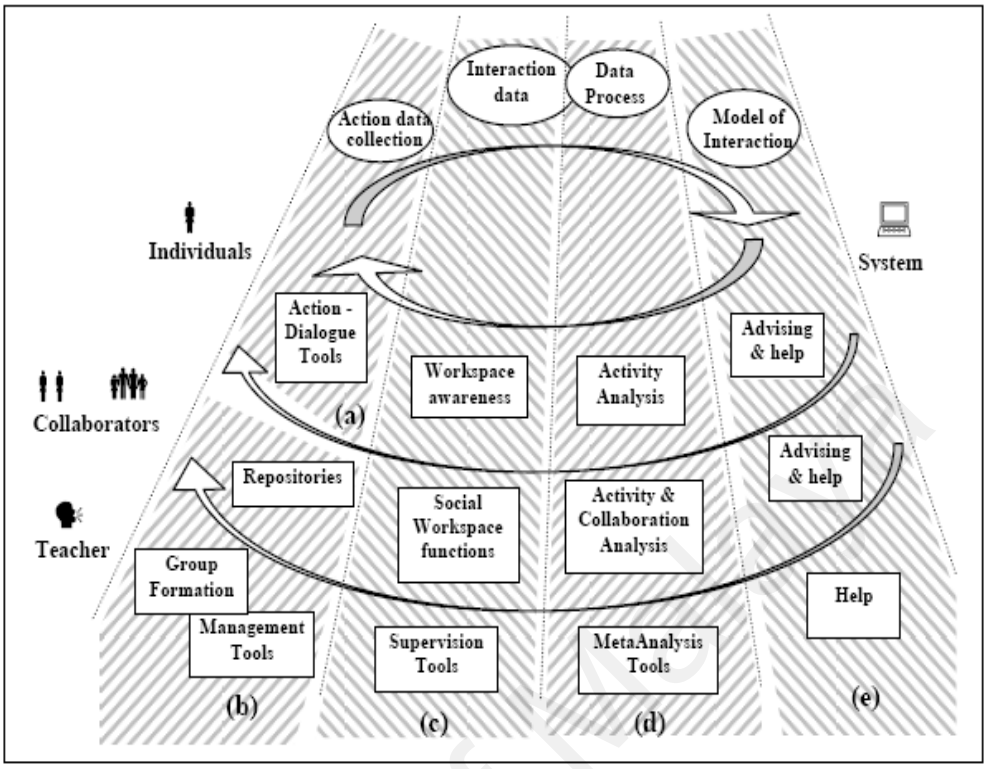


Figure 2.6: System processes during collaborative activity that offer tools and functions

2.6.2 A vision of all agents and cognitive systems involved in collaboration learning settings

There are two important main components involved in the system which are the student and the teacher. This component seems to be considered in some collaborative environments as a learning community formed of individuals and groups. These components are the agents that must be considered during collaborative activities. The components are divided into four categories which are:-

2.6.2.1 The Individual

Learners who study alone are considered as individual learner. Usually, all the activities are done independently.

2.6.2.2 Each Specific Team

Team mean more than one person. The student is pairing with another student to do some activities. Each of the teams can discuss within their group and try to answer the questions or activities set by the teacher.

2.6.2.3 The whole learner that is formed

The students can share their answer and knowledge among their team and their friends after finishing their activities. Here, the team and teacher can collaborate to discuss what they have done in the previous stage.

2.6.2.4 The Teacher

The teacher can check the student's answers and share with all the team members.

2.6.3 A complete view of the necessary tools and functions supporting collaborative learning

During the collaborative learning process, there are five general functions involved to support a collaborative learning process. These five functions are:

2.6.3.1 Action and Discussion

In the learning process there are tools that assist and help the students achieve what they want to choose and learn. These tools produce an action, text production and dialogue tools. For this function, interaction of students can take place within a community by using a variety of Net-

based, synchronous and asynchronous communications for example video, audio, computer conferencing, chats, or virtual world interaction.

2.6.3.2 Course Management

The teacher manages the learning materials and tools such as repositories, group formation and organize work. Basically, the teachers form the group and manage all the resources by uploading all the notes, tutorials, discussion points and any information to the database. Here, all the information is placed in repositories and the content can be accessed by the learners and other teachers.

2.6.3.3 Workspace Awareness

Important function tools related to the wider environment learning community. Here the student and their partner will carry out the activity given by the teacher in the collaborative environment.

2.6.3.4 Analysis and Meta Analysis Tool

Support self-regulation and meta cognition for students, including tools for the teachers to supervise and analyze collaborative interactions either online or offline. The teacher can monitor students during the learning and teaching process.

2.6.3.5 Help and Advising Functions

Important functions to help and assist students and teachers. The teacher helps the students and give guidance to the students. The teacher

should answer all the questions that have been asked by the students in the virtual learning process as long as all the content is in the subject syllabus.

2.6.4 A vision of a mixed category of collaborative learning system

Analyzing what kind of tools is developed in the system. For this system process, there are two dominant systems, a system that focuses on the collaboration between small groups of learners and a system that develops the beginning of a wide community of learners. These two categories can be sufficiently developed for each kind of environment to solve problems and exchange ideas.

2.6.5 A vision of the control of the collaborative process as distributed to all the Agents

The expansion of the collaboration management would be possible according to an approach based on a number of principles. The components involve are the individual, collaborators, teacher and systems. This expanded collaboration management is possible according to the human and artificial elements. All the agents are involves during the collaborative process. This make that each of the agents have their own objectives, thus controlling their own task.

According to the four fundamental considerations above, it shows the process of collaborative learning system involves three agents as a user. The users are the individual, collaborators and teacher. From the Figure 2.6, each of the users can interact with each others simultaneously in the collaborative learning system. The collaborative learning system collects the data internally from each user's actions as well as the interactions among all participants. Then, the system process this data, and eventually constructing a

model of actions and interactions. This framework shows that each of the users has their own activities. The individual student has available the tools for action and dialogue in order to function in a private workspace which lead his/her to do own activities. From the process, the individual student may interact together with their friends and collaborate in a shared workspace. This brings the discussion among the team members to support all the groups' activities through communicating by using the action dialogue tools such as chatting, forum and email. The teacher may also involve by advising the student and monitor the student's work.

2.7 MODES OF INTERACTION

According to Anderson and Garrison (1998), there are three common types of interaction discussed in distance education involving students – (student-student; student-teacher; student-content), which can be extended to three other types of interaction – (teacher-teacher; teacher-content; content-content) as shown in Figure 2.7.

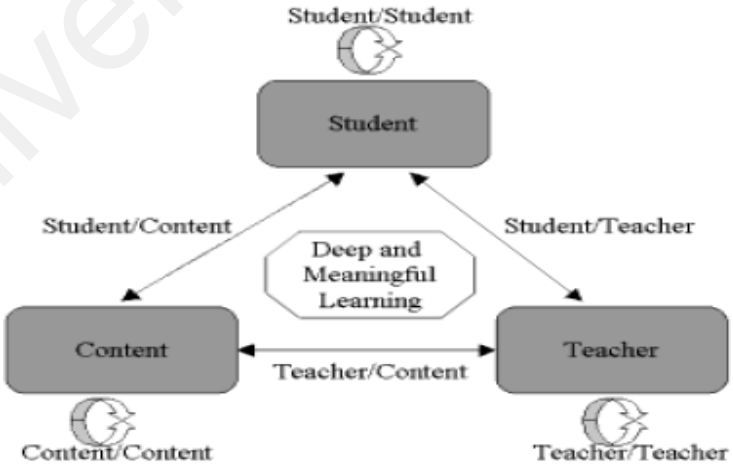


Figure 2.7: Modes of Interaction in Distance Education

2.7.1 Student Interaction

Student-student interaction is critical for the skill proficiency needed for collaborative or cooperative tasks. Student-teacher interaction makes a student feel connected with the teacher, thus it forms a relationship between them and brings them closer, yielding a perceived value. Some student-teacher interactions can be automated by learning through the content resources. In the context of collaborative learning system which is more on the web-based system, the interaction of student-teacher can also be practice in the mode of Net based forms such as emails, chatting, forum, conferencing and discussion. Students can also interact with content such as teacher videos, virtual labs and in person.

2.7.2 Teacher Interaction

Teacher-student interaction is generally the least scalable type of interaction. The teacher is an agent that can perform many functions, especially those of bookkeeping, clerical, or others of an organizational nature, thus migrating teacher-student and teacher-content interaction to content-student and content-content interaction. Usually, the teacher prepares all the learning materials and contents including, teacher's notes, quizzes, tests and also evaluation of the students. That involves the teacher interact with the contents. In collaborative learning, the teacher prepares all the learning material and uploads it into the server. The student can download the learning material easily and they can also communicate using real-time messaging such as chatting. This interaction consists of two-way communication.

2.7.3 Content Interaction

Berners-Lee (1998) highlighted that the 'semantic Web provides an environment in which content can be formalized and manipulated, stored, searched, and computed automatically through technology'. It means that the content of resources plays an important part in the learning process. Students can use the content that has been prepared by the teacher and use the content as part of a learning process. It allows the development of a greater useful value to the teacher and the learner. The value of the content is dependent on the extent to which it engages students or teachers in interaction, leading to relevant knowledge construction.

2.8 COMPUTER MEDIATED COMMUNICATION (CMC)

Computer Mediated Communication (CMC) is a process of communicating using a computer tool between the students and the teacher. It can involve chat, email, listserv, newsgroups, and message boards. This medium of communication can be used as a learning process between the student and the teacher.

According to Arja and Else (2000), 'information can be easily stored, presented and accessed in multiple formats (e.g. text, graphics). Communication within communities of education (students, tutors, moderators, teachers, etc.) can be facilitated by the use of CMC systems (e.g. chat box, email, newsgroups)'.

CMC can be categorized into two types which are synchronous and asynchronous communication tools. The synchronous communication tools use a real time based

environment such as chat, white board, ICQ, Web-phone, whereas asynchronous tools include email, discussion forum and bulletin boards.

Nowadays, the CMC tools have become the important functions in learning process. This tool helps the student and teacher to collaborate and communicate. Collaboration can take place at any where by the use of asynchronous and synchronous systems. According to Fulford and Zhang (1993), 'The benefits of using both asynchronous and synchronous strategies have become evident as learners provide feedback about their learning experiences'. The usage of synchronous and asynchronous tools helps the student to enhance their learning process to gain knowledge. The tools such as email, chatting, forum and video conferencing make the student activities become easier since everything is conducted via online. This online tools make the students feel flexible to organize their study and easily communicate to discus the problems and shared it among students. Each of students has their own profile where all of them are integrated by using a computer. Computer hardware such as Internet and network-based computer programs offer new opportunities for collaboration, communication and learning. A paper by Fahraeus (2000), explains the characteristics in CMC, and is represented in Figure 2.7.

2.8.1 Characteristics of Computer-Mediated Communication

2.8.1.1 Independent of Time and Place

The significance of independence of time and place is whenever the senders send the message, it cannot exactly control the time when the recipients reads the message. The sender may have to wait several more days to get feedback, for example an email. Emails provide a means of

communication which is to send and to receive messages at anytime by using the Internet.

2.8.1.2 Permanence

All the information in the computer system can be retrieved, reused, and reflected upon again and again. It means the data that already been stored into the database can be used without any disturbance.

2.8.1.3 Text Based

The interaction between individuals is based on a text based form of online communication such as chatting. Using the text based form, the communications are, easy to send, saved, archived, edited, and can be written and read many times.

2.8.1.4 Technology

The communication process can be in multiple modes. The CMC tools whether synchronous or asynchronous communication, gives a space and opportunity for students to build knowledge through it. Technology like the Internet, email, forum, chatting and bulletin board allow the students to share and update the information faster and at any place and time.

2.8.1.5 Dependency on the Task

The degree in which restricted communication influences collaboration depends on the task at hand. The task may be varies such as do

assignment, upload/download notes and assignment and answer some quizzes. The collaborative

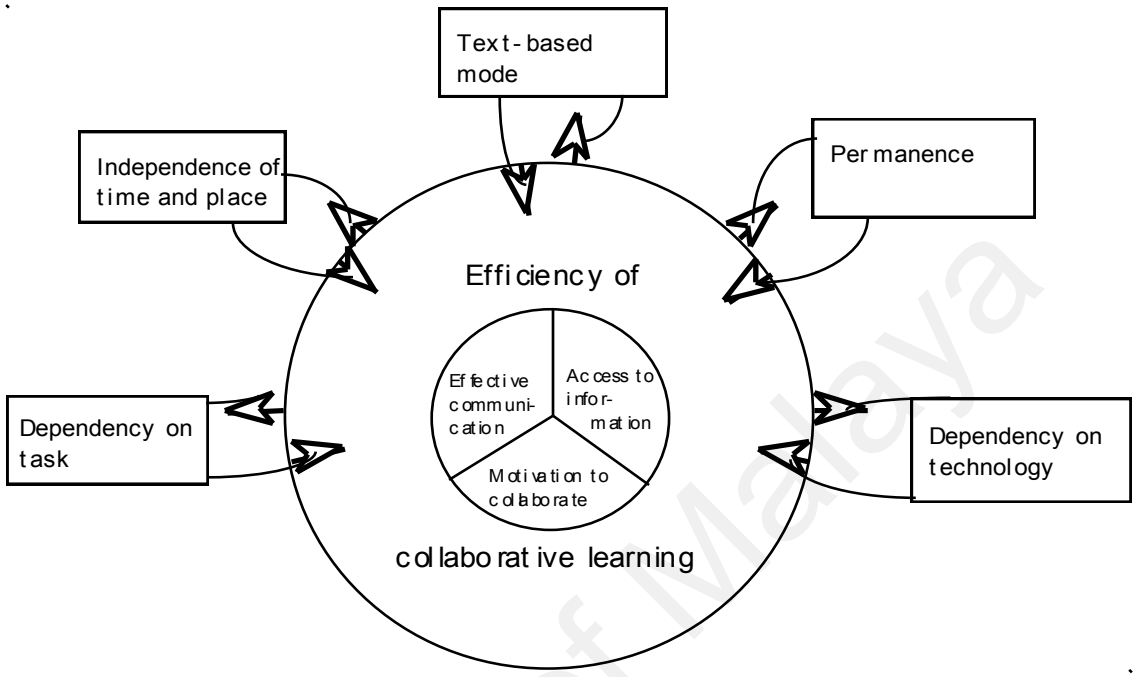


Figure 2.8: How characteristics of CMC can augment (marked by outward arrows) and impede (inward arrows) collaborative learning.

2.9 RESEARCH ON SIMILAR EXISTING SYSTEMS

Research on similar existing systems involves five other systems, as discussed in the following paragraph:

- Web-Based Collaborative Learning System (WebICL)
- Learning through Collaborative Visualization (CoVis) Project
- Virtual Learning Environment (VLE)
- CoMMIT - Collaborative Multi-Media Instructional Toolkit
- GREWPtool

2.9.1 Web-Based Collaborative Learning (WebICL)

According to Jianhua *et al*. (2000), WebICL system describes the modelling and system design. WebICL includes systematic necessary, tutor's necessary, and peer's necessary which are:

i. Systematic Necessary

Focuses on development, implementation, operation, and interaction which will impact flexibility and adaptability of WebICL.

ii. Tutor's Necessary

Focuses on how to facilitate the teaching effect, how to organize instructional approach, and how to realize the teacher's role of leader, designer, facilitator, guider, assistant, and evaluator and assessor.

iii. Peer's Necessary

Focuses on learning content (curriculum knowledge), learning resource, interaction approach, learning tools, learning environment and the systematic interface. Organizing the learning group process includes two statuses. The first status is that the data of the learning group structure will be fetched from the group structures database interface module (peer and tutor), database module, curriculum knowledge module, evaluation module, tutor module, and CL tools module.

The working mechanism and processes of each module describe that when a student logs in through the student interface, the WebICL system search his/her registered account number in the student records database. Then the data of the

student model is acquired and sent to the student grouping module. Below are some commonly perceived advantages and disadvantages of using WebICL.

Advantages:

- Provides the member login function.
- Consists of a variety of functions that fulfil the collaborative teaching processes and activity.
- The databases are well-arranged.

Disadvantages:

- WebICL seems to be too complicated for the level of users.

2.9.2 Learning through Collaborative Visualization (CoVis)

Basically CoVis, is a software that focuses on how to use applications of high performance computing and communication technologies to support science education reform. CoVis is learning through Collaborative Visualizations and functions as a "collaborative learning environment" for Science education. The CoVis Project provides students with a range of collaboration and communication tools. These include desktop video teleconferencing, shared software environments for remote, real time collaboration, access to the resources of the Internet, a multimedia scientist's notebook and scientific visualization software. According to Gomez *et al.* (1996), the CoVis Project is specifically designed for learning ability and usability by students, teachers, and new groupware environments to support collaborative learning and work by students and educators. Below are some commonly perceived advantages and disadvantages of using CoVis.

Advantages:

- It provides graphics which are fairly good and very suitable for its purpose. of displaying weather conditions.
- The result is accurate.
- Includes collaborative functions.

Disadvantages:

- Lack of normal functions like user guide, member login etc.

2.9.3 Virtual Learning Environment (VLE)

According to O'Leary (2007), 'VLEs can be used in social work and social policy by using experiential learning through the chat rooms provided'. This system is divided into four sections which are 'Study Room', 'General Office', 'Meeting Room' and 'Work Room'.

As with any technology used in teaching and learning, VLEs have no intrinsic educational value in themselves. The way in which online courses and online activities are designed and delivered can add value and increase effectiveness. Below are some commonly perceived advantages and disadvantages of using VLEs.

Advantages:

- Easy online delivery of materials.
- Easy to use for both students and lecturers.
- Widens students access on and off campus to learning materials and resources.

- Offers flexible support for educators who do not need to be in a fixed time or place to support and communicate with students.
- Has the potential for new ways of learning and teaching such as active and independent learning, which make use of online communication, online assessment and collaborative learning.

Disadvantages:

- Can become a 'dumping ground' for materials not designed to be delivered online.
- Copyright of materials needs to be considered.
- Off campus access to hardware and networks can be problematic for both students and educators and raises issues of equality. Disability legislation and accessibility to online materials also needs to be considered.
- Need to plan online support careful.
- Such independent learning still needs to be guided and supported. Appropriate training and ongoing support is still needed for both students and educators.

2.9.4 CoMMIT - Collaborative Multi-Media Instructional Toolkit

This system provides computer support for a variety of educational models including cooperative, distance, and problem-based learning. The CoMMIT also provides a comprehensive and collaborative environment. The students could work together in a group, or do independent work that is later shared with the group. The students are instructed to record their findings in an individual paper-based journal. (Lautenbacher *et al*. 1996).

During the activities, the notes can be generated by an individual group member. Every member can respond to each individual's notes. This is called a collaboration sequence among members. Notes can further be discussed among the group using the asynchronous activity sessions before they reach a conclusion. Two reviewers perform a scoring evaluation of the entries from both the electronic and paper cases.

Advantages:

- CoMMIT is supported with multiple graphics which help students understand its concept easily.
- Since CoMMIT uses both electronic and paper bases, it can be seen that the notes on materials are more organized in the electronic base.
- The concepts to be learned in the electronic case are better documented and the coherence of thought chains is higher in the electronic base.
- More interaction is documented between team members in the electronic case.
- There is better coherence, accuracy and use of scientific facts in the electronic case.

Disadvantages:

- The interface design is not really suitable for student level since it looks very complicated.
- The system lacks real-time communication tools for student to collaborate with each other.

2.9.5 GREWPtool

GrewpTool is an online collaborative system that allows students to experience a collaborative learning environment. GrewpTool provides a few communication tools to students including a chat window which lets the students communicate using instant messaging. This is a collaborative editor that allows one or more students to simultaneously edit code, and a pair of browser windows where students can navigate through the assignment and a manual. All user interaction with the tool is logged and there is a playback mechanism, which allows one to analyze the learning session in great detail. Students will be given a time frame to complete a post-test, and the tests are intended to assess three categories of coding knowledge; vocabulary, syntax, and semantics. (Taneva, 2005).

Advantages:

- Provides a communication space which is known as 'chatting window', and the students may interact with one another in real-time.
- Includes an editor that allows one or more students to edit the same document at the same time.
- Includes a pair of browser windows where the students are able to navigate through help pages and watch other students' webpage views.
- It records a precise history of every key stroke of the students, including the delete key, the number of key strokes each user has typed, the number of chat messages each user has sent, and the detailed activity of each user.
- The history file can then be played back and can be played forward and in reverse.

Disadvantages:

- The length of talk between students cannot determine the students' correctness of answer. Students might talk frequently for the wrong answer.
- The amount of time spent talking can determine the closeness of the students but not the depth of collaboration.
- Lack of collaborative activities.

After discussing and doing the research about the similar existing learning system, the researcher found out that each of the system has their own advantages and disadvantages. The system has their own privilege that makes it suitable and usable to the students, teachers, and new groupware environments that can support collaborative learning. Those system are been compared by three category of collaborative learning characteristics which are the agent – student or teacher, usage of the CMC and tools to support collaborative learning which consist the system functionality. Based on the results, it guides the researcher to develop the new system and helps to understand the collaborative learning precisely. Table 2.8 shows the comparisons of the collaborative learning characteristics compared to five existing systems.

2.9.6 Summary of the existing collaborative learning systems

Table 2.8: Collaborative Learning Characteristics Compared to Five Existing Systems

Collaborative Learning (CL) Characteristics by	System Functionality	Web-Based Collaborative Learning (WebICL)	Learning through Collaborative Visualization (CoVis) Project	Virtual Learning Environment (VLE)	Collaborative Multi-Media Instructional Toolkit (CoMMIT)	GREWPtool
Agent (Student) (Teacher)	Member Login	√	√		√	√
	Group formations	√	√	√	√	√
	Group Joining	√	√	√		
	Group Activity		√	√	√	√
Necessary tools that support the Computer-Mediated-Communications (CMC)	Chat Room	√				√
	Bulletin board		√			
	Email		√			
	Forum	√	√		√	
	Video conferencing		√			
Additional tools to support CL	Upload/ download		√	√	√	
	Search Engine	√	√	√		
	Online Assessment				√	√
	Online Supervisor		√	√		
	Visualizer		√	√		
	Working Space		√	√	√	√
CL Characteristics	Techniques	N/A	N/A	N/A	N/A	Pair Annotations

N/A= cannot be determined

Table 2.8 represents the comparison of five existing collaborative systems. The table shows the suitability of the CoVis system for collaborative learning, and it also exhibits that CoVis has more collaborative characteristics than the others. The CoVis system also supports the framework. Most of the CMC tools such as bulletin boards, email, forum, and video conferencing are indicated to support the collaborative activities. As shown in the above table, the students and teachers are apparently the primary users who use the system. For real time communication, WebICL and GREWPtool allows the students and teachers to communicate online. Some of the systems such as GREWPtool and VLE are not supported with other CMC tools except for WebICL and CoMMIT, which use a forum for interaction with other students. Most of the collaborative learning systems are equipped with upload/download and search engine functions. These functions are basically to upload and download the notes or assignments and to seek other information via the Internet. Systems like VLE use an online supervisor where the teacher can monitor the students' activities during collaborative learning. The CoMMIT and GREWPtool, the systems use an online assessment module where all the students' assessments are calculated before being sent back to the students. All the systems are attached with a working space for the students to learn activities except the WebICL. The GREWPtool system uses the pair annotations technique. The other systems cannot be determined what are the collaborative technique that been using due to a lack of information, as they require a registered username and password.

2.10 SUMMARY

Rapid development of information technology and acceptance of global usage in various educational fields is becoming one of the main reasons for using new technologies in education. The usage of the Internet, especially web access, is the most popular type of

learning method. Internet and network-based computer programs offer new opportunities for collaboration, communication and learning. The interaction between students and teacher and online accessing are important components in developing a system. Collaborative learning is more likely to occur in certain educational situations. The aim of it is to produce an environment for the students to share information, to discuss and learn from each other. In addition all instructions are aimed at the students for receiving instruction in the collaboration and communication processes. Collaboration can take place at a distance, by the use of asynchronous and synchronous CMC systems. The teacher, student and content of resources play a major role to make the collaborative system run successfully. This type of learning systems can become a platform for education which helps students explore and exchange ideas and information. This is to encourage them to be part of a team and to cultivate new ideas. In conclusion, at the beginning the collaborative learning generally discussed about the teacher not being the only one who transfers knowledge to the students. Students need to work together as a team to gain more knowledge from each other. The teacher should act as a facilitator in the way of collaborative learning. The early concept of collaborative learning was the classroom-based environment which has now changed to a web-based collaborative learning environment. The purpose of the web-based collaborative learning environment is to let students discuss with each other to gain more knowledge. It is not a system to let students memorise. Clearly, a collaborative learning system lets students achieve their academic learning in a collaborative way, with the teacher playing a very important role as the guide leading the students through the learning process.

CHAPTER 3
THINK-PAIR SHARE TECHNIQUE
FOR COLLABORATIVE LEARNING APPLICATION

3.1 INTRODUCTION

This chapter discussed the proposed collaborative learning technique and framework that is used in the system development. This chapter explain also discusses how the TPS approach can be implemented using an adjusted system process framework.

3.2 THINK-PAIR-SHARE TECHNIQUES (TPS)

Based on discussions of the advantages and disadvantages of the various techniques in the previous chapter, the Think-Pair-Share technique has been chosen for system development. According to Millis and Cottel, (1998), 'Think-Pair-Share is a short and quite low-risk collaborative learning structure. It usually only involves two learners and suits the learners who have less experience with collaborative learning'. This technique can enhance more positive interdependence where the structure gives all learners the opportunity to discuss their ideas and to become comfortable with one and another. This is important because learners start to construct their knowledge in these discussions and to find out what they know and do not know. This active process is not normally available to them during traditional lectures. (Lymna, 1981).

3.2.1 What is Think-Pair-Share?

Think-Pair-Share is a cooperative discussion strategy developed by Lymna (1981) and his colleagues in Maryland, United States of America. It is a cooperative learning strategy, which allows students to think about a question, idea,

issue, and opinion and share their thoughts with a partner. This strategy allows students to share their thoughts and learn to share with a range of group members and where the opinions of all members of the group are valued. The terms of Think-Pair-Share represents three stages of students' action, with emphasis on what students are to be doing at each stage.

3.2.2 What is its purpose?

The Think-Pair-Share strategy provides "think time" which increases the quality of the students' responses towards the learning process. Students become more actively involved in thinking about the concepts presented in the lesson. It introduces the elements of think time and peer interaction, which are two important features of collaborative learning. The Think-Pair-Share's purpose is to help students process information, develop communication skills, and refine their thinking.

3.2.3 How does it work?

3.2.3.1 Think

During the first stage the student thinks individually about a question posed by the teacher. The teacher posts a question or a problem as a file or text on the presentation table or using audio/text and introduces the collaboration process. The teacher gives the students 'think time' and directs them to think about the question.

3.2.3.2 Pair

During the second stage the students form a pairs and exchange thoughts between each other. The students may wish to revise or alter their

original ideas before produce the best solution. They can view their partner's work and discuss whether it is correct or wrong. The time can vary depending on the question and the nature of discussion within the pairs. They compare their work and identify the answers they think are best, most convincing, or most unique.

3.2.3.3 Shares

In the third stage, the pairs share their responses with other pairs, other teams, or the entire group. Students present their answers to the class and also to the teacher. In addition, students' ideas becomes more refined through this three-step process.

3.2.4 ADVANTAGES OF TPS

3.2.4.1 Independence

Students need to think individually and must answer from the given questions within the time limit. The student cannot rely on others to get the answer. This think stage helps students to brainstorm and work independently.

3.2.4.2 Confidence

During the pair stage, a student can discuss with the partner assigned by the teacher. The discussions must be within the time limit to get the conclusion about what they did in the think stage. They can discuss the answer using synchronous tools such as instant messaging, chatting and message tools. It encourages the partner to give some ideas and allows idle students to answer questions without being left out.

3.2.4.3 Sharing

Finally, the pair's work shall be shared with the whole class. Students can view the work of other groups and learn from the other pairs. It is a very good way of learning that lets students learn from all sections of the class. Students may find limitations in discussion during the pair stage, but when they move towards the share stage, they can learn from the whole class.

3.2.4.4 Quick

Using this technique, the preparation from the teacher is faster. It does not take much preparation time and personal interaction motivates many students with less basic knowledge.

3.2.5 DISADVANTAGES OF TPS

3.2.5.1 Duration is too short

Students need to perform the task within the time limit; the duration for each stage is set by the teacher. Students may need more time to perform well and may do so if the duration is adequate or unlimited.

3.2.5.2 Teacher should assign the pair carefully

The teacher must know every student very well so they can pair the students successfully. The teacher needs to pair the students carefully to avoid inactive pairs. Care has to be taken to make sure at least one of the students in the pair is active.

Notwithstanding the minor disadvantages, the Think-Pair-Share technique is chosen for the collaborative learning system development. The system follows the three stages of student actions, with an emphasis on what students should be doing at each of those stages. This activity ensures that all students are interacting with the information. The system supports the student's activities including answering questions given by the teacher, uploading and downloading assignments and also communicating with their partner and teacher using instant messaging and chat applications.

3.3 ADJUSTED SYSTEM PROCESS FRAMEWORK

In order to develop the collaborative learning system, the framework chosen is the one designed by Dimitracopoulou (2005). This framework has been amended to meet the school requirements and the research conducted annotated in Chapter 2. The framework includes both the teacher and students using the TPS technique.

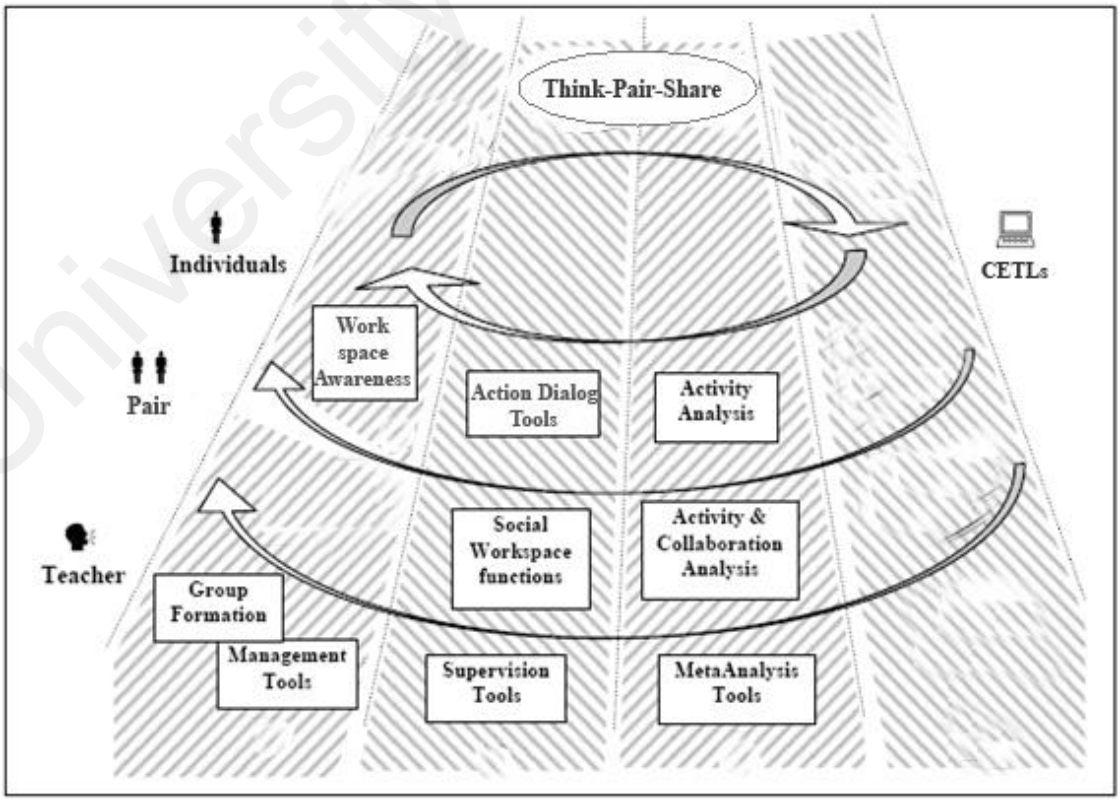


Figure 3.1: Adjusted Framework for Think-Pair-Share

The framework of the collaborative learning system shows CMC tools and the functions are designed and implemented to support the students' activities process. The interaction of the individual learner and the other learner uses the TPS technique. Basically the framework shows the new arrangement that is suitable with the development of the CL application. The CL is divided by three groups which are individual student, pair group and teacher. Details of the explanations are given below:-

3.3.1 INDIVIDUAL

3.3.1.1 Workspace Awareness

The system provides ***Workspace Awareness*** for the student to perform the task given by the teacher. Here is where the process of 'think' happens and allows the student to concentrate on their own thinking process. During this stage, the student has to think and solve the question posted by the teacher independently. The student must answer the question within the time frame.

3.3.1.2 Action Dialogue Tools

To support the students' activities, the student can interact using the ***Action-Dialogue Tools*** such as instant messaging, chat applications and emails. During the brainstorming phase of problem solving, the real time messaging system allows unstructured synchronous dialogue. Each of the students is provided with this tool to communicate with their pair. The students need to use the tools in order to communicate between their partner and teacher. Thus, it can assists and helps the students to achieve what they want to choose and learn.

3.3.1.3 Activity Analysis

The students can do their individual activities during the process of learning. ***Activity Analysis*** includes uploading the assignment and downloading the notes, reading the announcements and composes an email. Since the student has a flexible time to participate in the activity, they can organize their time efficiently. This phase required student to be more independence and responsible to their own study.

3.3.2 PAIR

3.3.2.1 Social Workspace Functions

The system provides ***Social Workspace Functions*** for the student and their partner to communicate during the pair stage. At this time, the student and their partner corresponds using instant messaging. This process makes both students exchange ideas and discuss the questions that have been posted by the teacher within the time given. It also gives an opportunity to enhance their collaborative learning skills and develop understanding of the learning process.

3.3.2.2 Activity and Collaboration Analysis

In this stage, students have to discuss the same questions that been posted by the teacher with their partner. The students discuss the questions by using the instant messaging tools. Both of the students need to come out with their own opinion before agree to make their own answer. Once the answer has been agreed, the students need to submit their results to the teacher. The teacher checks and marks will be given to them. This activity

helps to maintain a good working relationship between members and provides the student with social and teamwork skills for solving the problem.

3.3.3 TEACHER

3.3.3.1 Group Formation

For every collaborative class, the teacher needs to do a ***Group Formation*** by assigning an activity for the students in think-pair-share manner. The teacher can view all the classes that were assigned under them. For each class, the teacher might also view the list of students registered, plus the number of think-pair-share groups available in the class. By default, the think-pair-share group is automatically assigned by the system, but the teacher has the right to change it (change the partner of a student). Once the class is no longer operating the teacher can 'retire' it.

3.3.3.2 Management Tools

The teacher can use ***Management Tools*** such as posting the announcement (bulletin board), create the collaborative class and also upload a new assignment for a particular class and determine the due date of the assignment. Students must upload their answer to the teacher before the final date in order for them to get marks. The assignment will be automatically closed once it reaches the due date. The teacher is also provided with the 'upload notes' function, where they may upload various kinds of notes for a specific group of students.

3.3.3.3 Meta Analysis Tools

The teacher can use the ***Meta Analysis Tools*** to access the students individually. All answers from each student need to be submitted to the teacher during the initial collaborative activities. The teacher is able to access and evaluate the individual's work online by giving marks and comments. From the submission of each pair on the given task, the teacher will make an evaluation by giving comments to each question, together with the marks.

3.3.3.4 Supervision Tools

During the final or 'share' stage, the system provides the ***Supervision Tools*** for a user whereby a special interaction place which is a chat room, in which every member in the collaborative class can be involved. The role of the teacher is to give solutions and answers to any questions from students regarding the current collaborative activities. The interaction happens in chat-basis, where each student is identified by their names.

As explained, the new CL application using TPS is called Collaborative Environment for Teaching and Learning Science and the development of the system is based on Rational Unified Process (RUP) methodology.

3.4 SUMMARY

There are a lot of techniques that can be found in collaborative learning. Basically, the techniques are to help the students learn effectively according to the criteria of the techniques for example, jigsaw, roundtable, pair share and many more. For the purpose of the development of the collaborative learning application, the chosen technique is the Think-Pair-Share. Practically, the TPS is to give the students an idea, issue and problem that are to be discussed with other students. The technique helps the student identify the essence of the subject where they can think individually and produce their own answer. Then, the student discusses and shares their thoughts with their partner before moving to the share stage. During this stage, they produce the results from discussion and share the point with other groups and the teacher. Finally, the new CL application using TPS is called Collaborative Environment for Teaching and Learning Science (CETLs) and the development of the system is based on Rational Unified Process (RUP) methodology.

CHAPTER 4
RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter describes about research methodology that is used research. It also discusses the process in Rational Unified Process methodology (RUP) for development of CETLs.

4.2 RESEARCH METHODOLOGY

The literature review is the primary source of information for this research; books, journals and other types of written articles are studied and used in addition to online materials. Many types of collaborative learning technique are studied and Think-Pair-Share technique is chosen. Collaborative learning framework is also studied to identify important components in collaborative learning applications. Then, several existing collaborative learning applications are studied to examine their important features. Results obtained from the studies on existing system features and components in the CL framework are used in the designing CETLs. The development of CETLs is based on the RUP methodology. Finally, testing is carried out to test the system before implementing it in schools. User evaluation is also conducted and the feedback is collected using the evaluation questionnaire and analyzed using the Statistical Package for Social Science (SPSS) and Microsoft Excel 2003. Figure 4.1, shows the flow of the research methodology.

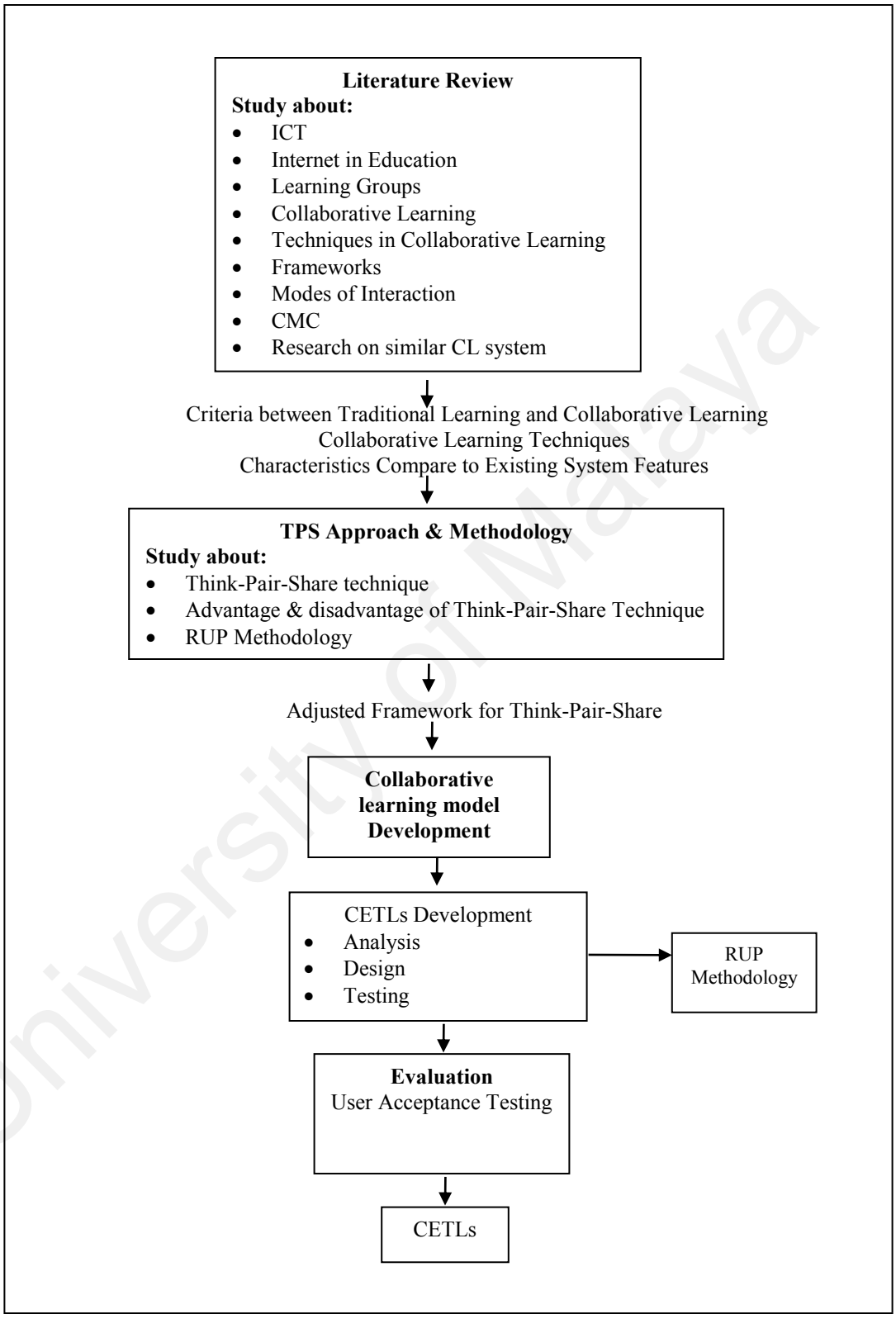


Figure 4.1: Research Methodology Model

4.3 RATIONAL UNIFIED PROCESS METHODOLOGY

The methodology is intended to guide the design and implementation in a consistent and coherent way. For development purposes, the system adopts a structured and documented approach according to the methodology. There are numerous design methodologies such as SDLC, OOAD, RUP and many more. These design methods generally consist of a set of guidelines, heuristics, and procedures on how to design the system. For the development of the CETLs, the methodology that is used is Rational Unified Process Model (RUP). As illustrated in Figure 4.2 by Chen (2002), the RUP life cycle is comprised of four phases which are Inception, Elaboration, Construction and Transition. The objectives of the phases of Rational Unified Process Life Cycle are as below.

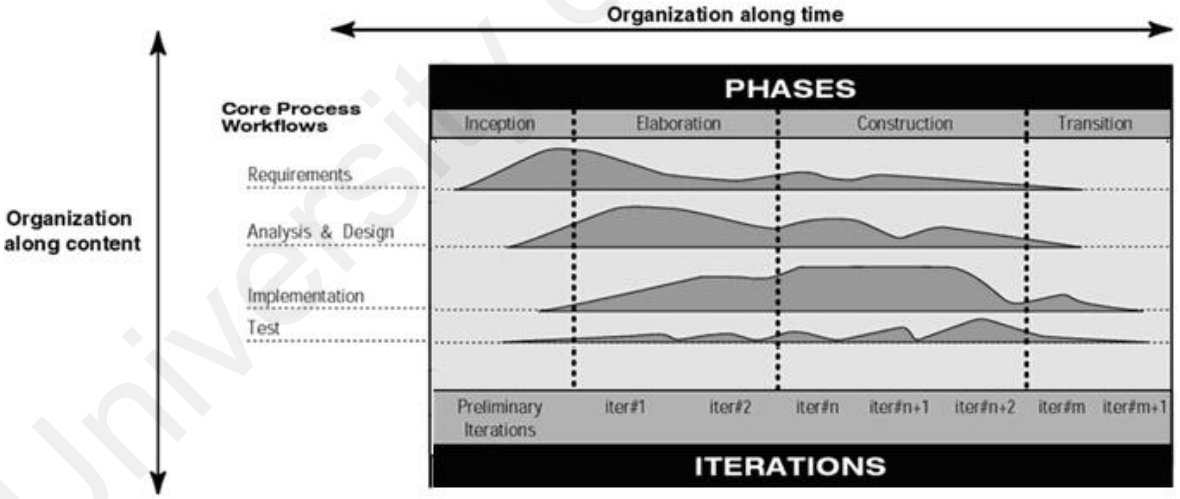


Figure 4.2: The RUP Methodology

4.3.1 RATIONAL UNIFIED PROCESS PHASES

4.3.1.1 Inception Phase

In this stage, the project's business case is stated and the team decides if the project is worth doing or if it is even possible. It is important to first formulate the scope of the project and also determine the resources. As in any project planning phase, it involves identifying all use cases and describes a few significant ones. The business case includes success criteria, risk assessment, and estimate of the resources needed, and a phase plan showing dates of major milestones to be taken. The outcomes of the inception phase are the initial use case, core project's requirements, key features, and main constraints and project plan, showing phases initial risk assessment and iterations.

4.3.1.2 Elaboration Phase

The elaboration phase usually involves an understanding of the whole system which is the scope, major functionality and non-functional requirements such as performance requirements. The phase also ensures that the architecture, the requirements and plans are stable enough to sufficiently mitigate the risks, so it can determine the cost and schedule for the completion of the development. This is an important phase because all the processes that are associated with changing the scope will be analyzed and the risks will be determined by the developers. The outcome of the elaboration phase is basically the use-case model – supplementary requirements capturing the non functional requirements

and any requirements that are not associated with a specific use case and the software architecture descriptions.

4.3.1.3 Construction Phase

During the construction phase, all remaining components and application features are developed and integrated into the product to be tested. The construction phase is a process with emphasis on managing resources and controlling operations to optimize costs, schedules, and quality. These parts include the details about the CL application such as the interaction between the student and the teacher, an activity that the students perform, how the data is stored, and maintaining the data and completing the help and user preferences. After the development is completed the source code must be tested to determine if the project has met the goal laid out in the inception phase. The outcome from this phase is the coding program.

4.3.1.4 Transition Phases

The purpose of the transition phase is to place the software into the hands of the users. Once the product has been given to the end user, issues usually arise that require developing new releases, correcting some problems, or finishing the features that were postponed. This includes unit testing and also user acceptance testing to validate the new system against user expectations. Once the CL system is in operation, it will train the user and maintainers.

During the process of the phases, each of the details over the phases is to be explained in the work flow of the RUP. This work flow describes meaningful sequences of activities that produce some valuable result, and shows interactions between each of the process iterations involved. Basically there are nine core process workflows in the Rational Unified Process, which represent a partitioning of all workers and activities into logical groupings. However, only six take place. Detailed explanations are according to Figure 4.2 above.

4.3.2 CORE WORKFLOWS OF RUP

4.3.2.1 Business Modelling

In the business modelling, the process of identifying the business process is called business use cases. This assures a common understanding among all the stakeholders which is the client's process needs to be supported in the organization. The business use cases are analyzed to understand how the business should support the business processes. For the development of CETLs, the researcher chooses not to do business modelling and goes straight to the requirement process.

4.3.2.2 Requirements

The purpose of the Requirements workflow is to describe ***what*** the system should do and allows initializing the project plan. For the success of the development of the CETLs, the customer requirements, which are the teacher and student, must be taken out. This is to ensure that the customer requirements agree on the description.

4.3.2.3 Analysis and Design

The purpose of Analysis and Design workflow is to show ***how*** the system will be ***realized*** in the implementation phase. This component is important in development process where it is the process of collecting and analyzing information to be supported by the system, and using this information to identify users' requirements of new system. In analysis there are three feasibility elements that have to be considered. The feasibility categories are explained below:

i. Operational Feasibility

The operational feasibility is measured in terms of how the CETLs are operated and to make sure that the system is working well.

ii. Technical Feasibility

This function is to identify the availability of technical resources and expertise. During this feasibility, all the requirements are represented in the 'use case' and it is referred to as Use Case realization.

iii. Schedule Feasibility

The use of a Gantt chart is believed to be effective for project scheduling and progress evaluation. The use of a Gantt chart begins by accessing the potential time frame for start and completion dates within the project deadline and the affected changes.

The **design** model is on how the source code is structured and written. It also consists of the design classes structured into design packages and design subsystems with well defined interfaces, representing what will become components in the implementation. It begins by creating the logical design. The design consists of the database design where all the attributes, data types are identified. Another design includes the architecture of the CETLs, class diagram and activity diagram.

4.3.2.4 Implementation

The objective of this phase is to integrate the results produced by the developers into an executable system. Once a detailed design is approved, the logic coding of CETLs is transferred into an executable system. Here a manual is produces to train the end user on how to use the CETLs system.

4.3.2.5 Test

Together with the user manual, the testing procedures must be implemented within a certain period before the real working system is installed into the server. For the CETLs, the testing methods used are unit testing and user acceptance testing. Testing is conducted to ensure the system is working properly without any error.

4.4 SUMMARY

The methodology is intended to guide the design and implementation in a consistent and coherent way. Today, many types of methodologies can be chosen to channel the design and execution of the system. For the development of the CETLs, the methodology that is used is Rational Unified Process Model (RUP). The RUP methodology consists of four phases which are Elaboration, Inception, Construction and Transition phase. Each of the details over the phases is to be explained in the work flow of the RUP. This work flow describes meaningful sequences of activities that produce some valuable result, and shows interactions between each of the process iterations involved. The workflows include business modelling, requirements, analysis and design, implementation and testing. These workflows must be followed in order to achieve the successfulness of the development of CETLs.

CHAPTER 5
SYSTEM ANALYSIS OF CETLs

5.1 INTRODUCTION

This chapter represents the analysis for CETLs including the hardware and software requirements, functional and non functional requirements, system analysis represented in the use case diagram, assumptions and constraints.

5.2 REQUIREMENTS OF CETLs

5.2.1 HARDWARE REQUIREMENTS

The minimum specification required to run the system are INTEL Pentium Processor with 256Mb of RAM, a 40Gb hard disk, an SVGA monitor capable of a resolution 1024x768 or greater, a mouse, a keyboard and a network card compatible with the network. While this specification will be adequate to run the system, faster search performance will be possible on a 500MHz computer as shown in Table 5.1.

Table 5.1: Hardware Requirements

Description	**Hardware**
Type and speed of processor	Intel Pentium 4 processor 2.6GHZ
Amount of memory	256MB DDR SDRAM
Size of hard disk	40GB Hard Disk Drive
Operating System	Window XP

5.2.2 SOFTWARE REQUIREMENTS

This part consists of software that is uses to develop the CETLs. Choosing one of the web applications depends on several factors, including the operating system, web server software, and server side scripting and database technologies. The criteria for the technology are explained in Figure 5.2.

5.2.2.1 Operating System for Web Server

CETLs use ***Windows XP*** as an operating system. Windows XP Professional offers many new and more effective features and technologies. Windows XP has new security tools that can help keep the computer more secure, and new technologies that run in the background, making the computer more efficient and reliable. The advantages of windows XP include:

- Improves daily work
- Easy to use
- Can work from anywhere

5.2.2.2 Web Server Software

For the web server software, the CETLs used the ***Internet Information Server (IIS),*** which provides an application environment. The IIS is a powerful web server that provides a highly reliable, manageable, and scalable web application infrastructure. The advantages of IIS:

- Easy to upload to the server.
- Can implement, configure, monitor and support server features.

5.2.2.3 Server-Side Scripting

Active Server Pages (ASP) is a technology that enables the developer to make dynamic and interactive web pages. It is also a reflective programming language. Originally designed as a high level scripting language for producing dynamic web pages, ASP is used mainly in server-side application software. ASP pages are similar CGI scripts, except they are usually written in VB Script or Jscript. The advantages of ASP include:

- Can manage the content of any page and such dynamic code (or content) for the web browsers can be generated based on various conditions of ASP program.
- Can create interactive web pages applications, which are easy to develop and modify.

Java script is known as a scripting language and is most often used for client side web development. JavaScript is a dynamic and prototype based scripting C language. The code is written into the HTML page and converts the page for easy use. JavaScript is easy to learn. The advantages of JavaScript:

- Can use to create cookies for the registered users.
- Create sophisticated user interfaces.
- Can create effects and validating data on the client.

5.2.2.4 Software for Database Technologies

For the purpose of keeping the records, CETLs uses ***Microsoft Access*** as a database. It is a product from Microsoft and is also the most popular database system. The information can be stored and accessed easily. Databases can also be defined as computer applications that are used to create and manage computer based databases on a desktop computer and/or connected with computer network. The advantages and purposes of choosing Microsoft Access include:

- Easy to use as the database for basic web based applications.
- Compatibility with Structured Query Language (SQL).
- Access allows quick development.

5.2.2.5 Tools

Adobe Photoshop is a graphical editor or a tool that has been designed to edit images, media editing, animation, and authoring. This tool can provide a non-linear editing and special effects services, such as backgrounds, textures, and web design. Adobe Photoshop CS is a professional image-editing standard which allows professional designers and graphics producers to create sophisticated images for print. Advantages and purpose of using the Adobe Photoshop CS includes:

- Provides the tools for image editing.
- User friendly.

Macromedia Dreamweaver MX is a web authoring tool that can create impressive web pages. The tool is designed to produce better-looking websites. Features include new layout and graphics tools which make it easier to design. It helps navigating through the site, and seeing file structure, visually such as ASP, HTML, CSS, and Java/JavaScript. The advantages of choosing Macromedia Dreamweaver includes:

- User friendly.
- Fast development of system.

Table 5.2: Software Requirements

Tools	**Software**
Operating system	Microsoft Windows XP Server
Web Server host	IIS
Database system	Microsoft Access
Server Side Scripting language	ASP
Tools	Adobe Photoshop CS, Macromedia Dreamweaver MX 2004, SPSS, Microsoft Excell

5.3 FUNCTIONAL REQUIREMENT

The functional requirements of the CETLs are the most important requirements that should be met in the system. These requirements are based on Chapter 2 'reviewing existing system' and the 'adjusted system framework' in Chapter 3. The table below shows the functional requirements according to the elements in the framework.

Table 5.3: General Requirements

Framework Elements	**Require-ments**	**CETLs Functions**
Management Tools	R1	The system shall provide a working space for the coordinator which will include: 1. System Administrator 2. Class Management 3. Announcement Management 4. Messaging System 5. My Profile
	R1.1	▪ Responsible to control and assign permissions and manage the system resources which include the user accounts and users. ▪ Responsible to register, edit and delete students and teacher information. The coordinator can also block/unblock the students from access into the system. ▪ Responsible to add new coordinator by opening and turn on the user profile.
	R1.2	▪ Responsible to create the new class and edit and delete the class information. They can also reset the class if the class name is wrong.

Table 5.3: General Requirements (cont.)

Framework Elements	Require-ments	CETLs Functions
		▪ Responsible to register, edit and delete class information and to enrol and remove the students from the class. ▪ Manage students groups and assign a teacher to the class. The coordinator can also change the assigned teacher to another teacher. ▪ The coordinator can also delete the class permanently.
	R1.3	▪ Responsible to create a new announcement and putting it on the bulletin board for student and teacher attention. ▪ The coordinator can use the announcement (bulletin board) module in two ways, to post or read it. An announcement can be posted to a variety of user types – all users, only teachers, all students, or a specific group of students. Old announcements can be deleted accordingly. ▪ Activate/deactivate announcements and reset the announcement if the announcement is wrong.
	R1.4	▪ Responsible for sending mails with an attachment to a variety of the users whether for all users, for only teachers, for all students, or a specific group of students.
	R1.5	▪ The coordinator can edit their profile and can update the password with a new one.
	R2	▪ The system shall provide working space for the teacher which includes: 1. Announcement Management 2. Assignment Management 3. Notes

Table 5.3: General Requirements (cont.)

Framework Elements	Require-ments	CETLs Functions
	R2.1	▪ The teacher can use the announcement (bulletin board) module in two ways, to post or read it. An announcement can be posted to a variety of user types – all users, only teachers, all students, or a specific group of students. Old announcements can be deleted accordingly. ▪ Activate/deactivate announcements and reset the announcement if the announcement is wrong.
	R2.2	▪ Teachers can upload new assignments for a particular class and determine the due date of the assignment. Students must upload their answer to the teacher before the final date in order for them to get marks. The assignment will automatically be closed once it reaches the due date. ▪ For existing assignments, the teacher is able to view the progress of the students. Each work submitted by the students can be seen and rated by the teacher. Teachers can assign marks together with their comments.
	R2.3	▪ The teacher is also provided with the 'upload notes' function, where they may upload a variety of kinds of notes for a specific group of students.
Group Formation	R3	▪ The system shall allow the teacher to assign collaborative partners 1. Class Management

Table 5.3: General Requirements (cont.)

Framework Elements	Require-ments	CETLs Functions
	R3.1	▪ For every collaborative class, the teacher needs to assign an activity for the students in think-pair-share manner. The teacher will give a chance for the students to work alone first; which is called the 'think' stage. ▪ They will then be grouped into pairs for the 'share' stage. After the submission of both tasks has been made, they need to be in the 'share' stage where the teacher will also be involved for a discussion
		▪ The teacher can view all the classes that are assigned under them. For each class, the teacher may view the list of students registered, plus the number of think-pair-share groups available in the class. ▪ By default, the think-pair-share group is automatically assigned by the system, but the teacher has the right to change it (change the partner of a student). Once the class is no longer operated, the teacher can 'retire' it.
Activity Analysis	R4	The system shall allow the students to do the following activities: 1. Active Assignment 2. Download Notes 3. Messaging System
	R4.1	▪ Students can download the assignments that have been uploaded by the teacher. They can also upload assignments to the teacher before the due date.

Table 5.3: General Requirements (cont.)

Framework Elements	Require-ments	CETLs Functions
		▪ Once the assignment has been closed (retired), the student can check the assessment marks provided by the teacher. The legend will show whether the students failed or passed.
	R4.2	▪ Students can view and download all the notes provided by the teacher.
	R4.3	▪ Students can send mail with an attachment to a variety of users – for all users, only teachers, all students, or a specific group of students.

Table 5.4: Think Requirements

Framework Elements	Require-ments	CETLs Functions
Workspace Awareness	R5	The system shall provide working space for each student to perform the task given by the teacher: 1. 'Think' stage (Student) 2. Timer
	R5.1	▪ During the 'think' stage, students receive the questions from the teacher and must answer individually. The student must 'think' the questions before the time elapses. If the student fails to answer the question within the time given, the system will give a message. ▪ After the questions are submitted to the teacher, the teacher will check and give marks after the test has been retired. If the result is passed, the legend will show in 'blue' colour and 'red' if the result is failed.

Table 5.4: Think Requirements (cont.)

Framework Elements	Require-ments	CETLs Functions
	R5.2	▪ The teacher will set the time according the number of questions.
Meta Analysis Tools	R6	▪ The system shall allow the teacher to assign a collaborative partner 1. 'Think' stage (Student) 2. Timer
	R6.1	▪ During the 'think' stage, the student is accessed individually. All answers from each student need to be submitted to the teacher during the initial collaborative activities. The teacher is able to access and evaluate the individual's work online by giving marks and comments.
	R6.2	▪ The 'think' activity will run successfully with a timer set by the teacher. Each assignment given by the teacher should be completed in a given period of time. Each student needs to submit it once the time is up.

Table 5.5: Pair Requirements

Framework Elements	Require-ments	CETLs Functions
Action Dialogue Tools	R7	▪ The system shall provide a real time messaging system for every pair (students). Each of the students communicates using instant messaging communication.

Table 5.5: Pair Requirements (cont.)

Framework Elements	Require-ments	CETLs Functions
Social Workspace Functions	R8	▪ Here the interaction between each pair of students should take place: 1. 'Pair' stage (Student) 2. Timer
	R8.1	▪ During the 'pair' stage, both students (pair) must collaborate to answer the questions using instant messaging communication. They must discuss and choose the best answer to be submitted to the teacher before the time elapses. If the student fails to answer the question within the time given, the system will give a message. ▪ After the questions are submitted to the teacher, the teacher will check and marks will be given after the test has been retired. If the result is passed, the legend will show in 'blue' colour and 'red' if the result is failed.
	R8.2	▪ The teacher will set the time according the number of questions.
Meta Analysis Tools	R9	The system shall provide the working space for the teacher to analyze the students' work. 1. 'Pair' stage (Teacher) 2. Timer
	R9.1	▪ From the submission of each pair on the given task, the teacher will make an evaluation by giving comments to each question, together with the marks.

Table 5.6: Share Requirements

Framework Elements	**Require-ments**	**CETLs Functions**
Activity and Collaboration Analysis	R10	The system shall provide a chat room. 1. Share (Student)
	R10.1	▪ Both of the students and the teacher can interact together and discuss the answers to the questions using chatting communication tools.
Supervision Tools	R11	▪ During this final or 'share' stage, the system provides the user a special interaction place which is the chat room, in which every member in the collaborative class can be involved. ▪ The role of the teacher is to give solutions and answers to any questions from students regarding the current collaborative activities. The interaction happens in chat-basis, where each student is identified by their names.

These functional requirements are represented into use case structure that consists of graphically summarized in a use case, which also shows which actors interact with which use cases. The use case diagram as shown in Figure 5.1.

5.4 SYSTEM REQUIREMENTS ANALYSIS

The purpose of the System Requirements Analysis is to obtain a thorough and detailed understanding of the requirements needed as defined in this research. During the system requirements analysis, the framework for the application is developed, thereby providing the foundation for all future design and development efforts.

The primary goal of this phase is to determine detailed functional requirements defining the full set of system capabilities to be implemented, along with accompanying data and process models illustrating the information to be managed and the processes to be supported by the new system.

After the requirements are collected and analyzed they will be present in the use case which is a method for capturing functional requirements. According to Bittner and Spence, (2006) 'Use cases, stated simply, allow description of sequences of events that, taken together, lead to a system doing something useful'.

Based on the functional requirements stated in Section 5.3, all the requirements are represented in the use case diagram. See Figure 5.1 below. The details of explanation of actors and descriptions are represented in Table 5.7 and Table 5.8.

5.4.1 Use Case

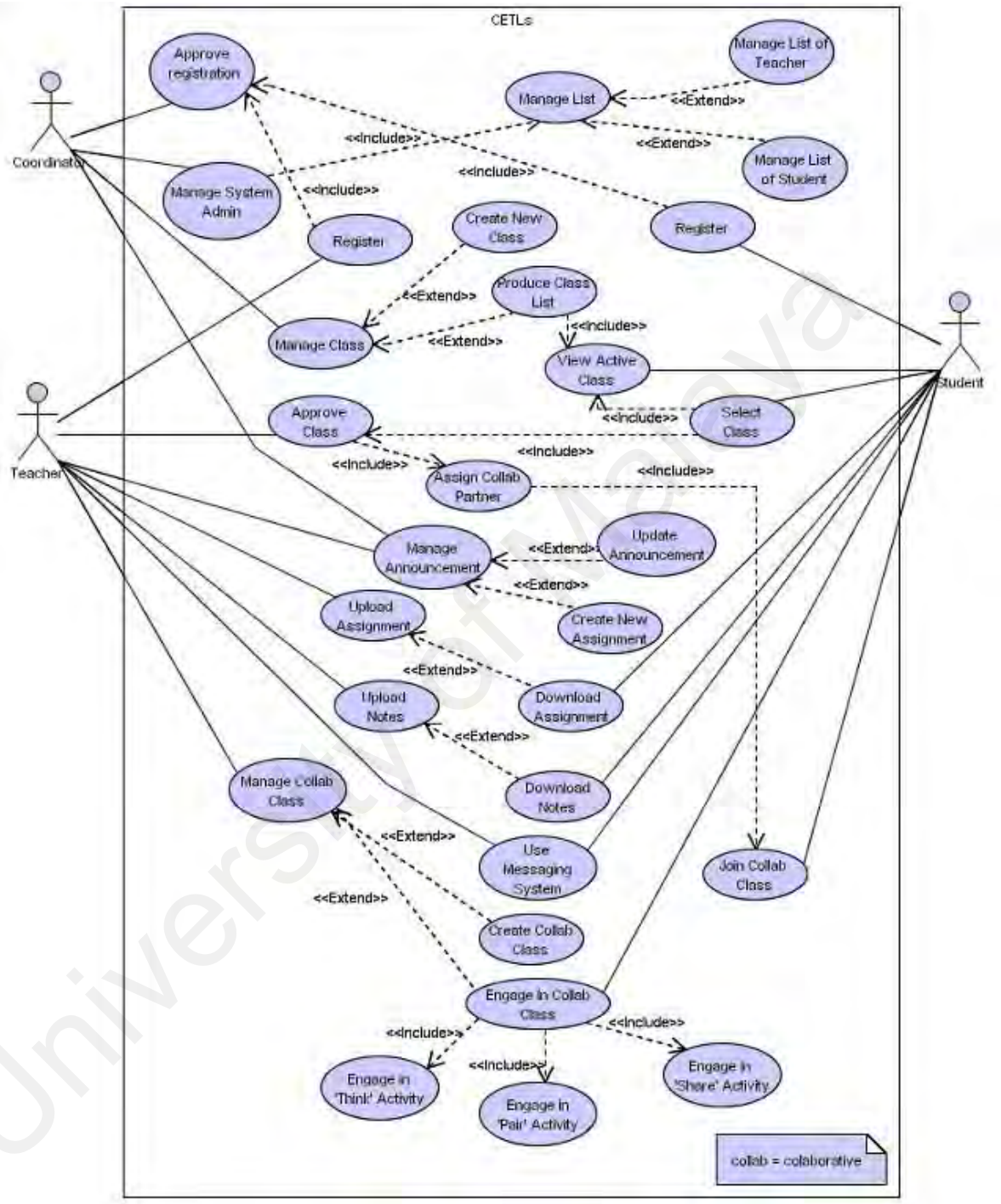


Figure 5.1: Use Case Diagram

5.4.2 Actor and Use Case

Table 5.7 Actors Description for CETLs Use Case Diagram

Actor	**Description**
Coordinator	Staff within the school whose role is to provide administrative support that enables the work of all system's users to take place.
Teacher	Staff who teach a particular class.
Student	Any student in the school which is registered with the system.

5.4.3 Use Case Description

Table 5.8: Use Case Description for CETLs Use Case Diagram

Use Case	**Description**
Register	When a new user (both teacher and student) enter the system for the first time, they need to register themselves.
Approval of Registration	When the new users register themselves, the coordinator needs to approve their registration by assigning the 'active/inactive' status.
Manage System Admin	This includes managing the list of teachers and students.
Manage Class	Whether to create a new class or to produce the class list according to the registration made by students.
View Active	All the classes opened will be displayed to students,

Class	to let them make selection.
Approval of Class	Teachers will determine whether or not to approve students' selection according to the given list.
Assign Collaborative Partner	This is the inclusion of 'approval of class'. The collaborative partner will be assigned by the teacher once they approve the students' selection.
Join Collaborative Class	Students will join the collaborative class opened by the specific teacher.
Announcement Management	New announcements can be posted while existing announcements can be updated or removed.
Upload Assignment	Teacher uploads the notes online. Each note uploaded will be labelled with the name, and the date uploaded.
Download Assignment	Students can download notes that have been uploaded by the teacher.
Messaging System	All parties may enjoy using the messaging system, compose and reply mail to each other.
Manage Collaborative Class	Every time the teacher wants to start the collaborative activity, they need to open the session first.
Engage in Collaborative Class	After the collaborative session is opened, the students are allowed to start the collaborative activity. This includes think, pair, and share activities.

5.5 NON FUNCTIONAL REQUIREMENTS

5.5.1 Performance Requirements

- **System Load Factors:** This system is a web-based system designed to operate on any terminal on the networked PC service. The program can only be access to one shared file, which is the Microsoft Access database. It is assumed that this database will be stored over a network on the server.

- **Database Factors**: The database is a file that will be shared across a network. The database is assumed to be able to handle limited simultaneous request on a table. This number of transaction will only be reached when there are multiple instances of the program running on separate terminals all accessing the database at the same time.

5.5.2 Safety Requirements

No data shall be lost when a power failure occurs as well as damage to the records stored in the database, it is because the data is protected from software and hardware faults.

5.5.3 Security Requirements

Each of the registered students are been given the username and password. This is to make sure that the level of authority is secured.

5.6 ASSUMPTIONS

In order to running CETLs, the students are assumed to have the basic knowledge of the Science subject. This is because, the CETLs are designed for subject Science. All the learning materials are followed the Science syllabus. The users also are assumed that to have a basic computer knowledge and personnel computer at home with Internet connection.

5.7 CONSTRAINTS

There are some constraints that have to identify before using the system. Firstly, the system only can perform when the system is accessed through the Internet Explorer (IE) web browser. It can not perform very well using other web browser such as Mozilla Firefox. IE is the best web browser to execute the system. Secondly, since the database system is using Microsoft Access, the system has limited database storage because it depends on the capacity available in the Microsoft Access. Thirdly, only registered user can be access to the system namely student, teacher and coordinator. Finally, the usage of the email functions is only restricted to the CETLs users.

5.8 SUMMARY

As a summarization of this chapter, it represents the analysis of CETLs including hardware and software requirements, functional and non functional requirements, system analysis represented in use case diagram that is represent the user to the system identified by the actor. In the CETLs there are 3 actors involves which are Student, Teacher and Coordinator. Other than the system ability and requirements stated, the assumptions and constraints of the system also take place when developing the CETLs. This is because, not

all the ability can be functions in certain area. This is due to the time management constraint and other problem occurs. As for development, CETLs uses ASP language and the database is Microsoft Access. Basically, the requirements in the CETLs are divided into two which are hardware and software requirements and the functional and non functional requirements. For hardware, CETLs use Intel Pentium 4 Processor 2.6 GHZ and 256 MB DDR SDRAM and Microsoft windows XP, IIS Adobe Photoshop CS, Macromedia Mx 2004 as software requirements. Finally, the flow of the CETLs is represented in the use case diagram.

CHAPTER 6
SYSTEM DESIGN OF CETLs

6.1 INTRODUCTION

This chapter describes the design phase in CETLs. To create the CETLs, it involves the architecture of the system, database design and UML diagram. This structure should be done carefully so that the output result does not look too bad and the system can be played with all the aspects that the user wants.

6.2 ARCHITECTURE OF THE SYSTEM

System design is one of the stages that need to be covered during the development of the system. System design is the process or art of defining the hardware and software architecture, components, modules and data for a computer system to satisfy specified requirements. System design also includes a complete description of the functions and interactions involved.

6.2.1 Client Server Architecture

Client server is the network server which separates a client from a server. Each instance of client software can send requests to a server. Specific types of server include application servers, file servers, and mail servers. The computers and web browser can let users access the CETLs system. Users send the requests to the web server and the web server finds all the information through the database server. The web server sends the information back to the web browser to let the user look at it. One type of client server architecture is three-tier client server architecture. According to Chen *et al*. (2000), 'The three-tier architecture aims to solve a number of recurring design and development problems, hence to make the

application development work more easily and efficiently.' For the CETLs system, three-tier client server architecture is use as the architecture of the system. The system concept is suitable with the client server concepts where the CETLs are a web-based system that needs to be accessed through the Internet. Therefore, the CETLs are intended to provide a scalable architecture and using it can increase the performance and consistency that maps to the open system architecture quite naturally. The three-tier client server architecture is divided by three phases which are:

6.2.1.1 Client Tier

This tier manages the input/output data and their display. This layer presents data to the user and optionally permits data manipulation and data entry. With the intention of offering greater convenience to the user, the system is prototyped on the Internet. The users are allowed to access the system by using any existing web browser software. The user interface tier contains HTML components needed to collect incoming information and to display information received from the application logic tiers.

6.2.1.2 Application Server/Tiers

The application server is to process all the business and data processing logic for the clients with a server computer dedicated to running certain software applications. Here the system performs query/update processing and transmits responses to the client.

6.2.1.3 Database Server Tiers

The database server generates data validation and database requests for transmitting to the server. The database provides the database services to other computer programs or computers. Here, the server accepts and process database requests from clients and check authorization. Database management systems frequently provide database server functionality as Figure 6.1 as mention by Juell *et al. (*2005).

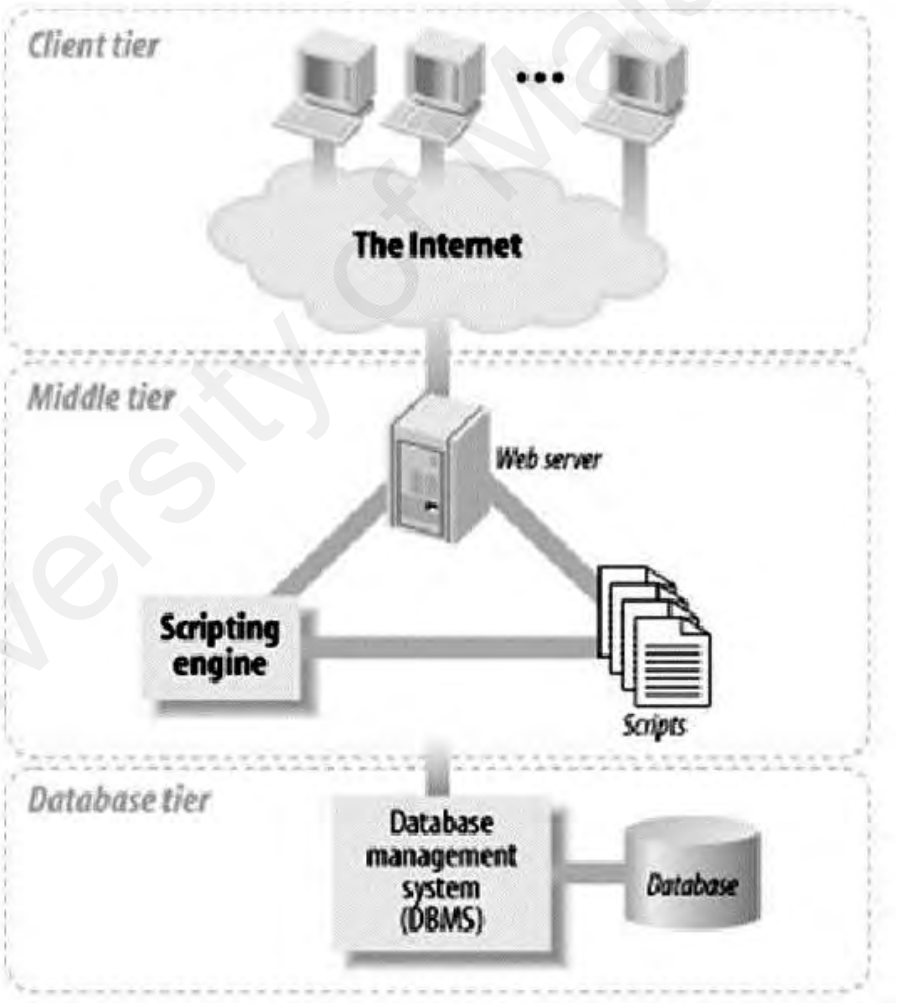


Figure 6.1: Three-tier Architecture model

6.3 DATABASE DESIGN

6.3.1 Data Dictionary

The data dictionary is a specialized application of the type of dictionary used as a reference for system analysts to guide them through the design phase. For the CETLs system 15 tables were created so that the data type can be determined and the information captured securely. All database designs are represented in table form and the **ID** column is for the primary key. All the data types, size and descriptions are presented in database design as shown in Table 6.1 until Table 6.15.

Table 6.1 Table for the Student

Field Name	Type	Size	Description
ID	AutoNumber	8	Student's ID
Name	Text	250	Student's name
IC_No	Text	50	Student's username for sign in.
Email	Text	20	Student's email
Last_login	Text	6	Student's last login
Dt_Register	Text	100	Student's date register
Status	Number	long Int	Student's Status
New	Number	long Int	New student
Pwd	Text	15	Student's username for sign in.
Date	Date/Time	Date/Time	Student's login date

Table 6.2 Table for the Teacher

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Teacher's ID
Name	Text	250	Teacher's name
IC_No	Text	50	Teacher's identification number
Email	Text	20	Teacher's email
Last_login	Text	6	Teacher's last login
Dt_Register	Text	100	Teacher's date register
Status	Number	long Int	Teacher's Status
Pwd	Text	15	Teacher's username for sign in.
New	Number	long Int	New teacher
Date	Date/Time	Date/Time	Teacher's login date

Table 6.3: Table for the Administrator

Field Name	Type	Size	Description
ID	AutoNumber	8	Administrator's ID
Name	Text	30	Administrator's name
IC_No	Text	50	Administrator's identification.
pwd	Varchar	20	Administrator's username for sign in.
Email	Text	10	Administrator's phone number
Last_login	Text	6	Administrator's gender

Table 6.4: Table for Collection

Field Name	Type	Size	Description
C_ID	AutoNumber	longInt	Class id
Col_name	Text	250	Class name
Col_rand	Text	250	Class random
Col_day	Number	longInt	Date of class creation
Col_month			
Col_year			
Active	Number	longInt	Active class

Table 6.5: Table for Student Homework

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Auto increment id.
ICNo	Text	50	IC number
Eday	Number	longInt	Date for student submission
Emonth			
Eyear			
Time	Text	250	Current system time
Mark	Number	longInt	Marks to the student
Comment	Memo	-	Comment to the student

Table 6.6: Table for the Group Formation (Student collection)

Field Name	Type	Size	Description
ID	AutoNumber	-	Auto increment id.
Day	Number	long Int	Day
Month	Number	long Int	Months
Year	Number	long Int	Year
Collection	Text	250	Class
Name	Text	20	Class Name
IC_No	Text	50	Identification number
Status	Number	long Int	Class status
Grouping	Text	50	Class group

Table 6.7: Table for Collaborative class (Student)

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Id Number
Collection	Text	250	Class
Std_Group	Text	250	Student group (pair)
StartTime	Date/Time	Date/Time	Start time
A1-A50	Memo	-	Answer 1 -50
C1-C50	Memo	-	Comment for student 1 -50
M1-M50	Number	longInt	Marks for student 1-50
Marks	Number	longInt	Marks for students

Table 6.8: Table for Notes

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Auto increment id
Day	Number	long Int	Date to show when the notes upload.
Month			
Year			
Desc	Text	250	Description of the notes
Doc_upload	Text	250	Upload document
Teacher	Text	250	Name of the teacher
Collection	Text	250	Collection

Table 6.9: Table for Assignment

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Auto increment id
Day	Number	long Int	Current system date
Month			
Year			
Desc	Text	250	Description of the notes
Doc_upload	Text	250	Upload document
Teacher	Text	250	Name of the teacher
Collection	Text	250	Class
Eday	Number	longInt	Date of assigning task
Emonth			
Eyear			
Active	Number	longInt	Activate the task

Table 6.10: Table for Collaborative Class (Teacher)

Field Name	Type	Size	Description
ID	AutoNumber	150	Auto increment id
Title	Memo	-	Title of the class
Minutes	Number	longInt	Time frame
Teacher	Text	250	Name of the teacher
Collection	Text	150	Class
Date	Text	250	Current system date
Active	Number	longInt	Active collaborative class
Total	Number	longInt	Total number of questions
Q1-50	Memo	-	Number of questions

Table 6.11: Table for Messages (Pair)

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Auto increment id.
Day	Number	long Int	Current system date
Month			
Year			
Active	Number	longInt	Active collaborative class
Text	Memo	-	Instant Message from student
For	Text	250	Receiver
Eday	Number	longInt	Date of collaborative session
Emonth			
Eyear			
Writer	Text	50	Sender

Table 6.12: Table for Homework (Think)

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Auto increment id
Day	Number	long Int	Current system date
Month			
Year			
Desc	Text	250	Description of the notes
Doc_upload	Text	250	Upload document
Teacher	Text	250	Name of the teacher
Collection	Text	250	Class
Eday	Number	longInt	Date of assigning task
Emonth			
Eyear			
Active	Number	longInt	Activate the task

Table 6.13: Table for Sending E-mail

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Auto increment id
MessageID	Text	250	Message Id
DateRecieved	Date/Time	-	Date of receiving e-mail
Title	Memo	-	Title of the email
Message	Memo	-	Description of the email
Attachment	Text	250	Files or document
From	Memo	-	Sender
To	Memo	-	Receiver
Status	Number	longInt	Status

Table 6.14: Table for E-mail

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Auto increment id
MessageID	Text	250	Message Id
DateRecieved	Date/Time	-	Date received the email
Title	Memo	-	Title of the email
Message	Memo	-	Description of the email
Attachment	Text	250	Files or document
From	Memo	-	Sender
To	Memo	-	Receiver
Status	Number	longInt	Status

Table 6.15: Table for Collection Message (Share)

Field Name	Type	Size	Description
ID	AutoNumber	longInt	Identification
Time	Date/Time	-	Time
Group_id	Text	250	Group identification
User_id	Text	250	User identification
Message	Memo	-	Message

6.4 DETAILED OF DESIGN

6.4.1 Class Diagram

A class diagram is a static model that shows the classes and the relationship among classes in the system. The class diagram depicts classes, which include both behaviors and states, with the relationship between the classes and interfaces. The following sections presents the descriptions of elements in the class diagram, followed by the way in which a class diagram is drawn as Figure 6.2.

Table 6.16: Class Diagram Descriptions

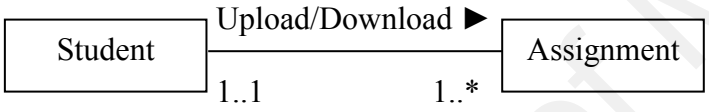
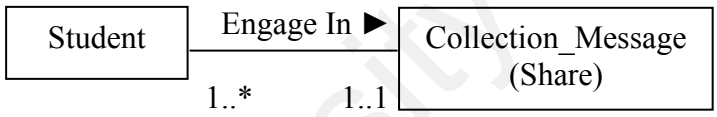
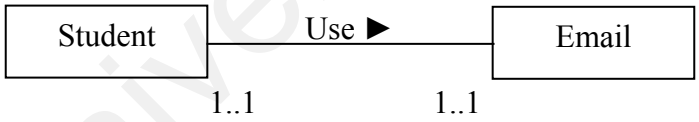
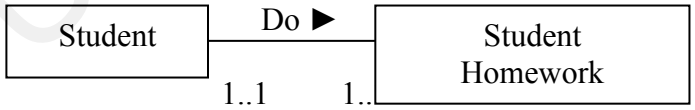
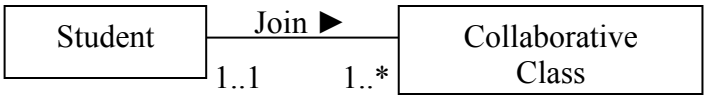
	A student can upload and download many assignments.
	Many students engage in one and only one Collection_Message (Share).
	A student can use one and only one email.
	A student does many student homework.
	A student can join many collaborative classes.

Table 6.16: Class Diagram Descriptions (cont.)

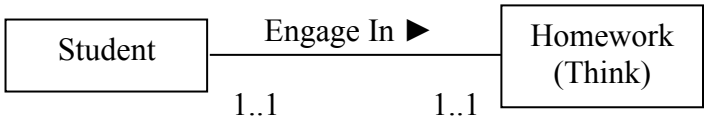
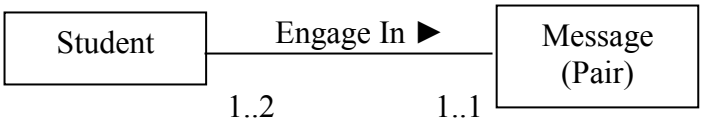
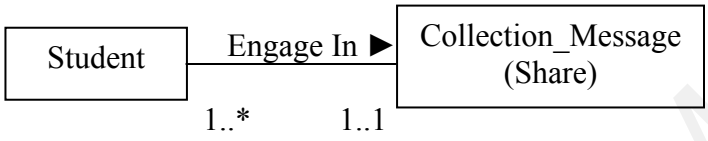
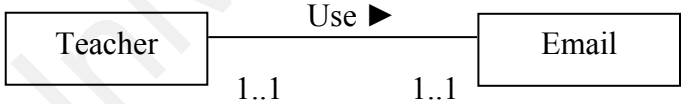
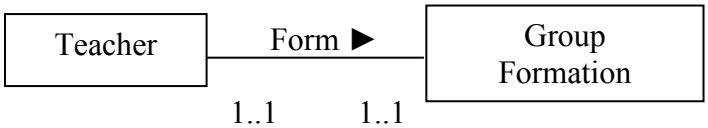
	A student get engage in one and only one homework (Think).
	Two students get engage in one and only one message (Pair)
	Many students engage in one and only one Collection_Message (Share).
	A teacher has upload many assignment
	A teacher has manage many assignments.
	A teacher can use one and only one email.
	A teacher form one and only one group formation.

Table 6.16: Class Diagram Descriptions (cont.)

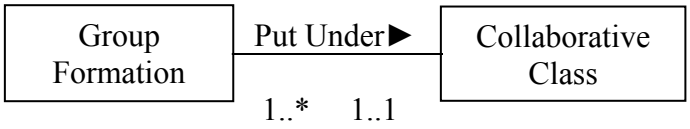
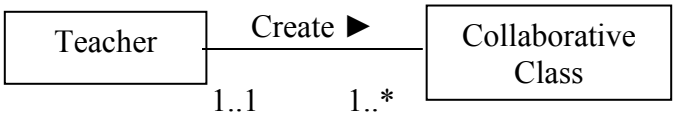
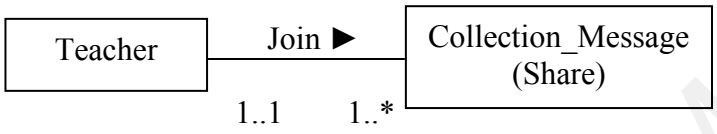
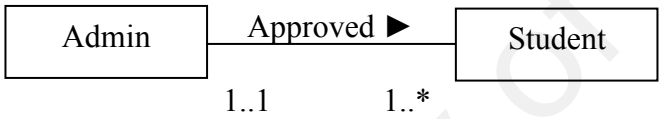
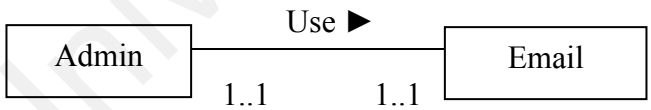
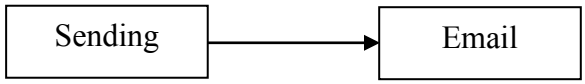
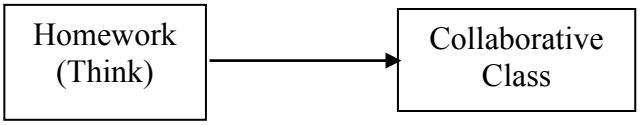
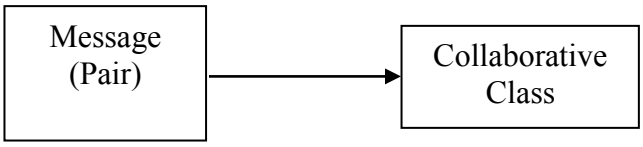
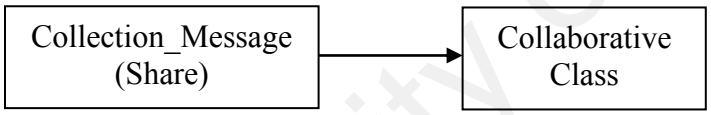
	Many group formations are putting under one collaborative class.
	A teacher can create many collaborative classes.
	A teacher joins in one and only one Collection_Message (Share).
	An admin can approved many students.
	An admin can approved many teachers.
	An admin can use one and only one email.
	Email is inherited by sending email, therefore all the attributes belongs to email is inherited by sending and this required no cardinality

Table 6.16: Class Diagram Descriptions (cont.)

	Collaborative class is inherited by homework (Think), all the operations belong to collaborative class is inherited by homework (Think).
	Message pair inherits collaborative class where all the operations belong to collaborative class is inherited by message pair. However, message pair performs another one new operation
	Collection_Message (Share) inherits collaborative class where all the operations belong to collaborative class is inherited by message pair. However, message pair performs another one new operation.

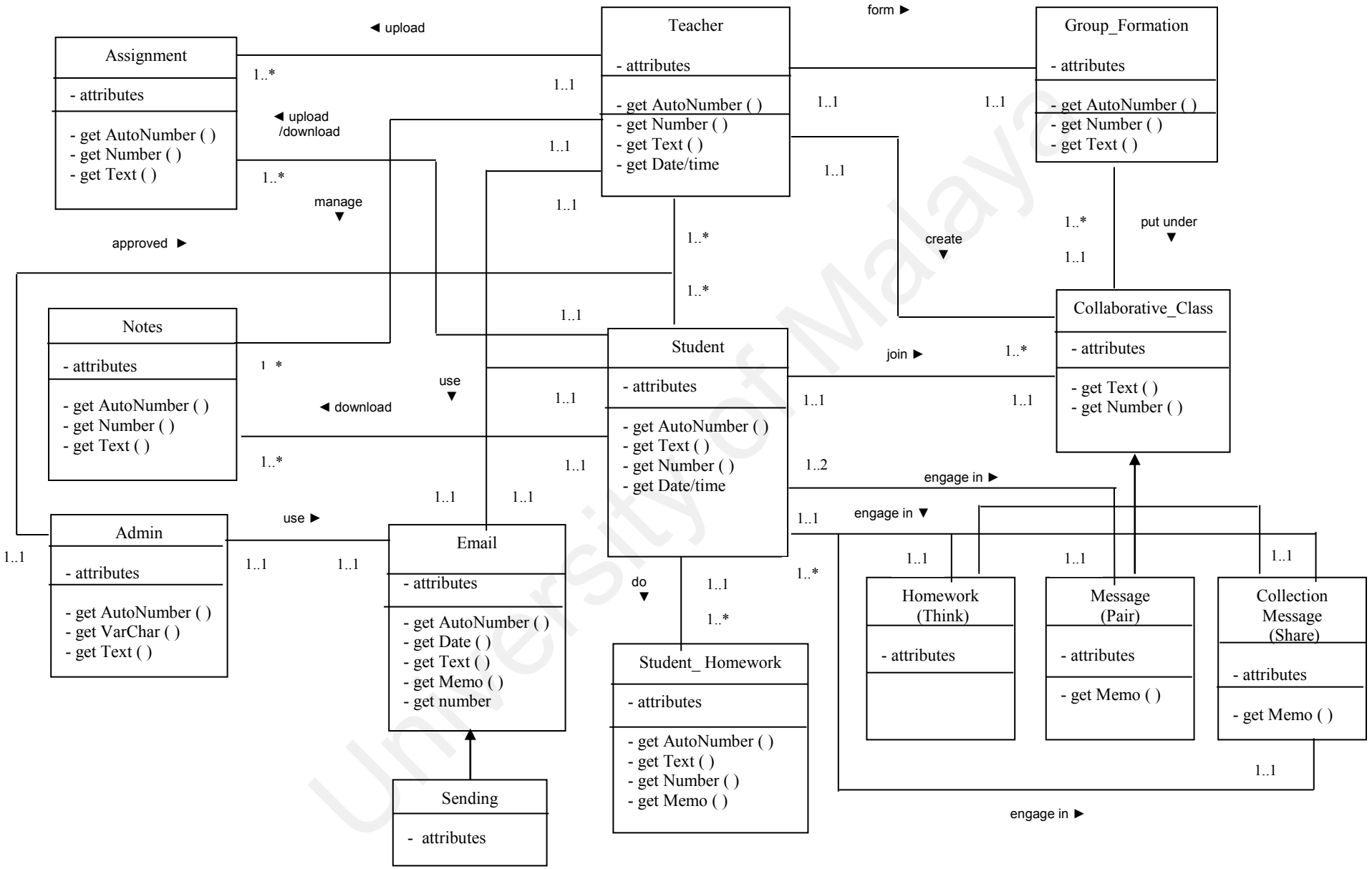


Figure 6.2: Class diagram for CETLs

6.4.2 Component Diagram

The component diagram's main purpose is to show the structural relationships between the components of a system. It is very useful because the component diagram shows the early view of the logical software components that runs on the system. Figure 6.3 presents the logical software component involved in CETLs. Basically, CETLs have five applications that connect with the users in the system. The application involved is System Administrator, Class Management, Notes and Assignment Management, Announcement Management and Collaborative Class. All the components have restricted access to the particular user. For example, the System Administration can only be accessed by the coordinator. Class Management and Announcement Management can only be accessed by the coordinator and the teacher. The Notes and Assignment Management and Collaborative Class can be accessed by both the teacher and student. All the components and the user involved are secured. This is because, each of the users is provided by the password and the data is protected by the security access control. Their account is actively persistence as long as the user doing the activity until their account is 'idle' for a certain time. This idle condition makes the system be inactive. When they are using the system, all the data is been stored into the CETLs database for the record purposes. The record is generated whenever the users access the system.

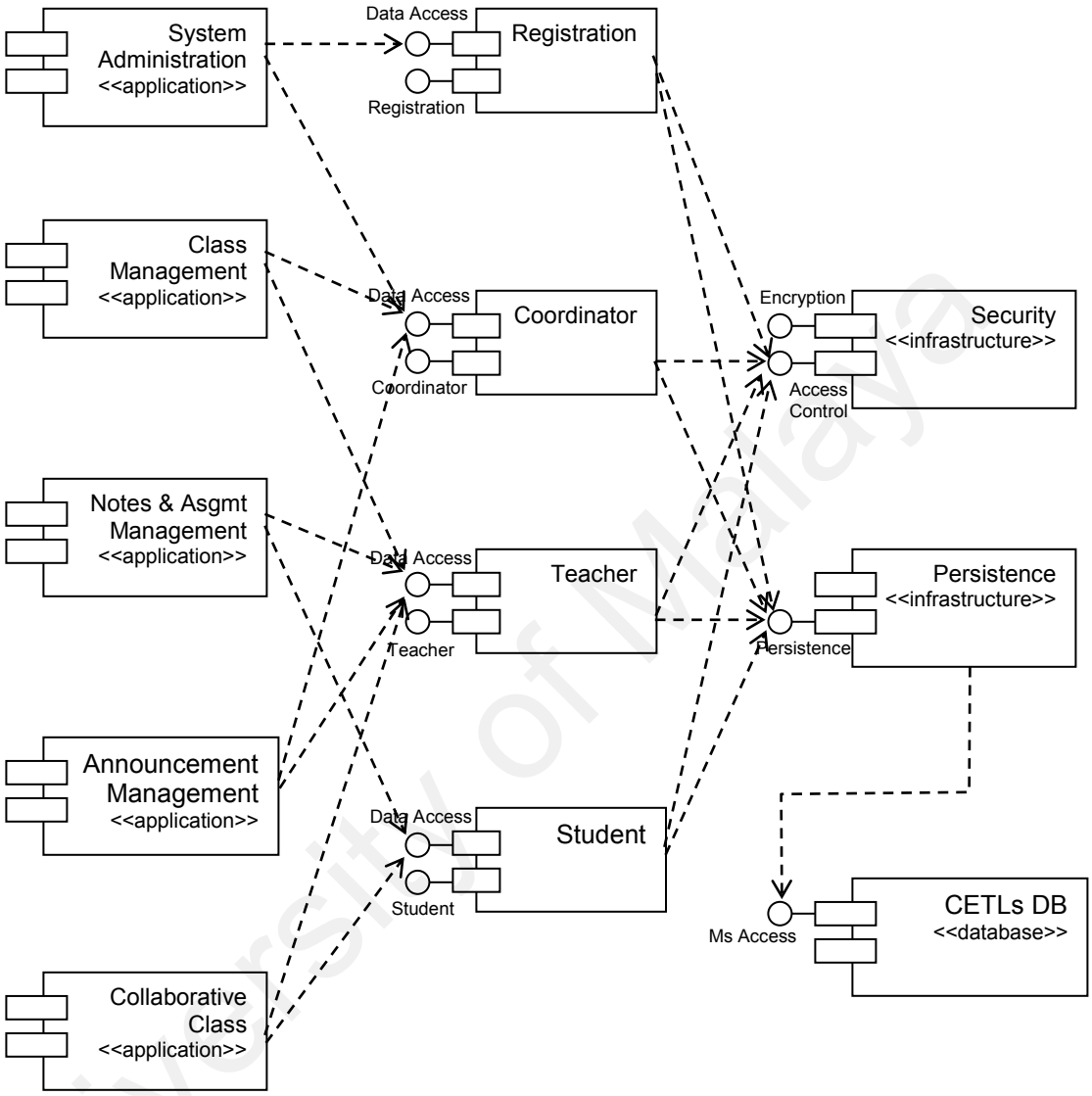


Figure 6.3: Component Diagram for CETLs

6.4.3 Deployment Diagram

Figure 6.4 shows how the connection of the CETLs system operates between the client machine, web server and database server. To access data in a system, the client which is the users of the system (students, teachers and coordinator) must request a web page through the Internet. Then, the web server uses middleware to generate a data query to the database server through the local area network (LAN) connection. Next the database server responds and submits the retrieved data to the web server. The data is translated into an HTML page and displayed back by the user browser.

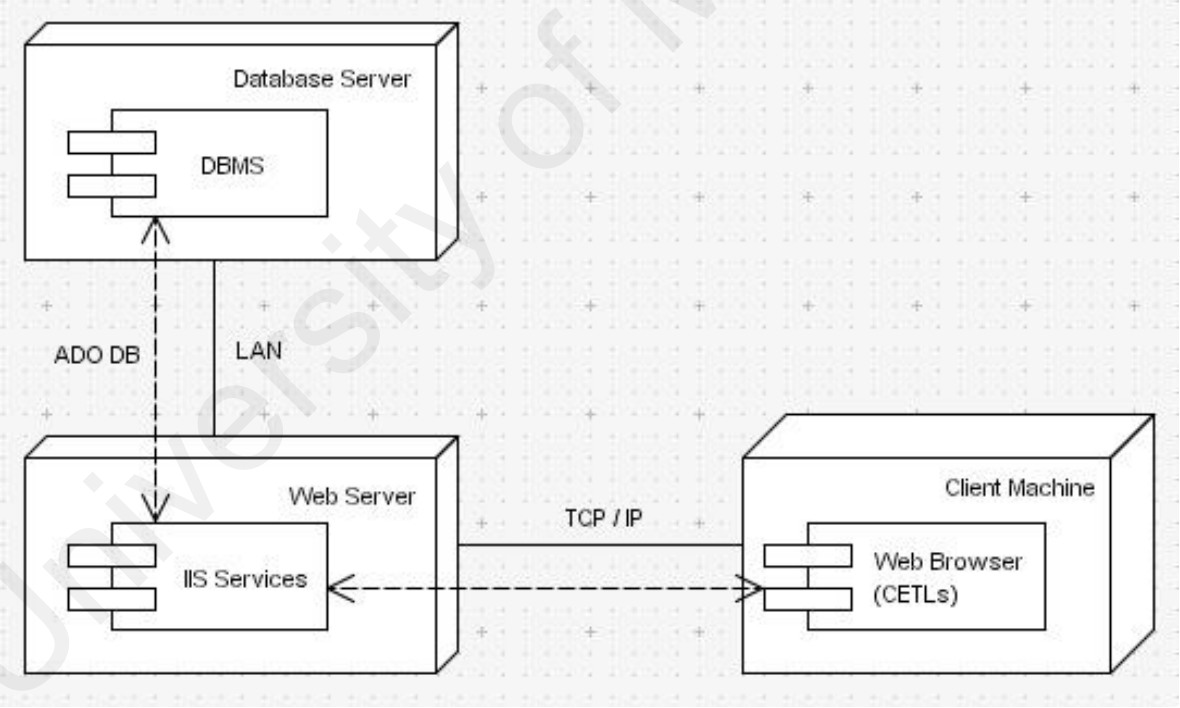


Figure 6.4: Deployment Diagram for CETLs

6.5 INTERFACE DESIGN

6.5.1 Design Priorities

The most important part that needs to be looked into, before attempting to develop this web system, is the collaborative part of the system, which needs to entice the students, not only with discussion, uploading and downloading functions, but also with a high-level design of user interface for each entity so that it appears functional to a great number of users. The resolution of monitors must be designed for various monitor resolutions. It is in the nature of the window's browser to resize to any dimension, according to the size of the monitor. Therefore it is extremely difficult to design a web page for an indefinite amount of users. Due to this shortcoming, the question of which monitors resolution to design for, should be based on the understanding and informed knowledge of the target audience and the main purpose of the site.

It is essential to decide the possible size of the web page by understanding the maximum amount of space offered by the computer monitor. Typically, monitors come in a variety of standard sizes, ranging from 14 to 21 inches. In this project, the most important measurement is made by identifying the total number of pixels available on the screen, given that, the higher the pixel is, the higher the details that can be delivered on the screen. It is essential to measure the availability of the pixels so that the page elements and graphic design can be done smoothly and in accordance with the findings.

6.5.2 Major Components of Interface Design

According to Dennis *et al.* (2002), 'the goal of interface design is to create a pleasant appearance for a system so that it makes it easy for the user to interact with the system in a clear manner.' For this CETLs project, the interface design is focused on five categories, which are, the navigation mechanism, input mechanism, output mechanism, and graphical user interface (GUI). The navigation mechanism includes buttons and menus used by the user to manoeuvre from one page to another and to give commands to the system about the task or actions that need to be executed. The input mechanism deals with the method used by the system to capture information. While the output mechanism is how the system provides information to users. GUI deals with the graphic icons and menus. These components will be discussed in detail, later in this chapter.

Here some interface design ideology, as introduced by the authors, can be applied with the previous four interface design components as discussed above. The ideologies are:

6.5.2.1 Layout

The layout of CETLs is divided into four main areas, namely, the system navigation, section navigation, page navigation and status bar as presented in Figure 6.5. It is believed that the layout concept introduced in this project can minimize the user's effort in terms of movement from one page to another and all areas are remain consistent in terms of size, shape, placement for entering data and results. It is deemed that the page is self-contained, for instance, the user is able to retrieve information from a single

link. In addition, the page will have an intuitive flow; from left to right and general to specific.

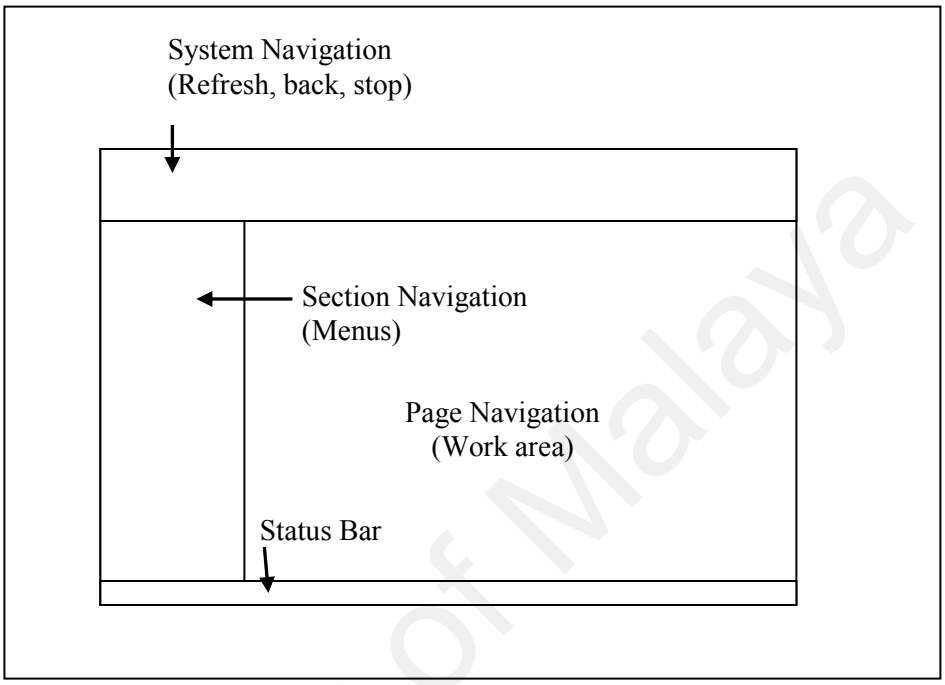


Figure 6.5 CETLs layout design

6.5.2.2 Consistency

Consistency in user interfaces seems a self-evident virtue. On the surface it appears that consistency and makes it easier for users to move from one application to another. It is proven that a user becomes familiar with something similar. Thus, keeping the similar look of the interface and appearance allows them to understand the system faster. The consistency in each page makes the system look neat and uncluttered.

6.5.2.3 Context Awareness

To avoid confusion, all interfaces have its own title so that it can make the user know which page they are working on. The system specifically divides the content for different users, which are coordinator, teacher, and student. Different level access is marked on the system, and the user will be notified about their status as well. It is important in this CETLs system to be clear and precise as the users are mainly of very young ages, and most of them are not expert personal computer users. They need guidance and a descriptive system. Therefore, adapting the content awareness in CETLs helps the users a lot, and the users can find themselves at ease when learning the web system.

6.5.2.4 User Experience

The basis of the user interface design for CETLs is to support the infrequent users; both novice and expert users who are involved with the use of this system. Since it involves a variety of level of users (teachers and students), CETLs are provided with images to speed up the learning process.

6.5.2.5 User Control

CETLs provide simplicity and flexibility where the user takes control, rather than the user being controlled. This can clearly be seen during the chat session, and they have the right to assign the timer on their own. Users have different ways of operating, they have different tasks from those thought of during design, and they wants to do things in different ways from the way envisaged. Forcing people into a straightjacket of

responses causes them to become frustrated and annoyed. When the users experience the flexibility during the system navigation, they feel comfortable and freer, thus they think that the work is not tedious.

6.5.3 Navigation Design

The navigation of the web page is kept very simple, systematic and consistent. It is placed in the left corner of the web page for all pages in the CETLs. It is represented as a tree menu that consists of a hyperlink to other appropriate pages. In the CETLs, there are three categories of user – student, teacher and coordinator. Each of the users has restricted access to the system. For instance, students can only navigate the system that is provided for them, which contains a menu specifically related to the student activity only. The same also applies for other users. This enhances the sense of orientation among the users of the system.

6.5.4 Input Design

The input design is used by the end user – teacher and student. The CETLs system is presented to the end user with a list of available alternatives that are relevant to the task performed. CETLs use a single menu and hierarchical menu approach. Using single menu, the user can input the data in the text based options and performed by different command. It display a text based options that can be individually selected by the end user. The users select the option from menu, and the command executes and any necessary output will generated. It is the simplest design and easier to navigate. Figure 6.6 show the example of single menu approach.

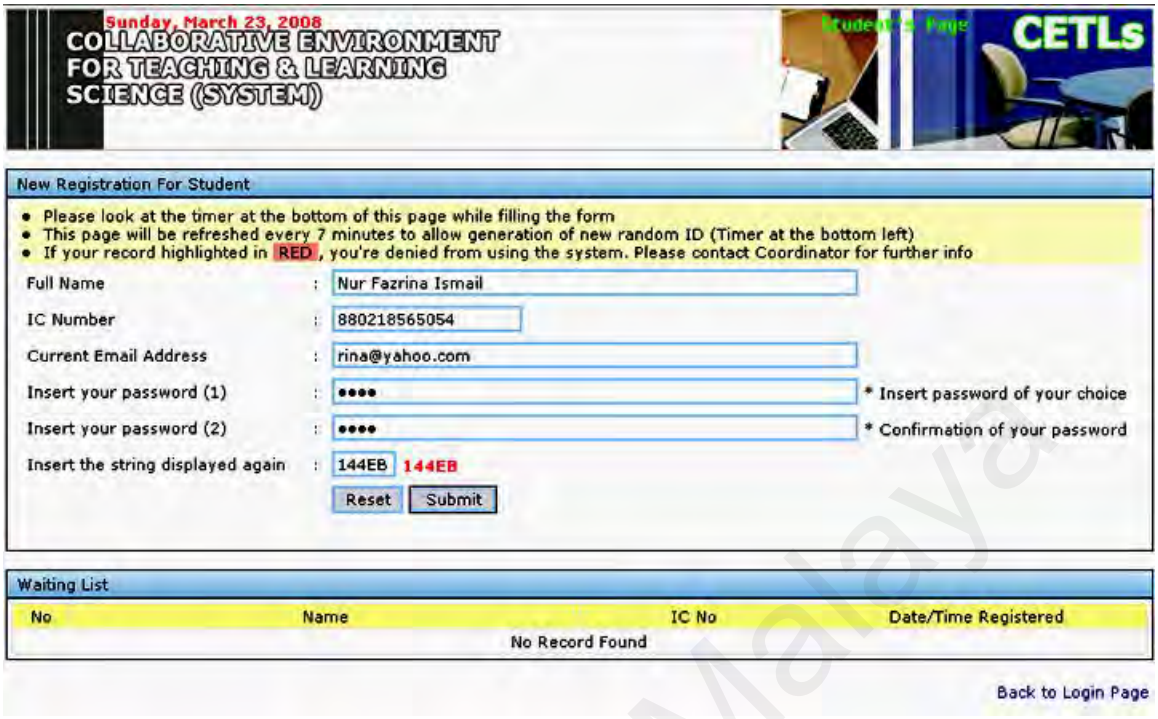


Figure 6.6: Single Menu Approach

The CETLs system also used the hierarchical menu approach where the main menu consists of submenus. With a tree menu control, also called treeview, the information is displayed in a hierarchical order, with the home topic at the top and the subordinated items underneath. Beginner users like to use a tree of folders because it is easy to learn and it is efficient in the number of clicks involved. Figure 6.7 shows the example of hierarchical menu.

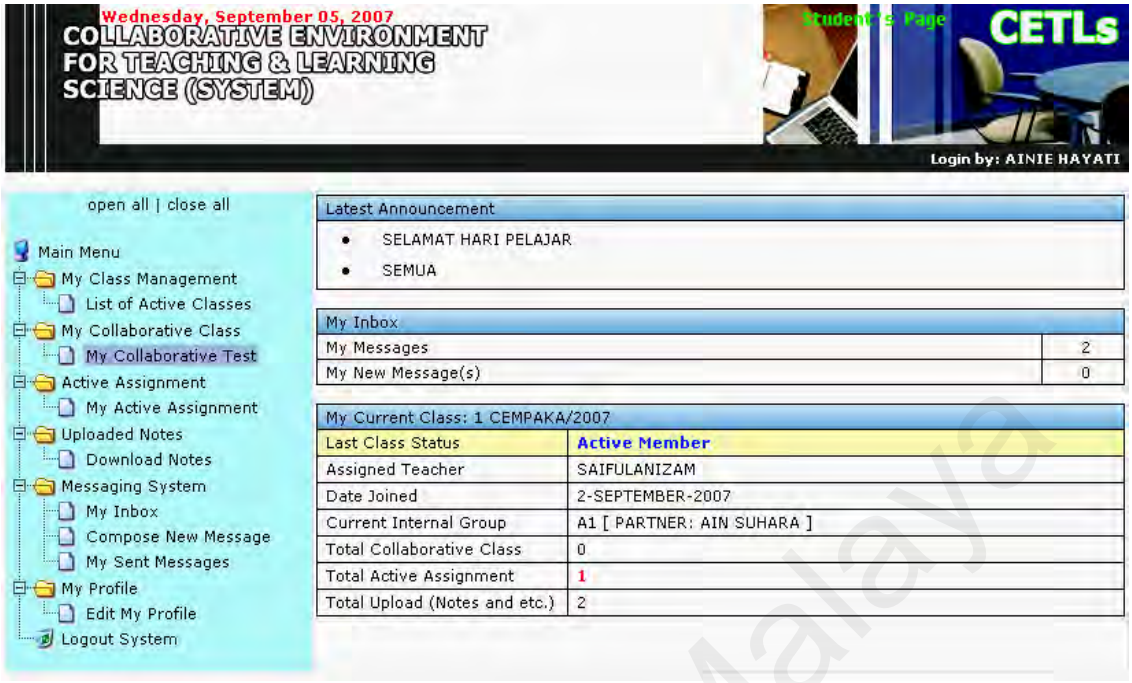


Figure 6.7: Hierarchical Menu Approach

6.5.4.1 Types of Input

In this project, three types of input are being used through the design of the Web systems forms. These inputs are the text box, drop down list box and check box. These text boxes can be used by the user to enter both text and numbers. The text box has the GUI capability which permits such actions including cut, copy and paste. Another input is the drop down list box, which allows the users to choose the value that ought to be entered rather than having to type it. This concept suits the novice user who has no experience in dealing with the system. This also speeds up and simplifies the input process. The CETLs system also uses other input types including the check box. It is a graphical user interface element that permits the user to make multiple selections from a number of options.

6.5.5 Output Design

The output design of the CETLs focuses specifically on designing the layout of the result for the assessment students as this component is very important for both end users – teacher and students. The output design represents the desired information to the end user in an understandable and a usable manner. In the CETLs system, the teacher gives the test results, assignment or exercise to the students. The students will log in to the system and must be able to see their results. The output is designed in such a way that the students can see but cannot edit. This is important to preserve the integrity of the marks and results.

6.5.6 Sample of User Interface Design

The designing of the interface is as important as the design of the site and the pages of the CETLs system. The GUI plays an important part in ensuring that the CETLs is a user friendly and simple to use. The icons and graphical user interface can help novice students and teachers use the system effectively. According to the Lynch and Horton, (2002), 'The interface should share the same basic layout grids, graphic themes, editorial conventions and hierarchies'. This mean in designing the interface of the system shall be built on a consistent pattern of modular units in order to give the users a familiar sense of using the same system. For the CETLs system, most of the designs are using the same layout and grid in order to make the user feel easy when they are using it. Before the CETLs is explained further, it is important to explain the interface design and navigational ability of the CETLs. The design consists of the GUI element such as combo box, text box, drop down list, hyperlink and button. Figures 6.8 until Figure 6.15 represent a sample user interface design for CETLs.

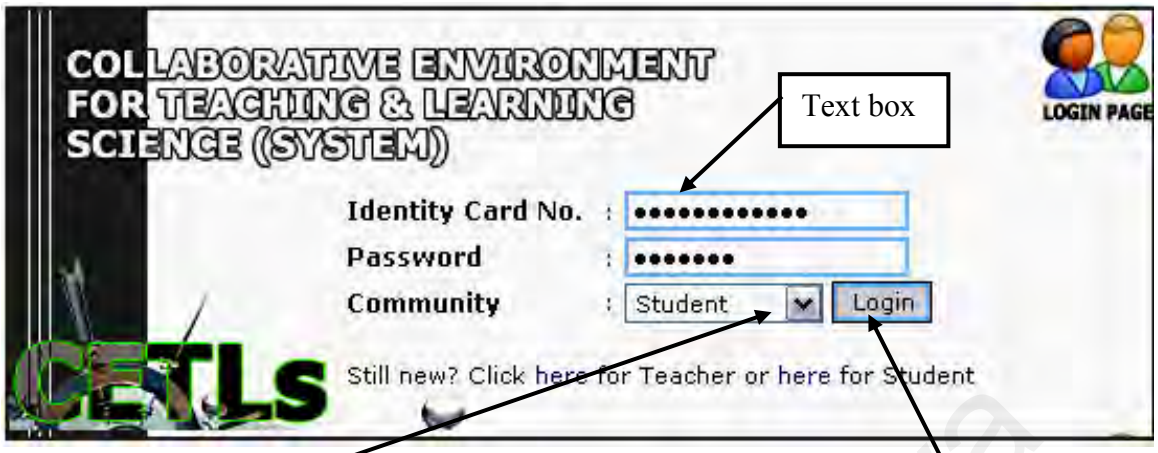


Figure 6.8: User Interface Design for Login Page

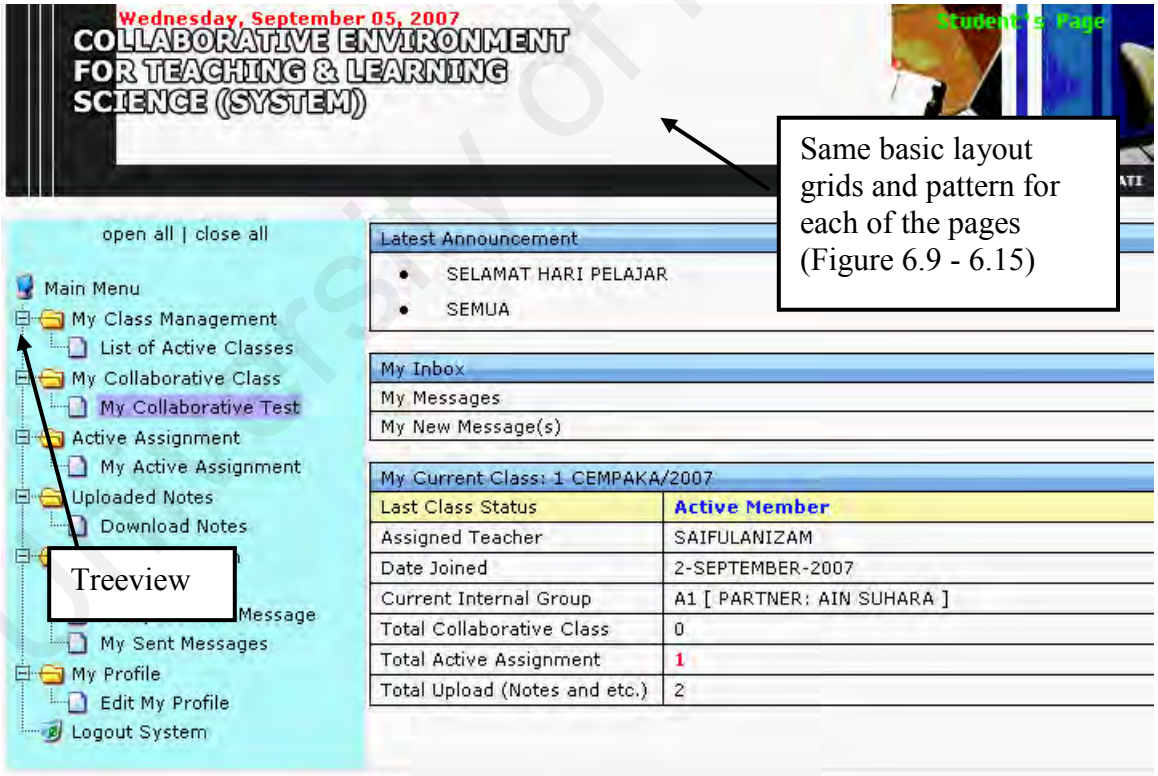


Figure 6.9: User Interface Design Student Main Menu Page

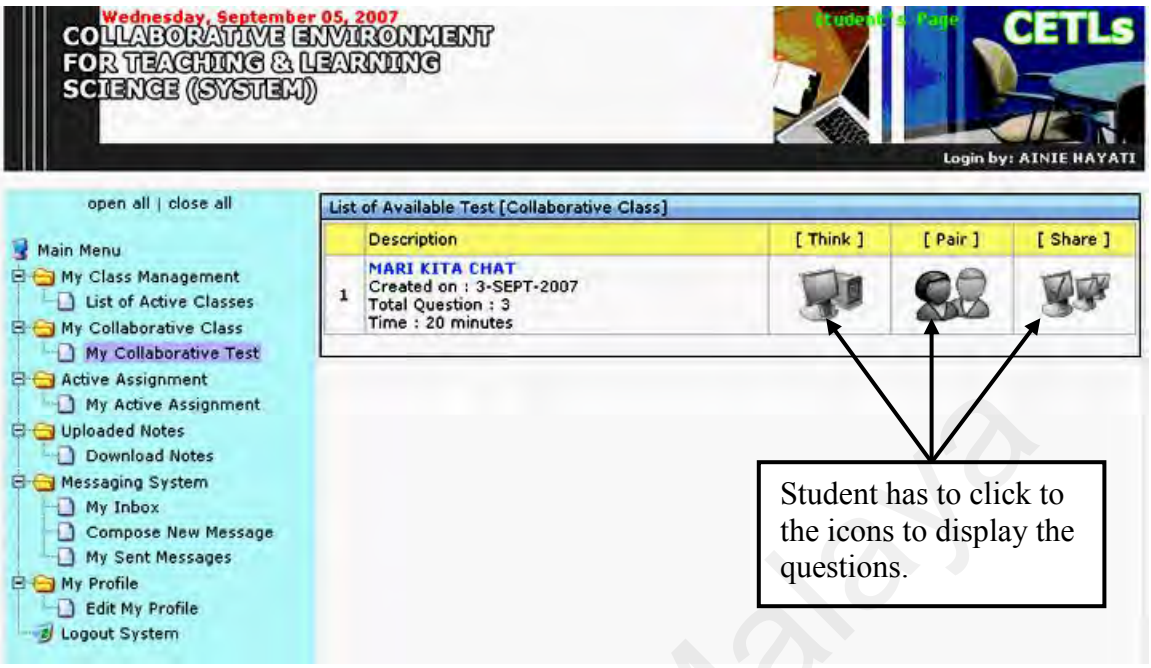


Figure 6.10: User Interface Design for Collaborative Class

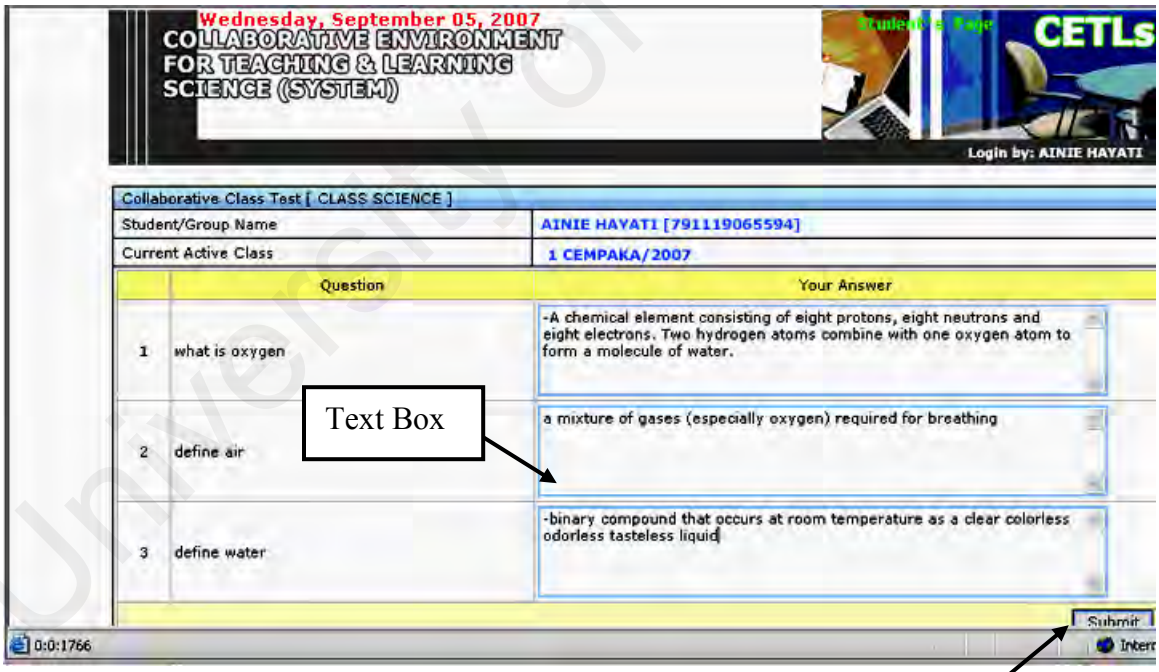


Figure 6.11: User Interface Design for Think Test

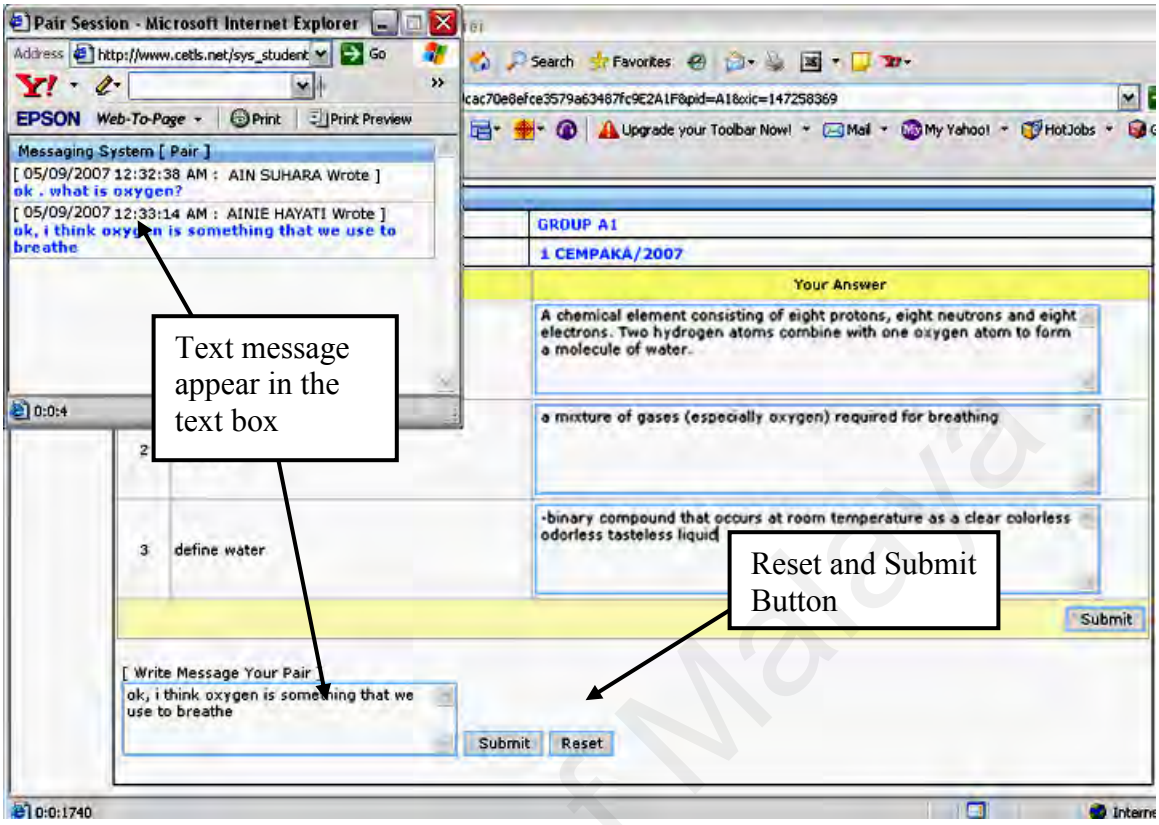


Figure 6.12: User Interface Design for Pair Test

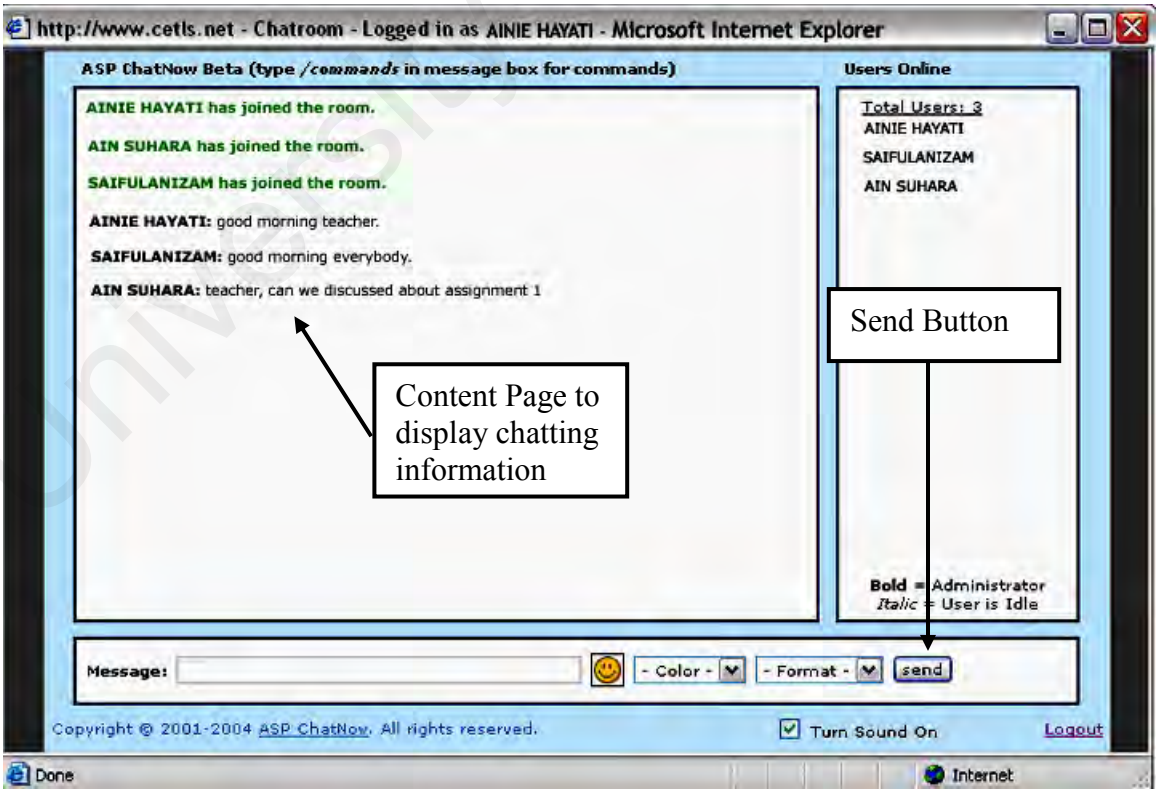


Figure 6.13: User Interface Design for Share using Chat Room

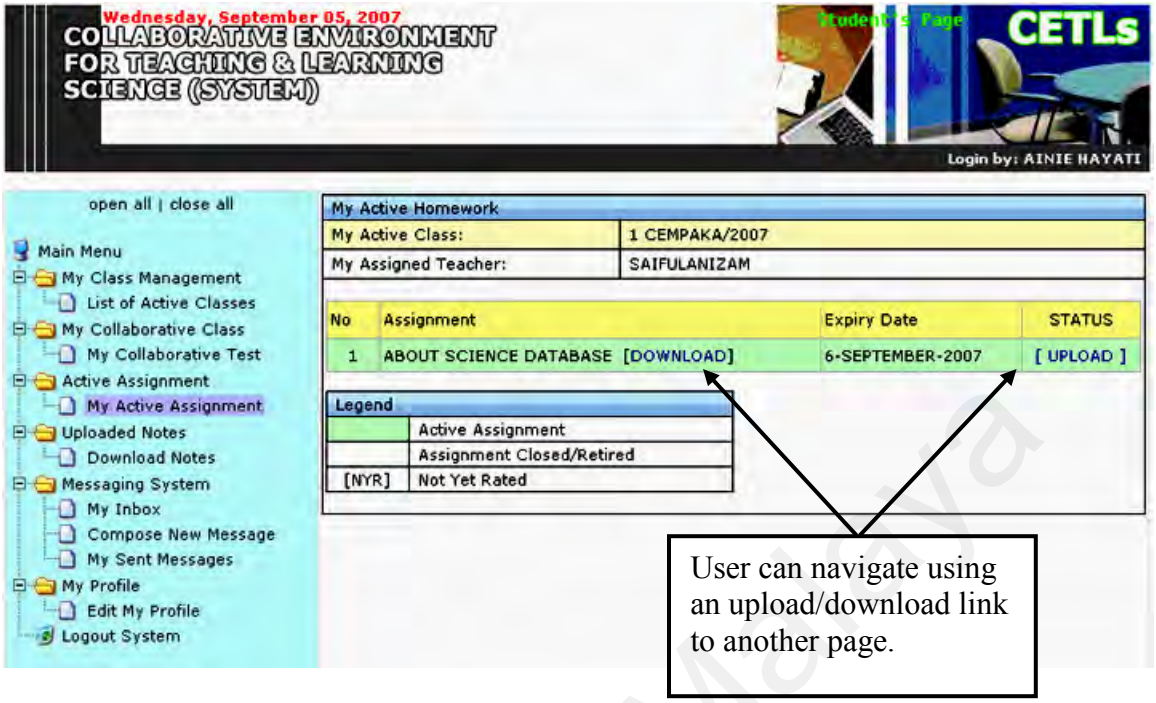


Figure 6.14: User Interface Design for Download Assignment

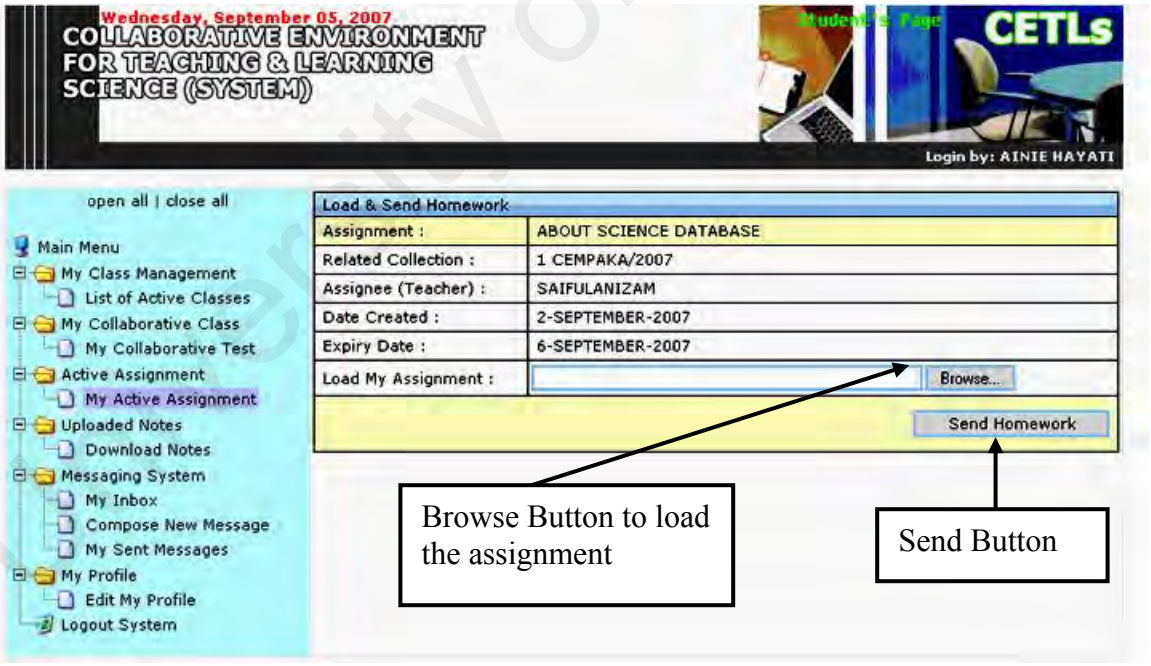


Figure 6.15: User Interface Design for Upload Assignment

6.6 SUMMARY

The objective of this chapter is to analyze the CETLs from its architecture through the design of the CETLs and its database. The CETLs uses the Three-Tier Client server architecture where the concept is suitable with the development of the CETLs. The CETLs is developed based on a web-based system that needs to be accessed through the Internet. Therefore, it makes the system more reliable and acquainted with each of the functions that rely on this framework. Other than that, the design of CETLs is represented by a class, component and deployment diagram. The interface design of the CETLs consists of the GUI element that make the system is interesting and user friendly. CETLs are design with simple yet attractive for both of the user. This is because the students and teacher is the primary user of the system. If the CETLs is developed with a complex design, it makes difficulty for the usage of a student, especially those who are lacking in computer knowledge. This is to show the overview of all phases that are involved in the CETLs development. Finally, the database design that represents each of the relationships and attributes consists of data types, attributes and table name.

CHAPTER 7
IMPLEMENTATION AND TESTING

7.1 INTRODUCTION

This chapter explains the implementation of important modules in CETLs and testing activities carried out on CETLs. The implementation section emphasized the algorithm of the Think, Pair and Share modules. It also explains the flow of the system from the user point of view analyzes the results from the test and questionnaire. The testing ensures the system can be executed before it is given to the user. It covers unit testing and user acceptance testing.

7.2 ALGORITHMS

The implementation emphasized the algorithms of certain part in the three main modules involved in the system. The codes are in ASP language. Details of the code are illustrated as below.

7.2.1 Main Menu of Think-Pair-Share

```
<div align="center">
<table border="0" cellpadding="2" cellspacing="1"
width="100%" bgcolor="#C0C0C0" id="table4">
<tr bgcolor="#FFFF99" height=22>
<td width="5%"> </td>
<td width="50%">Description</td>
<td width="15%" align=center>[ Think ]</td>
<td width="15%" align=center>[ Pair ]</td>
<td width="15%" align=center>[ Share ]</td>
</tr>
```

7.2.2 Think

```
Sub HandleTime
if hr2=0 and min2=0 and sec2=0 then
endtime
elseif min2>=0 and sec2>0 then
sec2=sec2-1
status=hr2 & ":" & min2 & ":" & sec2
intTimerID=setTimeOut("HandleTime",950, "VBScript")
elseif min2>0 and sec2=0  then
min2=min2-1
sec2=59
.
.
status=hr2 & ":" & min2 & ":" & sec2
intTimerID=setTimeOut("HandleTime",950, "VBScript")
elseif hr>=0 and min=0 then
hr2=hr2-1
min2=59
sec2=59
status=hr2 & ":" & min2 & ":" & sec2
intTimerID=setTimeOut("HandleTime",950, "VBScript")
end if
End Sub
```

7.2.3 Pair

```
Sub starttime
cleartimeout intTimerID
window.navigate("pair_chat.asp?y=<%=x%>&pid=<%=y%>")
end sub

SQY = "Select * From Std_Homework Where HMWK_ID = '" & nHw &
"' And NOKP = '" & Session("NOKP") & "'"
RS.Open SQY,db
If Not RS.Bof Then
komen = RS("Komen")
markah = "" & RS("Markah") & ""
End If
RS.Close
```

7.2.4 Share

Get Message

```
If IsArray(Application(ApplicationMsg)) Then
saryMessages = Application(ApplicationMsg) Else
ReDim saryMessages(6, 0)

Application.Lock
Application(ApplicationMsg) = saryMessages
Application.UnLock
End If
.
.
If bln RecordstoShow Then
Response.Write(vbCrLf & "var chatBoxHTML =
document.getElementById(""chatBox"");")
Response.Write(vbCrLf & "chatBoxHTML.innerHTML += addHTML;")
Response.Write(vbCrLf & "toBottom()")
End If
```

Post Message

```
If IsArray(Application(ApplicationMsg)) Then
saryMessages = Application(ApplicationMsg)
Else
ReDim saryMessages(5, 0)

Application(ApplicationMsg) = saryMessages
End If
.
.
function insertText(strText) {
var txtarea =
parent.frames["postmessage"].document.frmMessage.message;

txtarea.value = strText;
txtarea.focus();
}
```

7.3 FLOW OF THE SYSTEM

In order to use the system, there are flows and procedures that must be followed. This is to ensure that the using process is running smoothly. There are four activity diagrams that represent the flow of the system; the student, coordinator, registration and think-pair-share activities. These activities are represented by the activity diagram.

7.3.1 Registration Activity

The registration activity as shown in Figure 7.1, indicates that there are three parties involved categorized by swim lane (shown in doted line), they are the namely Student, Teacher and Coordinator. Basically, this diagram shows that coordinator's activities are to approve student and teacher activities as a user. Initially both student and teacher shall have to register to enter the system by filling in their participation. Next they have to submit the information for coordinator's approval. The coordinator shall review the registration request and decides on whether to accept the request or reject it. He/she shall block the user if the request is rejected and unblock accepted ones. Upon approval, the teacher is allowed to log in and "role" the "virtual class". The student, on the other hand can only log in and join the class when ruling teacher approve.

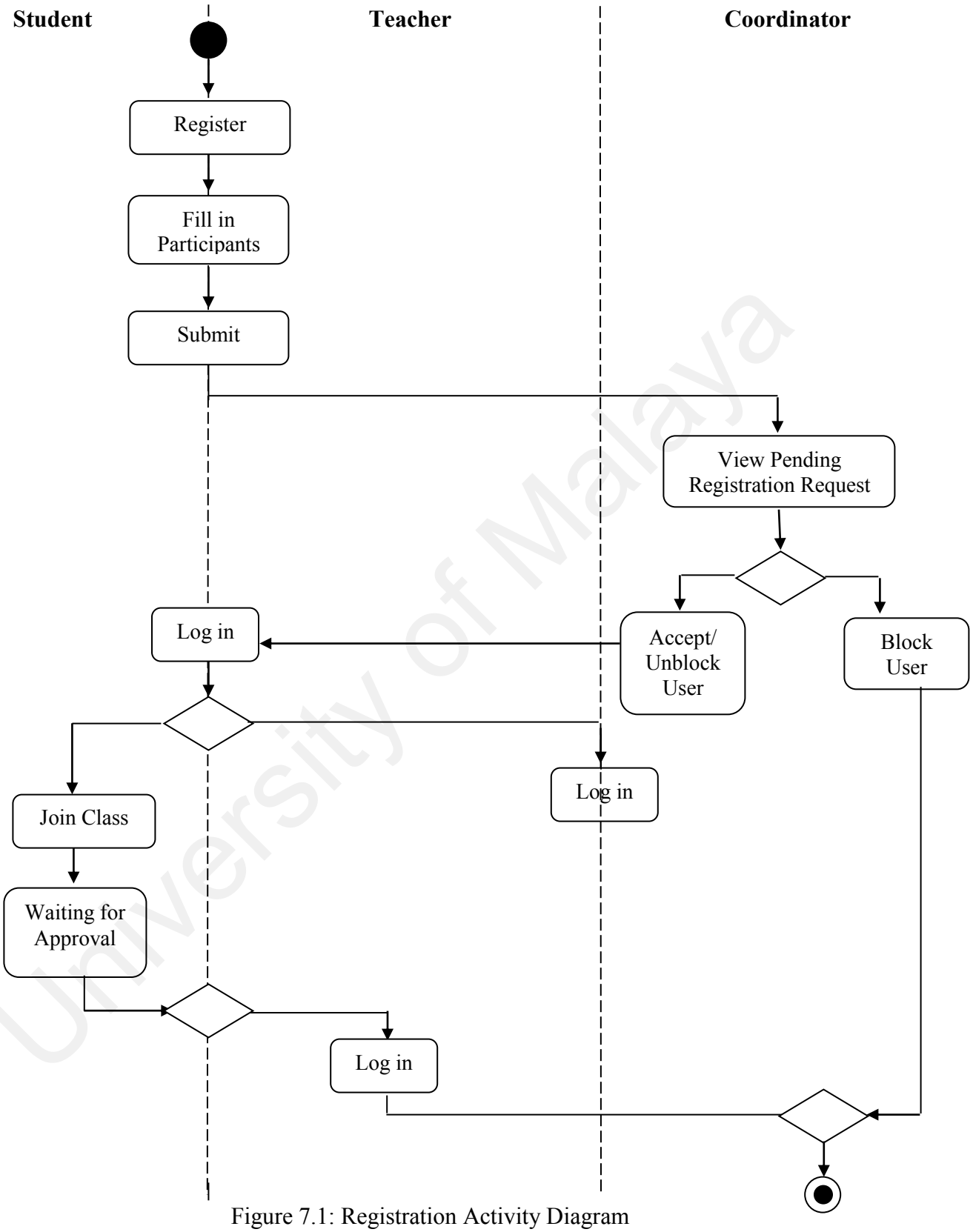


Figure 7.1: Registration Activity Diagram

7.3.2 Coordinator Activity

Figure 7.2 shows the flow of coordinator activities once he/she enters his/her CETLs. As usual, a coordinator has to enter correct his/her IC No. and password as required to show the "Main Menu". If either one or both were entered incorrectly, the "Main Menu" will not be displayed. The "Main Menu" contains 5 other components namely, "Manage System Admin", "Manage Class", "Manage Announcement", "Messaging System" and "Change Password".

Under the "Manage System Admin Menu", a coordinator is able to determine on whether or not to approve the teacher/students registration. He/she can check on the registrations by viewing the list of students and teachers. Once students and teachers have registered themselves into the system, it shall be the privilege of the coordinator to accept/approve the registration details. If the students and teachers have correctly entered their information details, the coordinator will unblock the system and allow them to access. But, if the user's registration is rejected, their access remains blocked.

Under "Manage Class Menu", a coordinator is able to create and organize the virtual class room for students. It shall be coordinator's duty to enter class detail, assign a teacher for the class and analyze the class status whether it active or not active. An active class shall be in the "Active Class List" and an inactive class shall be in "Inactive Class List". Subsequently when the class is organized, the coordinator can always monitor the class activity by viewing the class list.

In the "Manage Announcement Menu", the coordinator can create announcements for students and teachers perusal. Coordinator always able to list the existing announcement, update the announcement or even delete it. He/she also create a new announcement at any time. In creating the new announcement, a coordinator has to select the appropriate group, enter the announcement details and categorize the status whether it is active or not active.

The "Messaging System component", functions like e-mail but available only in a small group among CETLs users, that is coordinator, teacher and students. Coordinator can read their messages in the "Check Inbox" and compose massages with attachment files at "Compose New Message". The message is sent to the user via "Read Sent Message".

Finally in the "Change Password Menu", coordinator can always change their password for security. The procedure is simple, first the coordinator has to enter the current password followed by the new password and confirm it. To end these components or close the system (account), he/she can just "Logout".

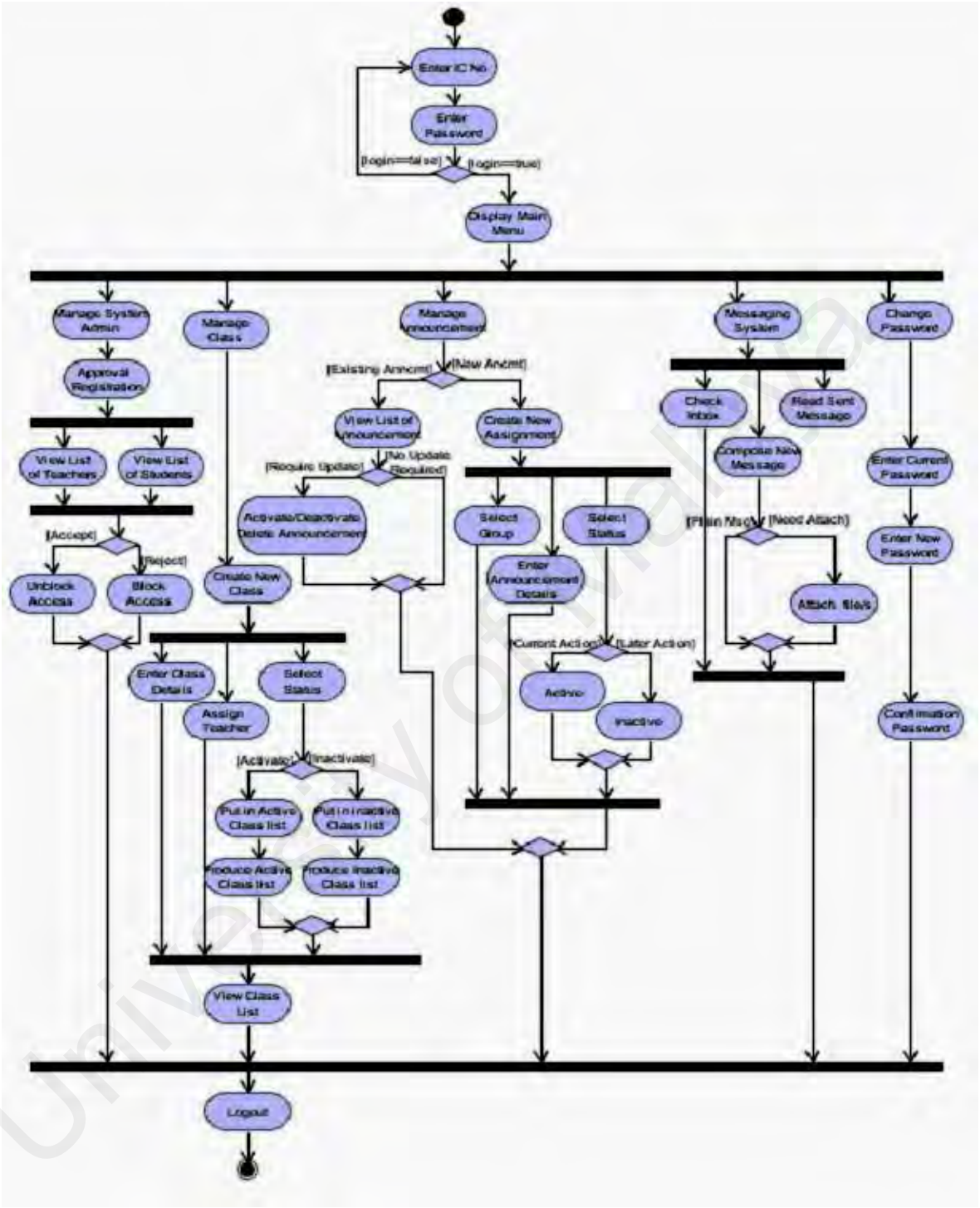


Figure 7.2: Coordinator Activity Diagram

7.3.3 Student Activity

Figure 7.3 represents the student's activity diagram which shows activities of each student. Students need to enter IC No. and password in order to display the "Main Menu". The Student Main Menu incorporate 6 components namely, "Class Management", "Assignment Management", "Notes Management", "Collaborative Class", "Messaging System" and "Change Password".

Under "Class Management Menu", the student who wishes to join the class needs to register first into the system and wait for approval from the coordinator. This requirement is only for new student only. Existing students can directly view their active class once they have accessed the system.

The "Assignment Management Menu", allow student to view and download assignment. Student's completed assignments and answer can be uploaded to their respective teachers. Under "Note Management Menu", student can view and download any related notes uploaded by the teacher to them.

In the "Collaborative Class Menu", students are required to join the collaborative class which consists of three stages namely, "Think", "Pair" and "Share". In the "Think" stage, a student has to think and answer independently question posted by the teacher and submit it before time elapsed. In "Pair" stage, student needs to discuss the question with their respective partner and provide the best possible solution to the teacher within the time given. In "Share" stage, students share their answers with other students and teacher in chatting room. After

the teacher had remarked the submission, student can able to view their mark given and comment by a teacher.

The "Messaging System component", functions like e-mail but available only in a small group among CETLs users, that is coordinator, teacher and students. Coordinator can read their messages in the "Check Inbox" and compose massages with attachment files at "Compose New Message". The message is sent to the user via "Read Sent Message".

Finally in the "Change Password Menu", students can always change their password for security. The procedure is simple, first the student has to enter the current password followed by the new password and confirm it. To end these components or close the system (account), he/she can just "Logout".

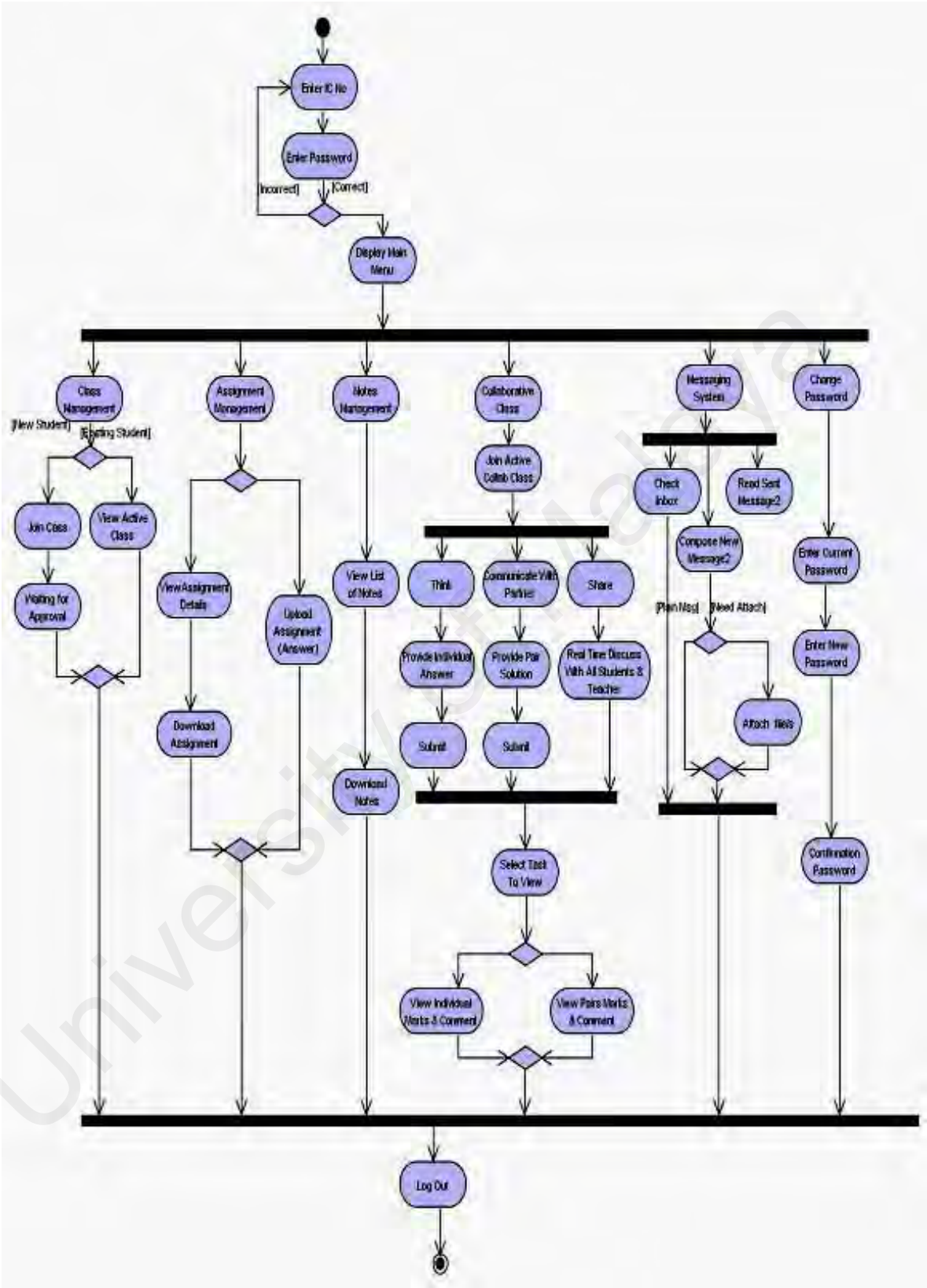


Figure 7.3: Student Activity Diagram

7.3.4 Think-Pair-Share Activity

Activity diagram for Think-Pair-Share as shown in Figure 7.4, basically involves teachers and students. The teacher needs to create the collaborative class and form groups of students (in pairs). Then, the teacher shall create questions for the students and assign the timer according to the number of questions given. The questions are provided in two stages. There are "think" and "pair" which need student's participation. The think stage requires the students to answer the questions individually. In the pair stage students discusses the questions and exchange ideas with their pair. All the answer from each of stage shall be submitted for evaluation. Teacher gives their marks and comments to the students after the class is been retired. In addition to the above, there is one more stage that need students participation called "share". This is the stage is where the students get together in the chat room to share their responses with other pairs, other teams, or the entire group. Students present their answers and have discussion with their respective teachers.

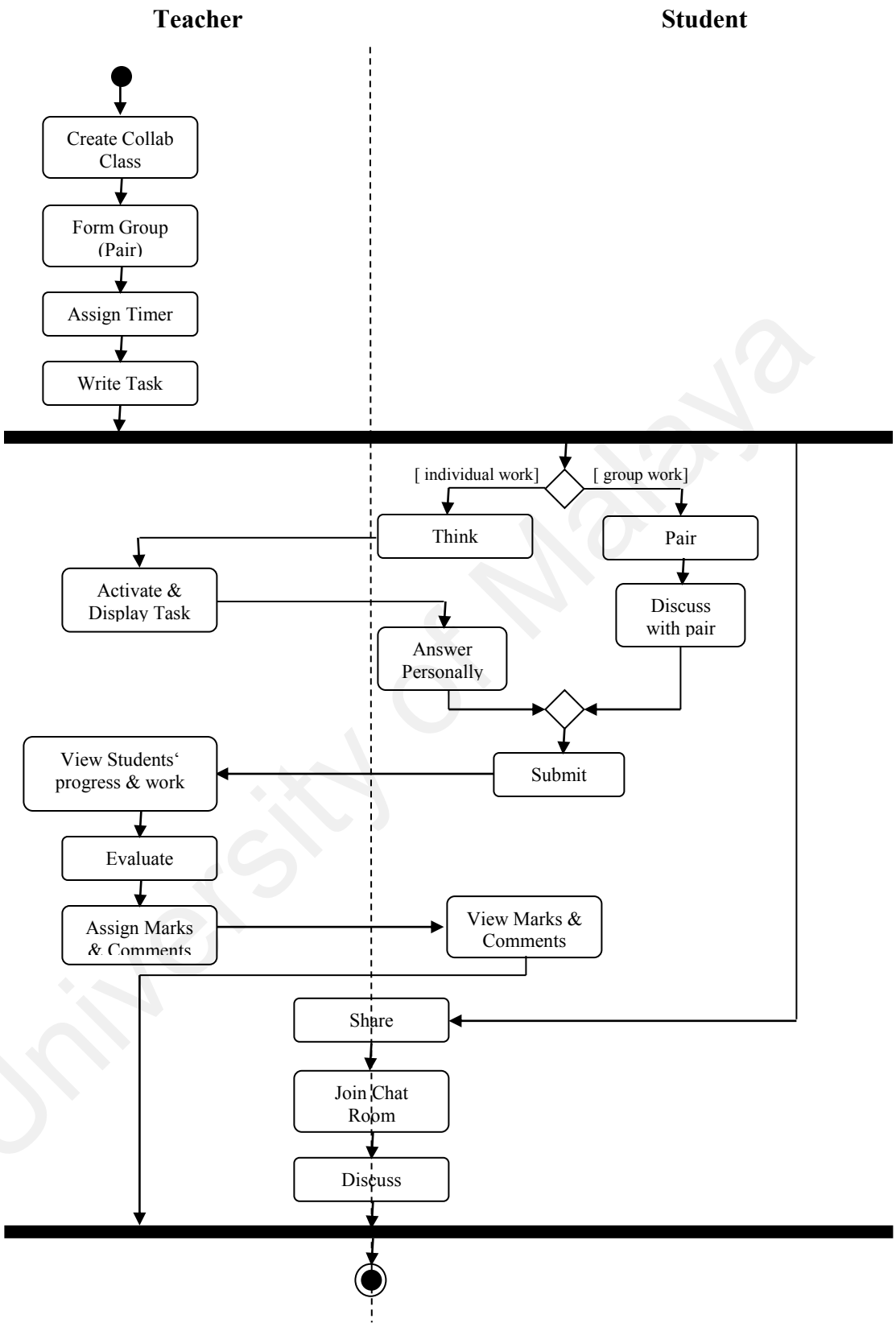


Figure 7.4: Think-Pair-Share Activity Diagram

7.4 EXECUTION CETLs FROM THE USERs POINT OF VIEW

The students contribute a major proportion of users. In designing the CETLs, the different level of students with different levels of knowledge and technical skills are considered. Other than students, coordinator participation is significant to ensure the process of executing the system is running efficiently. Thus, the CETLs shall be explained in the following section based on these two perspectives. The first perspective shows the CETLs from the student's point of view and the second perspective shows based on the coordinator's point of view.

7.4.1 Student Perspective

In order to use the system, the student needs to key in the address of the system using Internet Explorer (IE) for the CETLs login page to appear. This login page is accessible by all types of user including teacher and coordinator. To access the system, the student needs to key in their identification number and password in order to be authenticated and provided access to the CETLs system. Figure 7.5 shows the login page of the CETLs .

Figure 7.5: The Login Page

If the student enters their identification number and password wrongly, the same page will be displayed with an error message. The login page with the error message is shown in Figure 7.6.

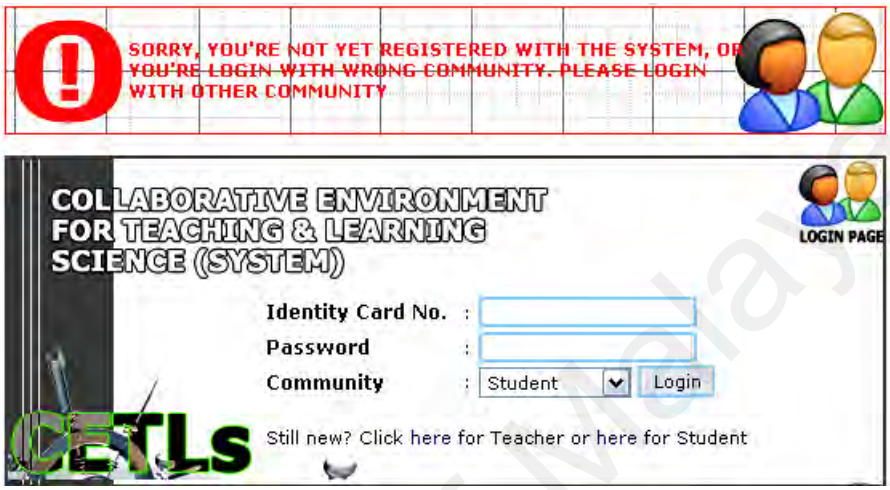


Figure 7.6: Login page with error message

If the student is a new student, they need to register by first completing the relevant information on the new registration page. When the coordinator accepts and approves the registration the student can access and use the system. Figure 7.7 shows the new registration page for students.

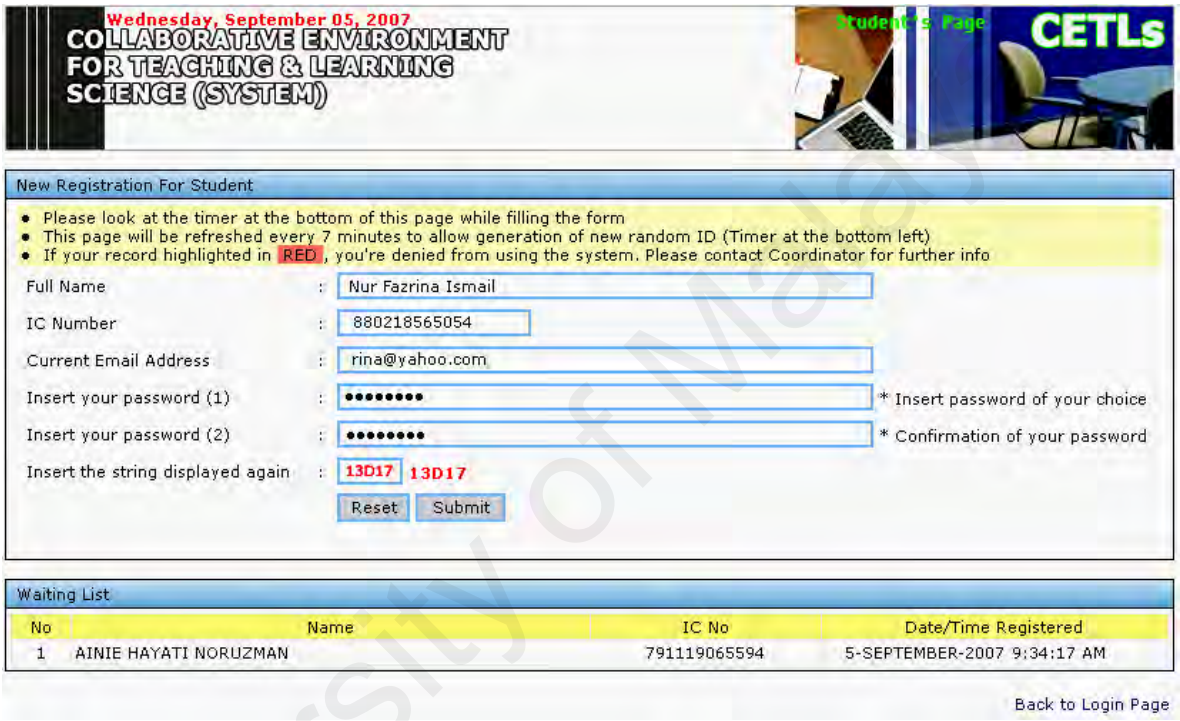


Figure 7.7: Registration New Student

After the coordinator approved the registration, the student needs to login again. Once the student has login successfully, he/she shall see main menu which consists of the calendar, latest announcement, my inbox and my active class status. If the student is not registered to any class, he/she needs to click the hyperlinked provided under my active class status to participate in the active class. Figure 7.8 shows the main menu of the student before he/she register to the active class.

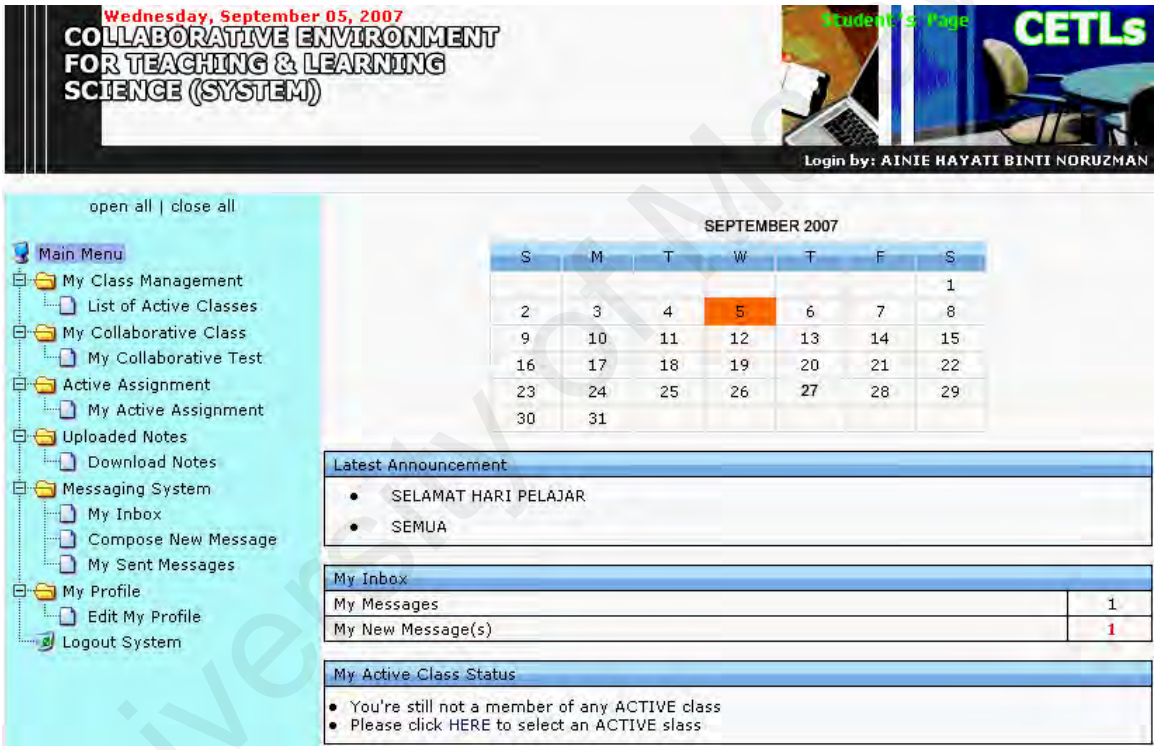


Figure 7.8: Student's Main Menu Before Select Class

After the coordinator approves the registration, the student needs to login again. Once the student has successfully logged in they should be able to see the list of active classes registered by the coordinator for that particular year. The student needs to choose which class they want to enrol in. At this stage the teacher and coordinator have to check whether the student has chosen the right class or not. If the student has chosen the wrong class, the teacher or coordinator needs to change it. Figure 7.9 shows the list of active classes from which the student may choose. The legend shows that the student is already a member of that class.

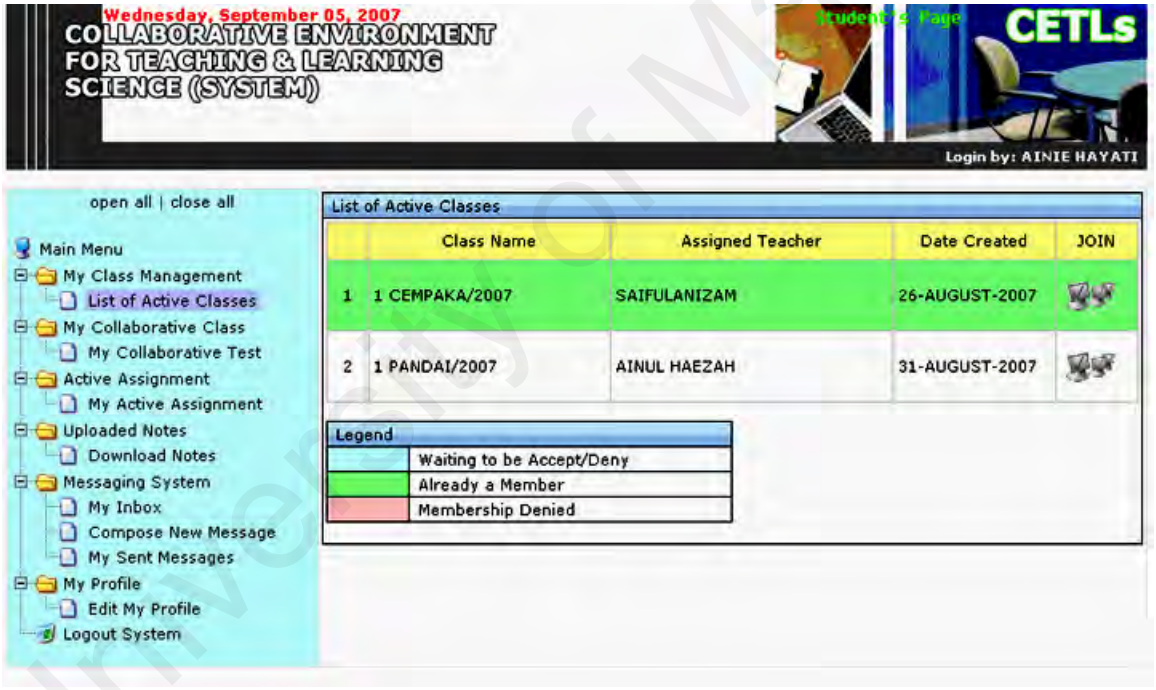


Figure 7.9: Select Active Class

After the student chooses the class, the teacher needs to verify whether the student is registered for that particular class or not. Once approved, the student is permitted access the CETLs system. Figure 7.10 shows the main menu consisting of 'latest announcement', my inbox and information regarding the class including current group assignment, total number of assignments, total upload of notes, the collaborative class and so on. The students can also navigate the tree menu on the left. The menu consists of the information about the class management, collaborative class, assignment, uploaded notes, messaging system and student profiles.

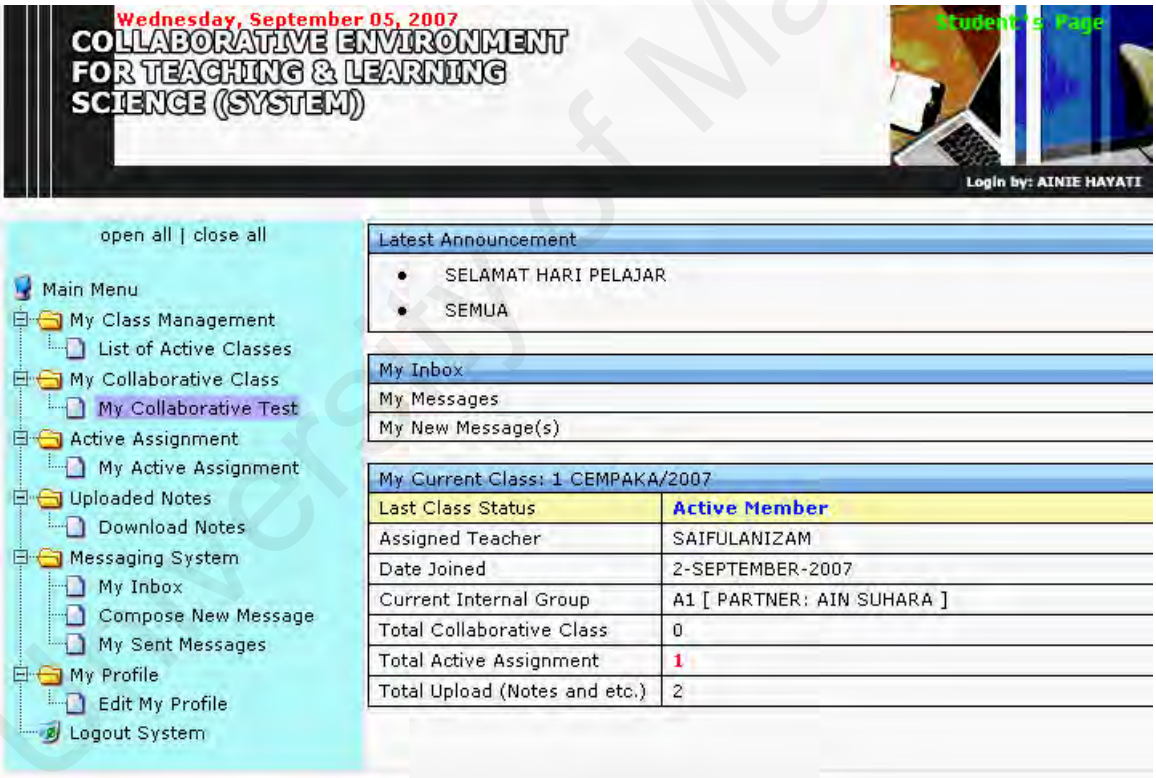


Figure 7.10: Student Main Menu

When the students want to access their activities they have to do it in the collaborative class. Figure 7.11 show the lists of the collaborative classes. Here, the collaborative class is created by the designated teacher. During the collaborative class, there are three stages that have to be carried out by the student. The stages are Think, Pair and Share. The student needs to choose the correct stage, beginning with think, then pair and lastly the share stage. If the student does not follow the correct order, the test will be closed and a message will appear.

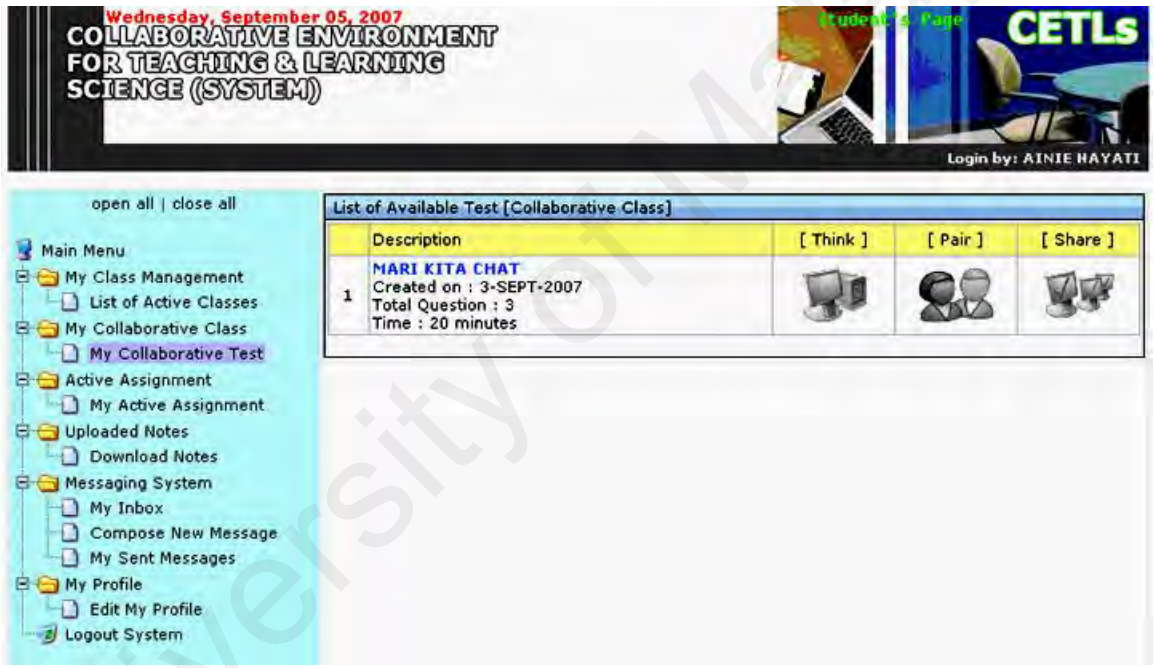


Figure 7.11: Collaborative Class

Figure 7.12 shows the "Think" page. In this stage the students are given a set of questions by the teacher. Students need to think and answer individually and submit the answer before the time elapses. If the student does not finish it within the given time the session will be closed. During this stage, the student is accessed individually. All the answers from each student need to be submitted to the teacher during the initial collaborative activities. The teacher is able to access and evaluate the individual's work online by giving marks and comments.

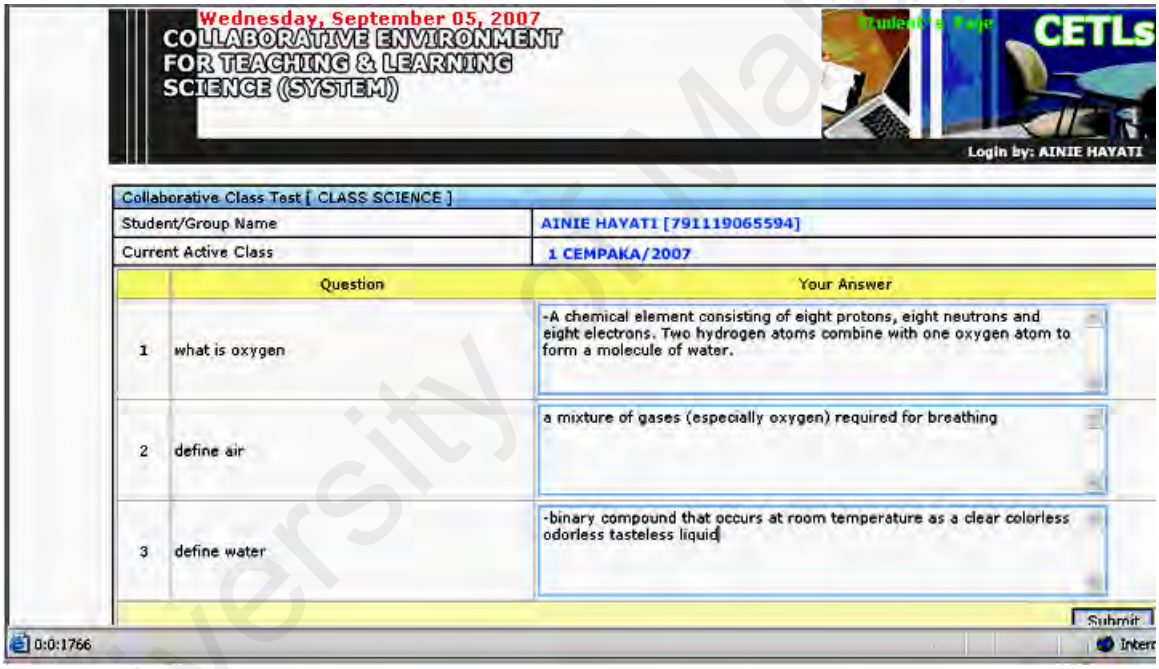


Figure 7.12: Think Test

Next, they have to do the "Pair" module. Figure 7.13 shows that students and their partner must collaborate to answer the questions using instant messaging communication. In this stage they shall discuss and choose the best answer to be submitted to the teacher before the time elapsed. If students fail to answer the question within the time given, the system will send a message. Figure 7.13 shows the answer given by the students in the working space provided.

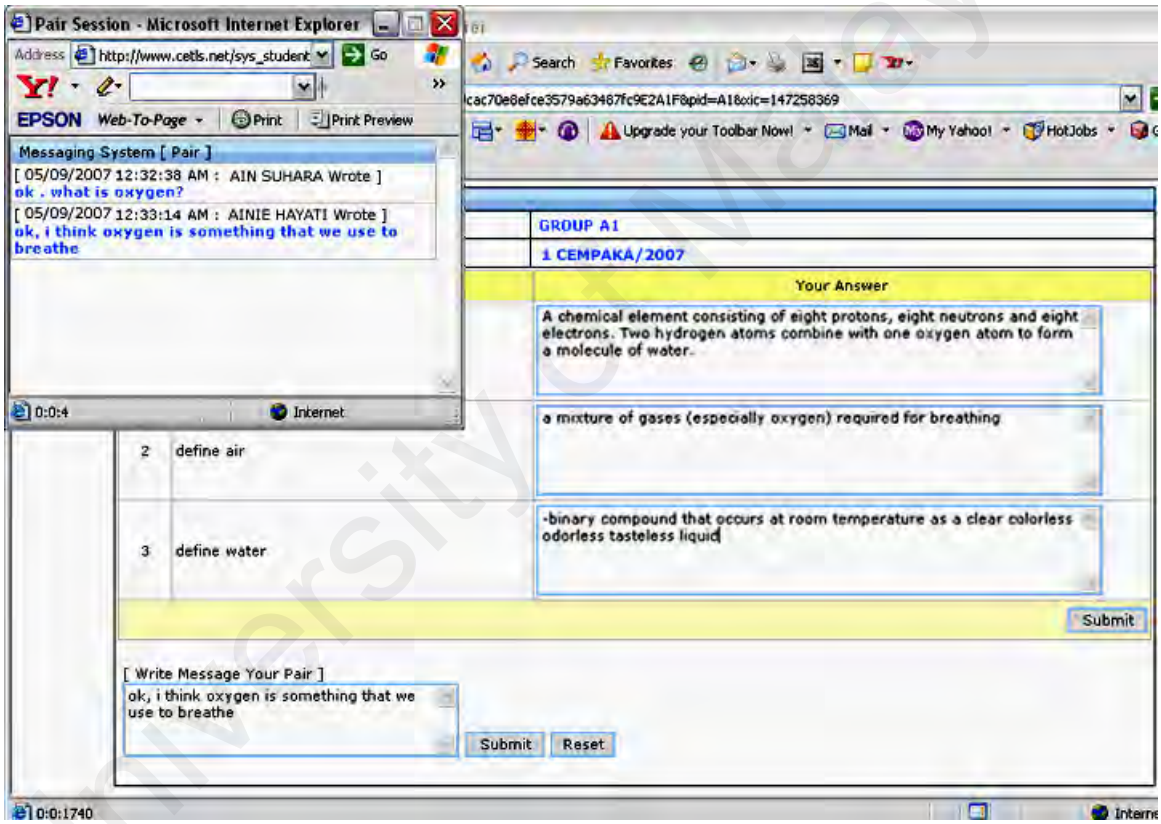


Figure 7.13: Pair Test and Answer

The last stage is the "Share" module. Figure 7.14 shows the students using the chat room to share their answers and discuss their answers with the teacher and friends. The interaction is in chat-basis, where each student is identified by their name.

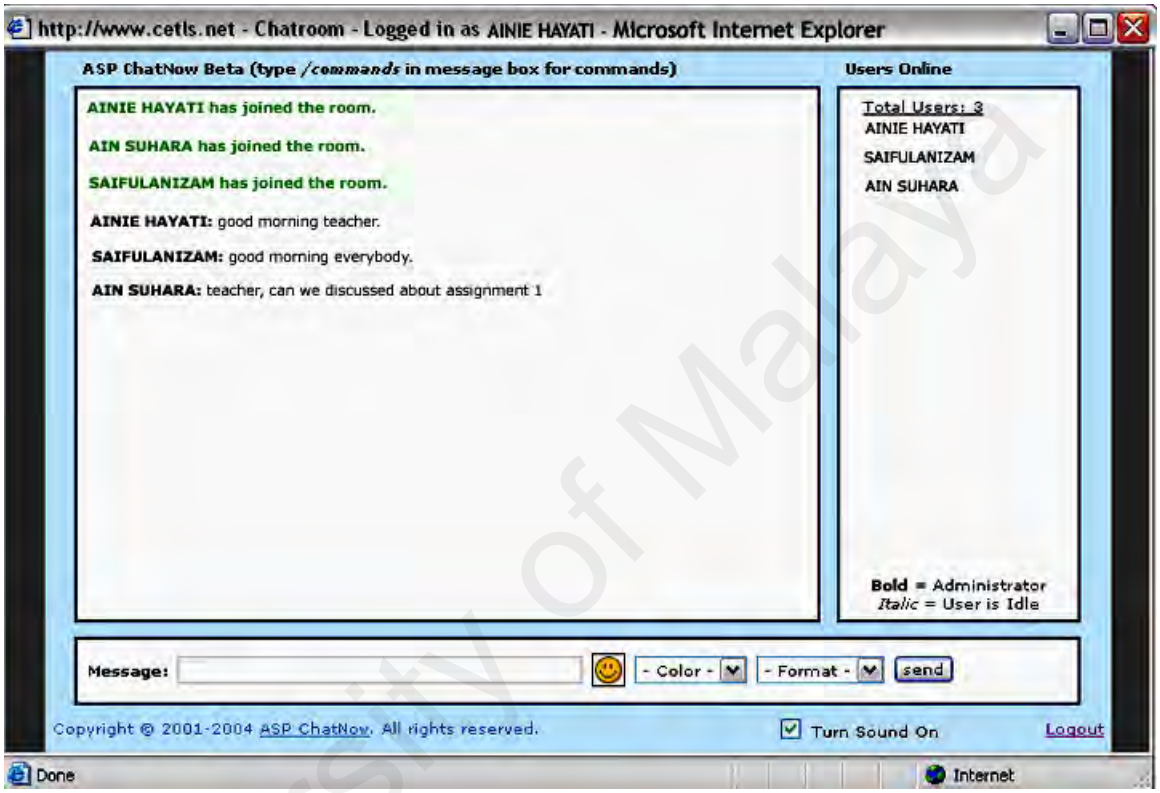


Figure 7.14: Share using Chat Room

Submitted answers will be check and marks will be given after the test has been retired. To view the marks, the student need to click the icon of think, refer to Figure 7.9. The test indicates the student's name, date and time send and final marks. The test also includes answers and the comment from their teacher. If the student passed the test, the legend will be shown in 'blue' and will show 'red' if the result is failed. Figure 7.15 shows the mark and comments for each student.

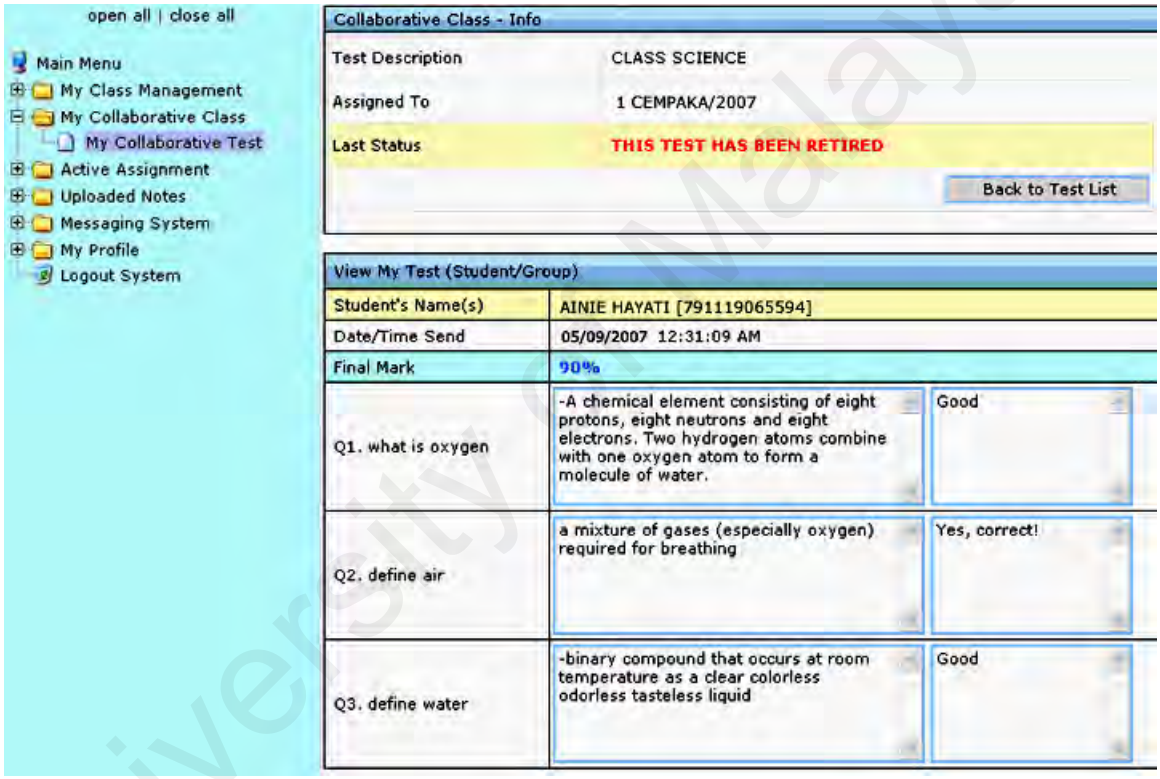


Figure 7.15: Think Mark (individual)

After the test is done, the student can see their marks and comments. Figure 7.16 shows the mark and comments for the group/pair work. To view the marks, once again the student needs to click the icon of pair, refer to Figure 7.9. The test indicates the student's name, date and time send and final marks. From the submission of answer from each pair on the given task, the teacher makes evaluations by giving comments and marks to each question. Passing results will turn the legend 'blue' and will turn into 'red' if failed.

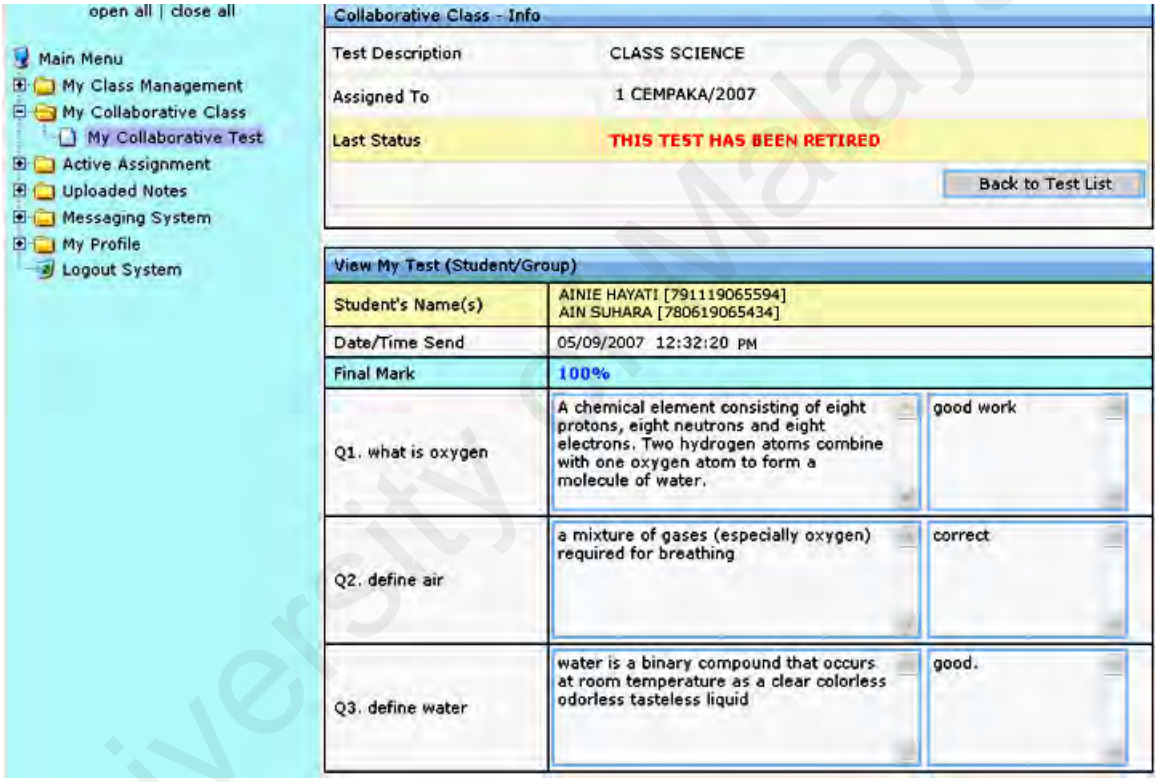


Figure 7.16: Marks Pair

From the main menu the students can also find out whether they have an assignment or not. The main menu shows the total of new assignments that have been uploaded by their respective teacher. In the main menu the active assignment will be displayed by a number ranging from 1 – N. Once a student clicks at the number of active assignment, it will directly go to the "My Active Assignment" page. This page indicates the assignment title, expiry date and status. Students can also upload their assignments to their teacher before the due date. Once the assignment is closed (retired), the student can check the assessment marks provided by the teacher. The legend in the "My Active Assignment" page shows whether the assignment is activate, closed or retired and not yet rated. Figure 7.17, shows that the assignment is already activated. Figure 7.17 shows the page for downloading the assignment.

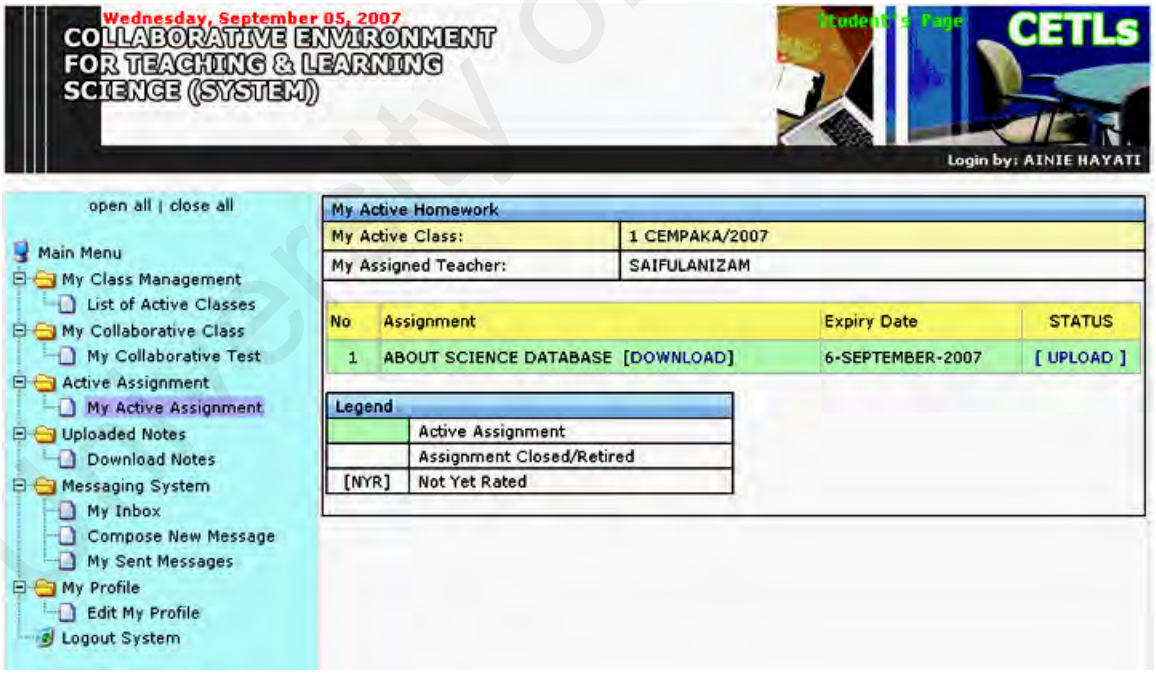


Figure 7.17: Download Assignment

Students can upload their assignment to their designated teacher by clicking at the "UPLOAD" link. Refer Figure 7.18. The UPLOAD hyperlink will automatically appear, once the teacher activates the assignment. The upload page display the assignment title, class, assigned teacher, date created, expiry date and "upload assignment" link. After uploading, the student needs to click "Send Homework" button. Figure 7.18 shows the page for uploading the assignment.

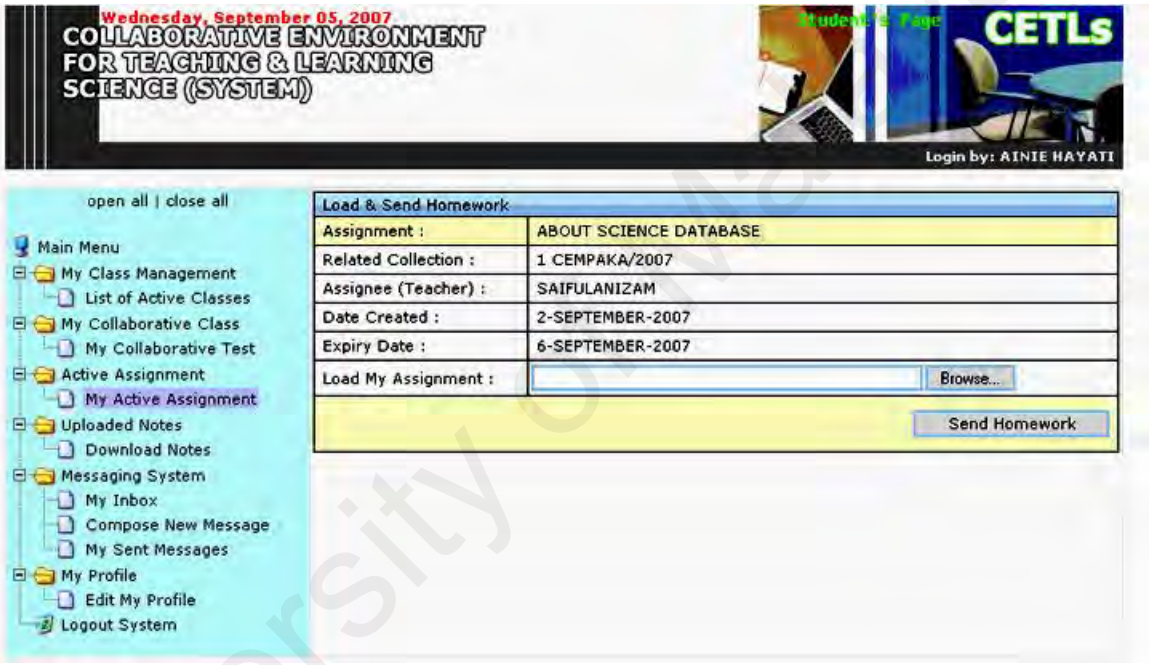


Figure 7.18: Upload Assignment

The students can download the notes provided by the teacher. The teacher can upload the notes to the students or to the class. Once they click the icon at view status, the standard save box will pop up. The students can choose to save the content in their preferred storage device. Figure 7.19 shows the page for downloading the notes provided by the teacher.

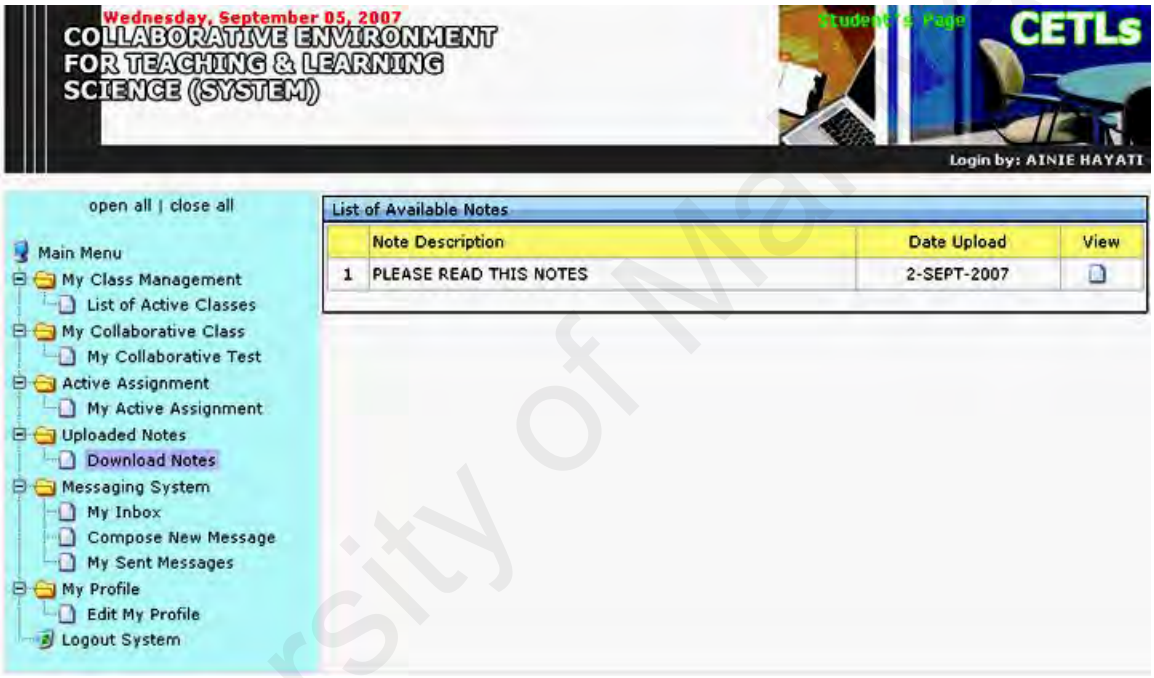


Figure 7.19: Download Notes

If the student clicks the Messaging System menu, 3 components will appear. The first component is "My Inbox" that indicates the list of email in the student's mail inbox. In order to read the email, the student needs to click the hyperlink shown in Figure 7.20. Students also can choose the options provided in the email page and perform task like deleting email and mark as read or unread by clicking the respective check boxes. Figure 7.20, shows the student's mail inbox page.

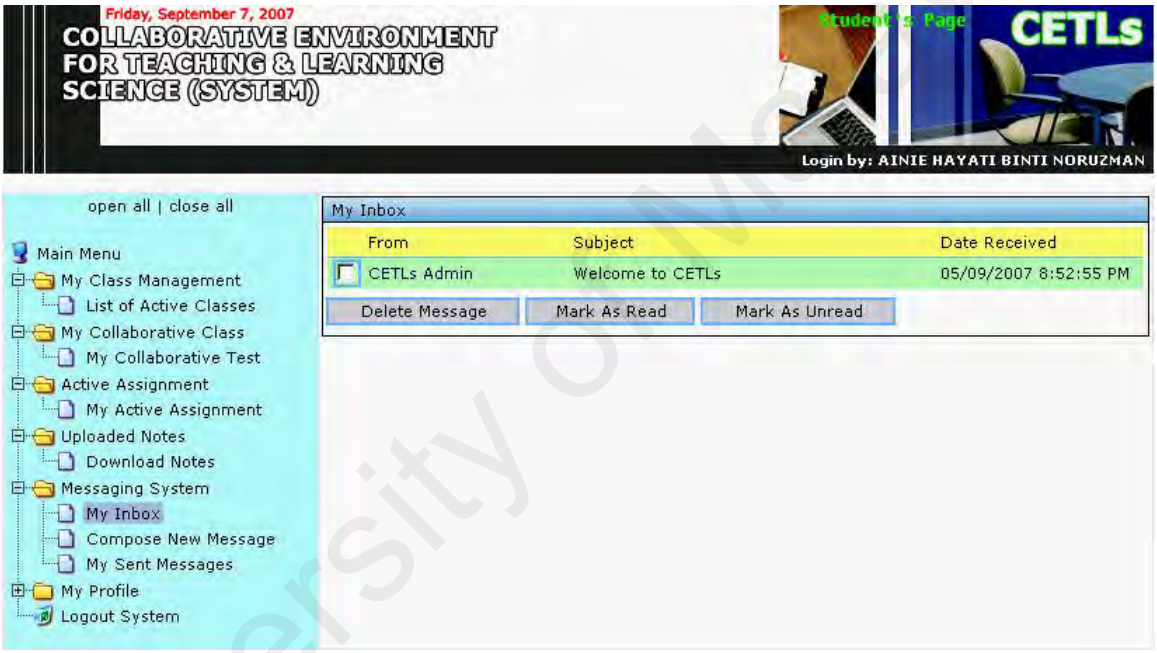


Figure 7.20: Student's Mail Inbox Page

Email can be sent via the messaging system. The student can be able to compose new email to their friends and teachers. The name of the students and teacher are generated from the database that was created by the coordinator. The messaging system includes the functions of attaching different file formats. Figure 7.21 shows the email page for the student to compose the new email.

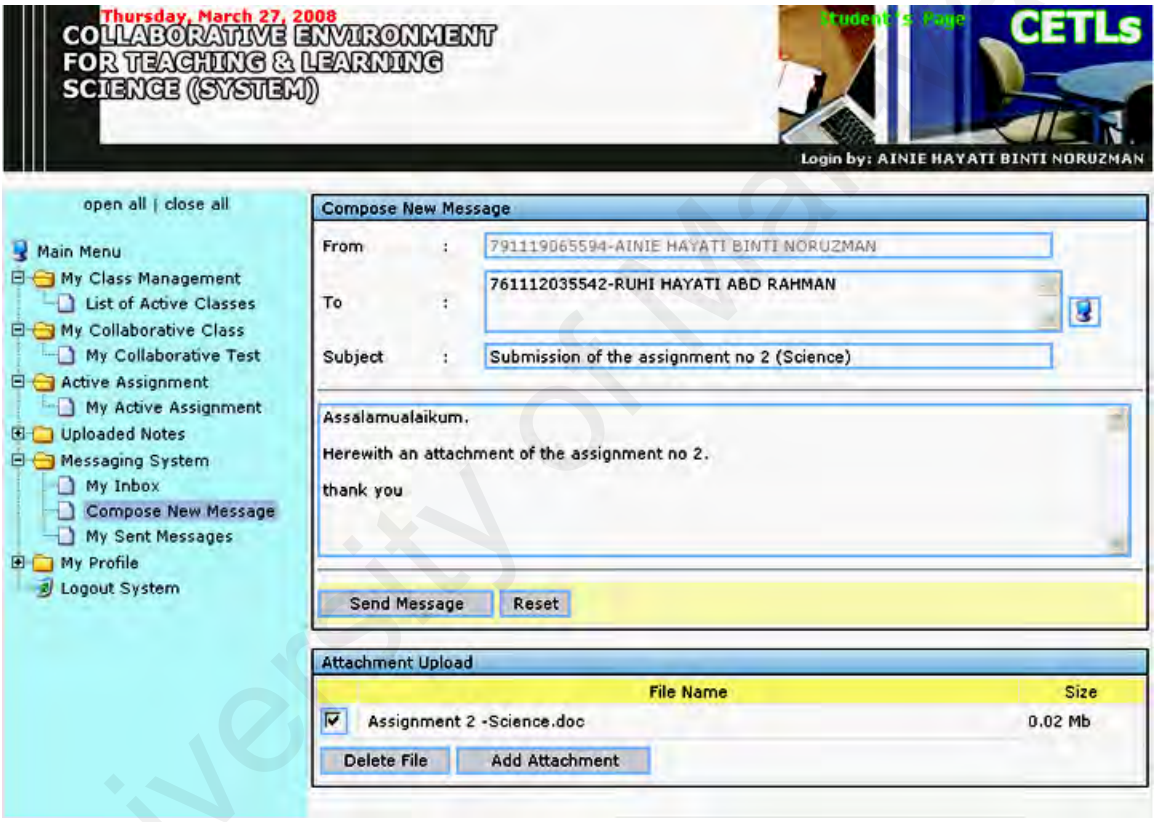


Figure 7.21: Compose New Message

Lastly, the student can change their profiles or password by editing their information in the profile pages. Figure 7.22 shows the students profile page.

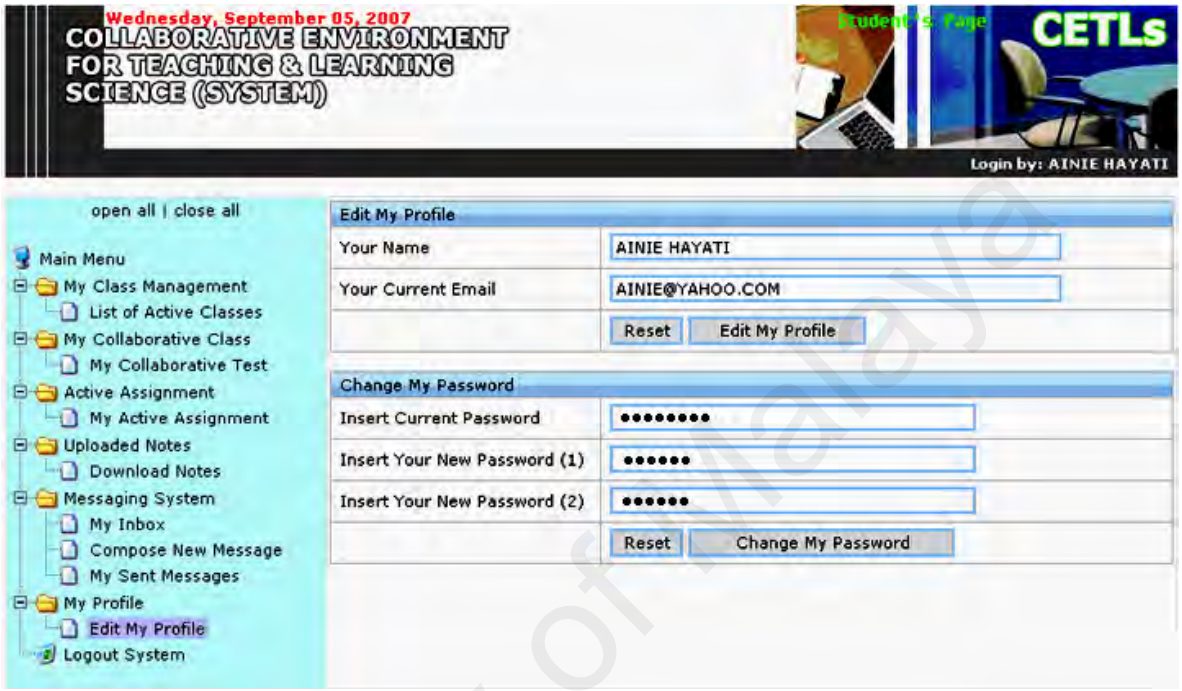


Figure 7.22: Edit Profile

7.4.2 Coordinator Perspective

Figure 7.23 shows the main menu of the coordinator. Here the coordinator is responsible for organizing the students and also the teachers. The coordinator is also responsible for creating the class and has privileges to delete and edit the information of the users. In the main menu, the coordinator can see the latest announcement, my inbox and latest statistics regarding the new teacher and students. The coordinator can navigate the tree menu on the left. The menu contains of information about the system administration, class management, announcement management, messaging system and coordinator profiles.

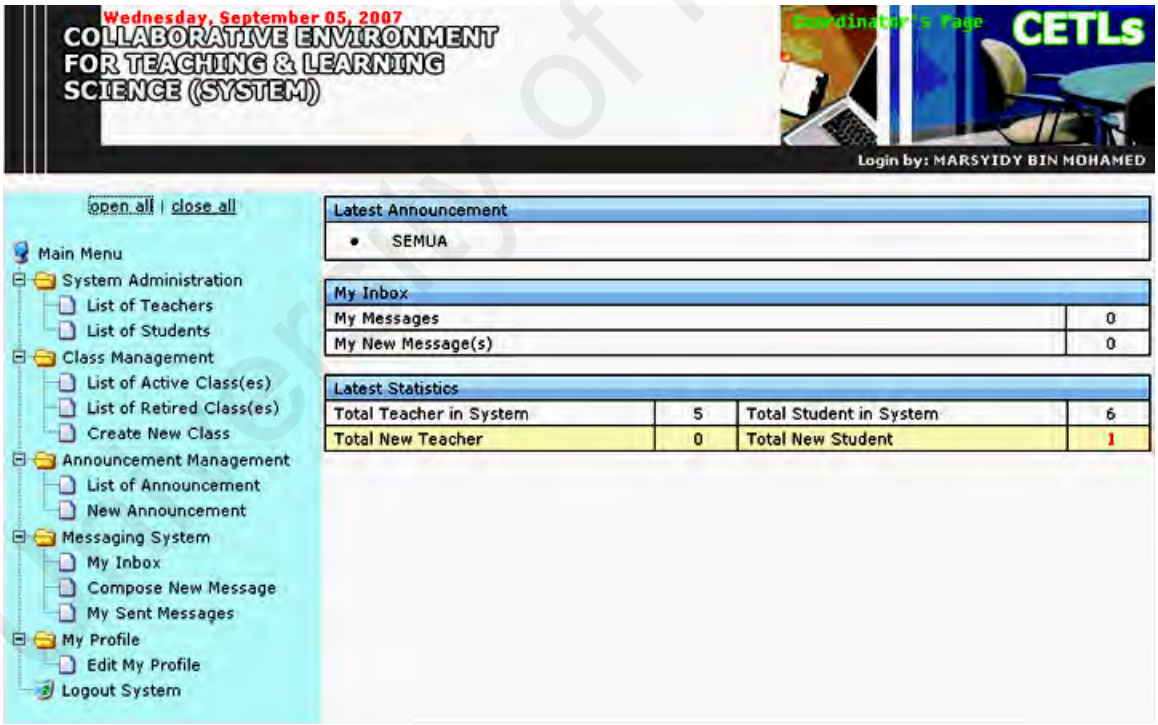


Figure 7.23: Coordinator Main Menu

Once the main menu is displayed, the coordinator has to accept the student that has already registered into the system. The total of new students and teacher will change based on the number of students and teachers registered. The total number is displayed in red color. By clicking on the numbers, the coordinator can accept / unblock or block students or deny any student. The same process can also be done in accepting the teachers. Once the students and teachers are accepted the total will be brought back to "zero". This process is illustrated in Figure 7.24.

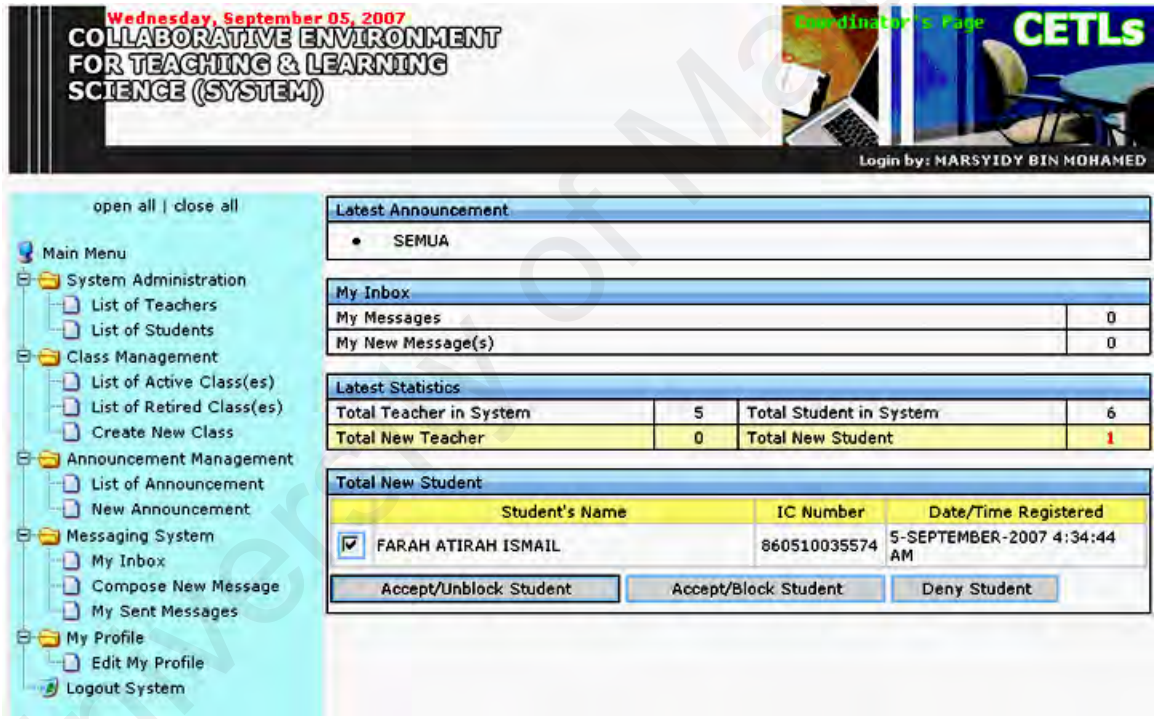


Figure 7.24: Accept Student

Figure 7.25 shows the list of students and teachers. The coordinator can block / unblock both the students and teachers in accessing the data inside the system. The coordinator can be able to view and delete the information of the users by clicking the box provided in the system. Figure 7.26, shows the student's information details page viewed by the coordinator.

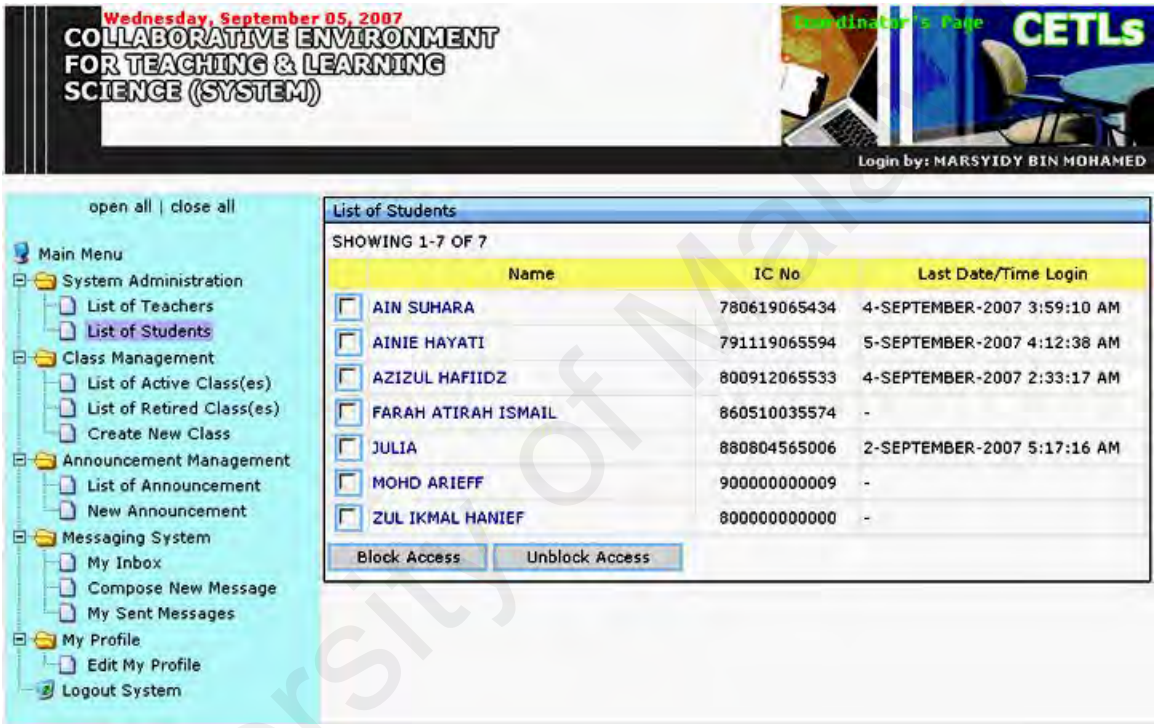


Figure 7.25: List of Students

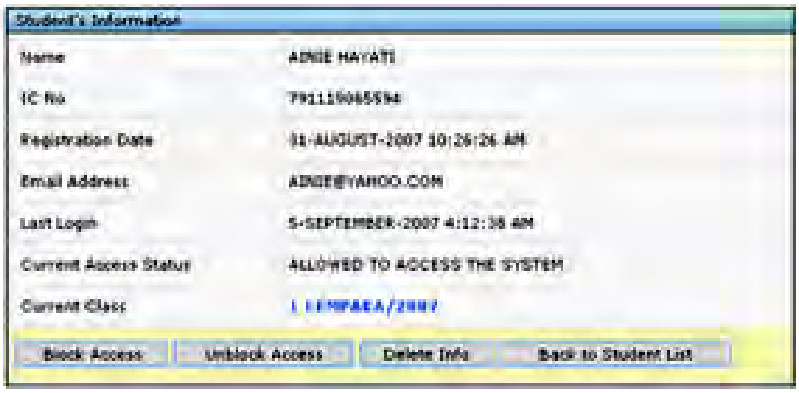


Figure 7.26: Student Information Details

The coordinator can also create a new class. All the related information shall be entered by the coordinator including class name, date created, teacher assigned and class status. The coordinator can also reset the class. Figure 7.27 and 7.28 show a coordinator creating a new class and the list of active classes that are already registered in the system.

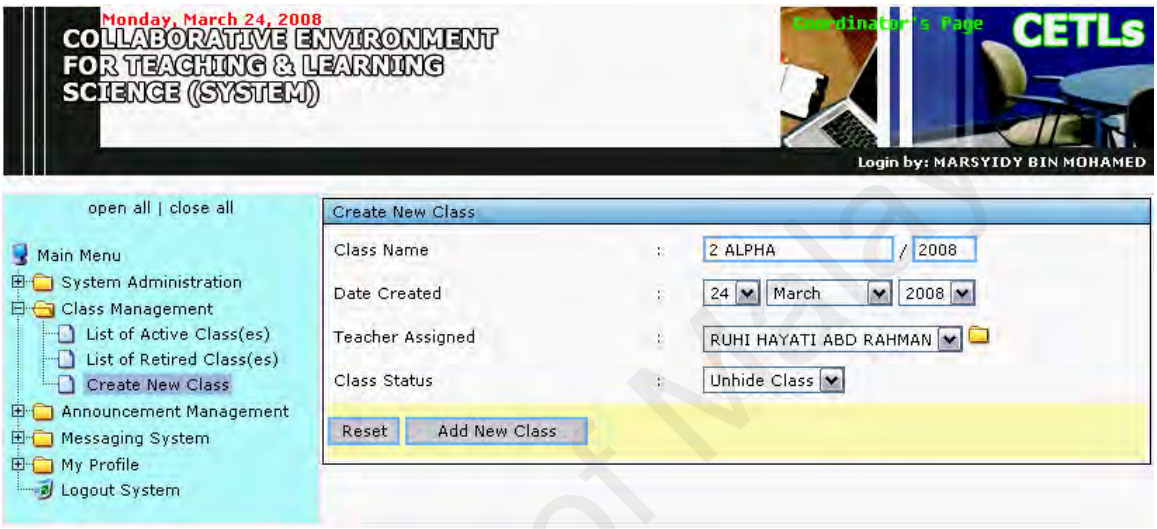


Figure 7.27: Create New Class

Figure 7.28: List of Active Class

Figures 7.29 and 7.30 show the page on creating and listing the new announcement by the coordinator. The coordinator is responsible for creating a new announcement and putting it on the bulletin board for students and teachers attention. The coordinator can use the announcement module for posting or reading announcements or information. An announcement can be posted to a variety of users. It can be for all users or limited only to teachers, or students, or a specific group of students. Old announcements can be deleted as well.

Figure 7.29: Create Announcement

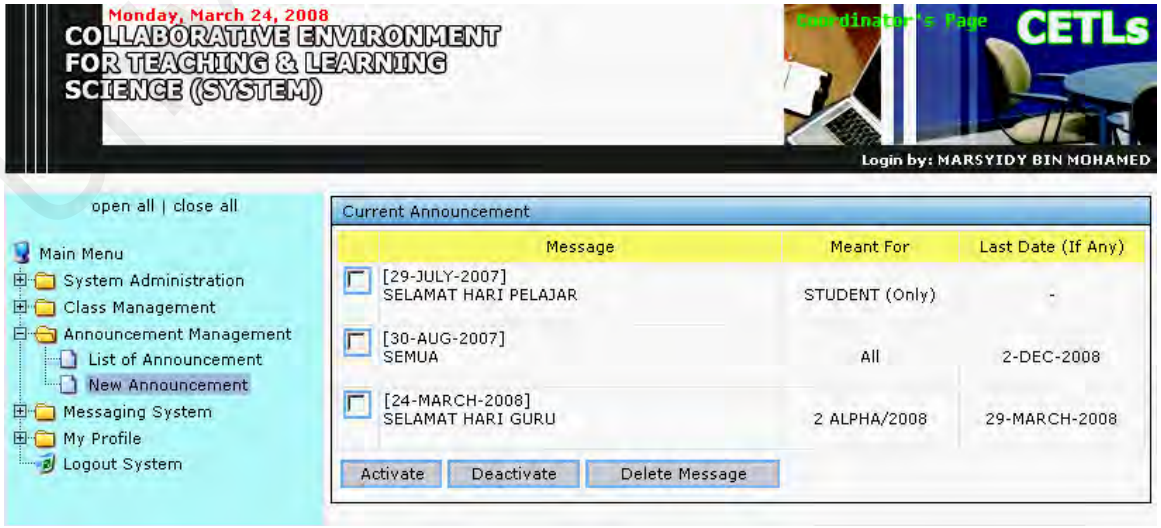


Figure 7.30: List of Announcement

The messaging system can be used by the coordinator to send emails. He/she can compose new email to students, classes and teachers. The name of the students and teacher are generated from the database that was created by the coordinator. The messaging system includes the functions of attaching the different file formats. Figure 7.31 shows the email page for the coordinator to compose the new email.

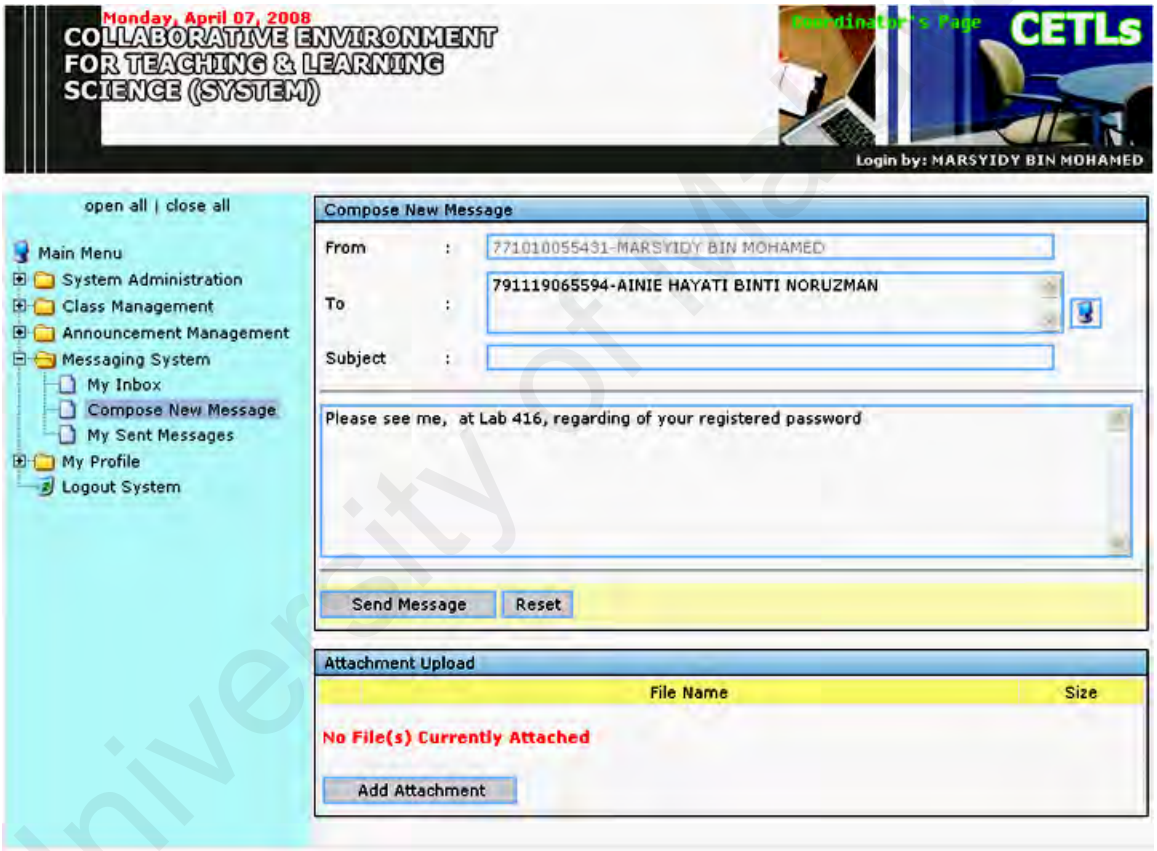


Figure 7.31: Compose new message

Lastly, the coordinator can change his/her profiles by editing the information in the profile pages. He/she will be able to change the password accordingly. Figure 7.32 shows the coordinator profiles page. The coordinator can also reassign the teacher as an administrator or promote the teacher as a coordinator as stated in Figure 7.33.

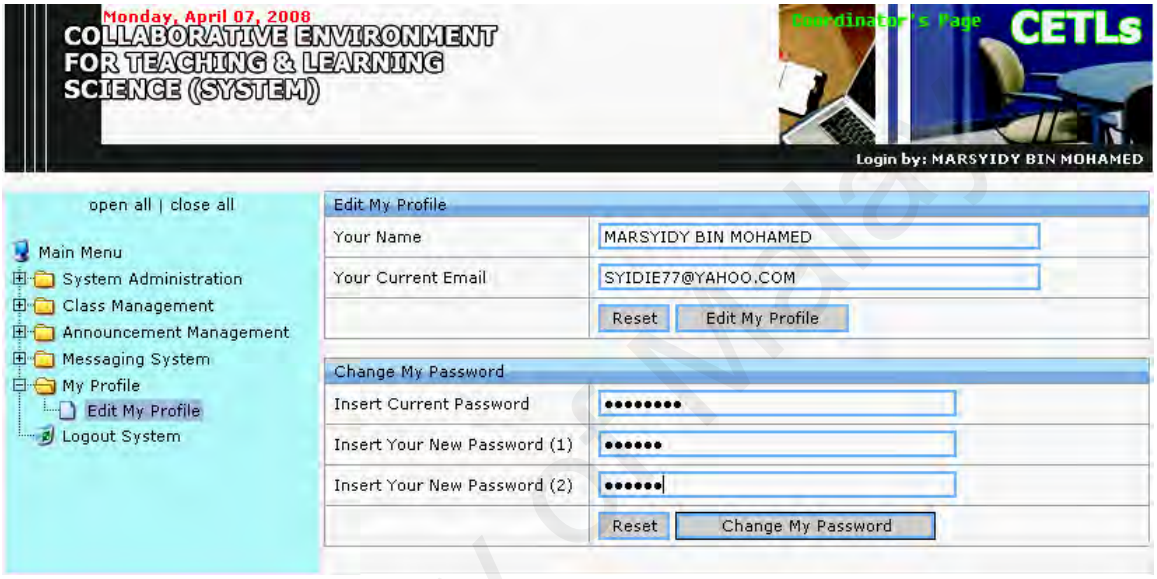


Figure 7.32: Edit Coordinator Profiles

Figure 7.33: Teacher Change to Administrator

7.5 TESTING

Testing should systematically uncover different classes of errors in a minimum amount of time and with a minimum amount of effort. The data collected through testing can also provide an indication of the software's reliability and quality. The development process involves various types of testing. Each test type addresses a specific testing requirement. This type of testing helps the tester to test each of the functions without an error. For the development of CETLs, the type of testing selected is unit testing and user acceptance testing.

7.5.1 UNIT TESTING

The Unit Test focuses on one unit which is a program module that performs specific functions that can be tested. This is to ensure that the module or program performs its functions as defined in the program specification. Unit testing focuses on the performance of the application system. This Unit Testing is performed only after the programmer believes the unit to be error free.

7.5.1.1 Testing Process

CETLs have been tested using 'black box testing'. Therefore it focuses on whether the unit meets the requirements stated in the program specifications. The process is to check each of the unit functioning without error. Table 7.1 until Table 7.6 show some samples of the test cases used in the testing.

7.5.1.2 Test Cases

Table 7.1: Test Case for View List of Active Class

TEST CASE

Tester : Ainie Hayati Binti Noruzman

Date : 31st August 2007

Results : ☑ Passed ☐ Need Improvement

Test Case No. : 001 **Required Addressed :** View List of Active Class

Objectives :

To ensure that only the active class assigned under the teacher can be viewed.
To ensure the list of active class will appear after the selection made.

Test Cases

Functional Requirement	Elements of GUI	Value Entered
1. R1.2 : Class Management (Active Class)	Combo Box	Select Blank
2. R1.2 : Class Management (Active Class)	Combo Box	Select 2 BETA
3. R1.2 : Class Management (Retired Class)	Combo Box	Select 2 BETA

Expected Results / Notes

Test 2 and 3 are a valid selection of the combo box. All others should be rejected.

Actual Results / Notes

Test 2 and 3 are accepted. Test 1 should be rejected.

Table 7.2: Test Case for Create Announcement

TEST CASE

Tester : Nik Azlina Nik Ahmad

Date : 31st August 2007

Results : ☑ Passed ☐ Need Improvement

Test Case No. : 002 **Required Addressed :** Create New Announcement

Objective :

Ensure that the selection made by the Teacher on the 'new announcement form' is valid.

Test Cases

Functional Requirement	Elements of GUI	Value Entered
1. R1.3 : Announcement Group	Combo Box	Select Blank
2. R1.3 : Announcement Group	Combo Box	Select All Users
3. R1.3 : Announcement Group	Combo Box	Select Teacher
4. R1.3 : Announcement Group	Combo Box	Select Student
5. R1.3 : Announcement Message	Text Box	text123_@#$%
6. R1.3 : Announcement Date	Combo Box	Select 7,Feb,2007
7. R1.3 : Announcement Status	Combo Box	Select Active
8. R1.3 : Announcement Status	Combo Box	Select Inactive

Expected Results / Notes

Test 2, 3, 4,6,7,8 are valid selection of the combo box. All others should be rejected.
Test 5 is a valid announcement message since this text box accepts all data types.
Test 1 is rejected

Actual Results / Notes

Test 2, 3, 4, 5, 6, 7, 8 are accepted.
Test 5 is accepted.
Test 1 was rejected with correct error message.

Table 7.3: Test Case for Notes Management

TEST CASE

Tester : Ainie Hayati Noruzman, Nik Azlina Nik Ahmad

Date : 31st August 2007

Results : ☑ Passed ☐ Need Improvement

Test Case No. : 003 **Required Addressed :** Notes Management

Objective :

Ensure that the notes uploaded by the teacher can be download by the students.

Test Cases

	Functional Requirement	Elements of GUI	Value Entered
1.	R2.3 : Upload New Notes	Text Box	C:\UM\notes.doc
2.	R2.3 : Upload New Notes	Browse Button	Click Button
3.	R2.3 : Note Description	Text Box	Blank
4.	R2.3 : Note Description	Text Box	Notes Chapter 1
5.	R2.3 : Group Assigned	Check Box	Uncheck
6.	R2.3 : Group Assigned	Check Box	Check
7.	R4.2 : Download Notes	Image Link	Click

Expected Results / Notes

Test 1 & 4 are valid input for the text boxes.
Test 2 & 7 are a valid mouse click as an input.
Test 6 is a valid input.

Test 3 & 5 should be rejected.

Actual Results / Notes

Test 1,2,4,6,7 are accepted.

Test 3, 5 were rejected with correct error message.

Table 7.4: Test Cases for Assignment Management

TEST CASE Page 1 of 2

Tester : Ainie Hayati Noruzman, Nik Azlina Nik Ahmad

Date : 31st August 2007

Results : ☑ Passed ☐ Need Improvement

Test Case No. : 004 **Required Addressed :** Assignment Management

Objective :

Ensure that the notes uploaded by the teacher can be download by the students.

Test Cases

Functional Requirement	Elements of GUI	Value Entered
1. R2.3 : Upload New Assignment	Text Box	C:\UM\notes.doc
2. R2.3 : Upload New Assignment	Browse Button	Click Button
3. R2.3 : Assignment Description	Text Box	Blank
4. R2.3 : Assignment Description	Text Box	Notes Chapter 1
5. R2.3 : Group Assigned	Check Box	Uncheck
6. R2.3 : Group Assigned	Check Box	Check
7. R2.3 : Assignment Activation	Combo Box	No
8. R2.3 : Assignment Activation	Combo Box	Yes
9. R2.3 : Assignment Close Date	Combo Box	Select 7,Feb,2007
10. R4.2 : Download Assignment	Image Link	Click
11. R4.2 : Upload Assignment (student)	Browse Button	Click Button
12. R4.2 : Upload Assignment (student)	Text Box	Answer for Asgmt
13. R2.3 : Assignment Progress	Image Link	Click
14. R2.3 : Assignment Assessment	Text Link	Click
15. R2.3 : Assignment Assessment	Text Box	abcxyz
16. R2.3 : Assignment Assessment	Text Box	45

Expected Results / Notes

Test 1,4, 12 &16 are valid input for the text boxes.
Test 10, 13 & 14 is a valid mouse click for links.
Test 6 is a valid input for check box.
Test 2 & 11 are valid mouse click for a button.
Test 7,8 & 9 are valid selection.

Actual Results / Notes
1, 2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14 & 16 are accepted.

Test 3, 5 & 15 should be rejected.

Table 7.5: Test Case for Messaging System

TEST CASE

Tester : Ainie Hayati Noruzman

Date : 31st August 2007

Results : ☑ Passed ☐ Need Improvement

Test Case No. : 005 **Required Addressed :** Messaging System

Objective :

To ensure that the e-mail is well-functioning.

Test Cases

	Functional Requirement	Elements of GUI	Value Entered
1.	R1.4 : Inbox,Compose	Text Link	Click
2.	R1.4 : Inbox, Compose	Button	Click
3.	R1.4 : Add Recipient	Image Link	Click
4.	R1.4 : Add Recipient	Combo Box	Select 'Teacher'
5.	R1.4 : Add Recipient	Combo Box	Select 'Student'
6.	R1.4 : File Attachment	Button	Click
7.	R1.4 : File Attachment	Text Box	C:\UM\file.doc
8.	R1.4 : File Attachment	Browse Button	Click
9.	R1.4 : Sent Messages	Text Link	Click

Expected Results / Notes

Test 1, 3 & 9 are valid inputs for the link.
Test 2, 6, 8 are valid mouse click for the button.
Test 7 is a valid input for text box.
Test 4 & 5 are valid input for combo box.

Actual Results / Notes

Test 1, 2, 3, 4, 5, 6, 7, 8 & 9 are accepted.

Table 7.6: Test Case for Collaborative Class

TEST CASE

Tester : Ainie Hayati Noruzman, Nik Azlina Nik Ahmad

Date : 31st August 2007

Results : ☑ Passed ☑ Need Improvement (Test Case 7)

Test Case No. : 006 **Required Addressed :** Collaborative Class

Objective :

Ensure that all the collaborative activities are working properly.

Test Cases

Functional Requirement	Elements of GUI	Value Entered
1. R3.1 : Create Collaborative Class	Text Box	blank
2. R3.1 : Create Collaborative Class	Text Box	text123_#$%^*
3. R3.1 : Choose Group	Combo Box	Select Blank
4. R3.1 : Class Management	Combo Box	Select 2 BETA
5. R3.1 : Assign Timer	Combo Box	Select 5 mins
6. R3.1 : Number of Questions	Combo Box	3
7. R3.1 : Questions Details	Text Box	Blank
8. R3.1 : Questions Details	Text Box	text123_#$%^*
9. R3.1 : Collaborative Class Activation	Check Box	Uncheck
10. R3.1 : Collaborative Class Activation	Check Box	Check
11. R3.1 : Collaborative Activity Progress	Image Link	Click
12. R5.1 : Join 'Think' Stage	Image Link	Click
13. R5.1 : 'Think' Answer Question	Text Box	blank
14. R5.1 : 'Think' Answer Question	Text Box	abc123_#$%^&*
15. R6.1: 'Think' Evaluation	Text Link	Click
16. R6.1: 'Think' Evaluation	Text Link	abcxyz
17. R6.1: 'Think' Evaluation	Text Link	45
18. R9.1: 'Pair' Stage	Instant Messaging	blank
19. R9.1: 'Pair' Stage	Instant Messaging	abc123_#$%^&*

20. R9.1: 'Pair' Evaluation	Text Link	Click
21. R9.1: 'Pair' Evaluation	Text Link	abcxyz
22. R9.1: 'Pair' Evaluation	Text Link	45
23. R10.1 & R11.1 : 'Share' Stage	Chat Box	blank
24. R10.1 & R11.1 : 'Share' Stage	Chat Box	abc123_#$%^&*
25. R10.1 & R11.1 : 'Share' Stage	Button	Click
26. R10.1 & R11.1 : 'Share' Stage	Check Box	Uncheck
27. R10.1 & R11.1 : 'Share' Stage	Check Box	Check

Expected Results / Notes

Test 2, 8, 14 are valid input for the text boxes.
Test 10, 26 & 27 are valid inputs for check box.
Test are a valid mouse click as an input.
Test 4, 5, 6 are valid selections for combo box.
Test 11, 17, 20, 21, 22 is a valid mouse click input for the links.
Test 15, 16, 19 are valid input for the Instant Messaging.
Test 23 & 24 are valid input for chat box.
Test 25 is valid mouse click for button.

Test 1, 3, 7, 9, 13 &18 should be rejected.

Actual Results / Notes

Test 2, 4, 5, 6, 8, 10, 11, 12, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26 &27 are accepted.

Test 1, 3, 9, 13, 18 were rejected with correct error message.
Test 7 need improvement.

7.5.1.4 Unit Testing Results

Table 7.1 until Table 7.4 shows that each of the component in CETLs system are successfully tested without any major problem and meet the requirement as stated in the program specifications. However, Table 7.5 shows that test cases no.7 need to be improved. This is due to the question details unit which is not working very well, but this is not a major problem as it does not disturb the performance of the CETLs. Each of the unit in the components is tested accordingly and the results are recorded during the test process. On top of that, the results show that the system is passed and ready for a user to use.

7.5.2 USER ACCEPTANCE TESTING

The User Acceptance Testing (UAT) is a key feature of projects to implement new systems or processes. It is the formal means to ensure that the new system or process does actually meet the essential user requirements. Each module to be implemented will be subject to one or more user acceptance tests before being 'signed off' as meeting user needs.

7.5.2.1 Purpose of Testing

The purpose of this document is to find whether CETLs is acceptable for secondary school teachers and students. The testing is divided into two parts which User Acceptance testing that is based on the functional requirement and the Questionnaire that is based on the 3 categories namely "Perceived Usefulness", "Perceived Ease of Use" and "Behavioral Intentions". Since the objective from Section 1.3 no. 3, is to evaluate the system usefulness and ease of use, therefore this dissertation focus on the

results of Perceived Usefulness and Perceived Ease of Use. These two parts shall be tested accordingly and the results shall be explained in Section 7.5.2.6.

7.5.2.2 Testing Scope

The testing scope shall be divided into two categories. One is the UAT that test the major functions of CETLs in accordance with the 'functional requirements' discussed earlier in Chapter 4. This is to ensure that the functional requirements meet user satisfaction. The other scope is analyzing the questionnaire. The results are to ensure that the CETLs is accepted by the students in terms of technology acceptance and also ease of use.

7.5.2.3 Testing Process

In order to do the testing, there are certain processes that need to be carried out. The process for the testing begins with the developer test the system based on the functional requirement stated in Chapter 4. During the testing process, the user gives their comment based on the functional requirement in CETLs. Each of the users is provided with a training manual in order for them to test/use the system smoothly. Then, the questionnaire is

Mozilla Firefox.lnk been given to the students and teachers after they have tested and used the system. The questionnaire involves three parts. They are 'Perceived Usefulness', 'Perceived Ease of Use' and 'Behavioral Intention'. Perceived usefulness is on how the system is accepted by the student and the teacher, perceived ease of use is whether the system can be

easily used or not and behavioral intention is to identify whether the student and teacher have the intentions to use the system or not. During the activity, there are 8 students and 4 teachers involved. The testing is done at Makmal Komputer 1, Sekolah Menengah Tengku Panglima Raja at Lemal, Pasir Mas, Kelantan.

For the UAT, the testing is conducted in a series of tests. The series of tests are stress on the functional requirements and the user comments and acceptance. The results are recorded according to the testing session made by the developer and the users. For the questionnaire, the results are based on parts of 'perceived usefulness' and 'perceived ease of use'. The results concludes whether, the students accept the system and easy to use or not. Table 7.7 is the sample of the UAT results. The complete set of UAT results is in the Appendix B.

Table 7.7: Student UAT Table

<table>
<tr><td colspan="5">Tester : Nik Azlina Nik Ahmad
User : Zul Ilman Thaqif b. Mazlan (Student)
Date : 11/01/08</td></tr>
<tr><td>Test Case No.:</td><td>008</td><td>Test Method :</td><td colspan="2">User Acceptance Testing</td></tr>
<tr><td colspan="2">Functional Requirement</td><td colspan="3">R4.1 : Active Assignment</td></tr>
<tr><td colspan="2">Developer Notes</td><td colspan="3">completed</td></tr>
<tr><td colspan="2">User Comments</td><td colspan="3">- Able to view and download all the assignments uploaded by the teacher.
- Also able to upload the solution of assignments back to the teacher.</td></tr>
<tr><td colspan="2" rowspan="2">User Acceptance</td><td>Yes</td><td>No</td><td>N/I</td></tr>
<tr><td>√</td><td></td><td></td></tr>
</table>

NI=Need Improvement

7.5.2.4 User Acceptance Testing Results

Based on the results and user comments in UAT test cases 022 until 025 stated in the Appendix B, most of the students found out that each of the functional requirement are working without any error. They also feel that each of the functions is easy to control and navigate. However, from the results and comment in UAT test cases 026 until 027, the students found out that the requirement of "think timer" in the think stage is not suitable and appropriate with the number of questions. The students think that, the number of questions is provided by the teacher should be suitable with the time given. The difficulties of the questions are factors which contribute to the fact that they not satisfied with the time given. In spite of that, the components are accepted.

For the test cases 030 and 031, the students feel that the submission of the group works can be done and able to view the results (marks). The same results noted in test cases 031 which indicates that the student like to have the 'chat functions' in the CETLs system. It also shows that, the function requirement in those tables is working.

Overall, the system functionality is works and is accepted by both the teacher and the students, only certain units such as class management and timer for students to answer the specific questions need to be improved.

7.5.2.5 Questionnaire Analysis

This section analyses the data that was obtained through questionnaires. This questionnaires survey was done to facilitate the process of gathering information on CETLs system. The questionnaire involves three parts which are 'Perceived Usefulness', 'Perceived Ease of Use' and 'Behavioral Intention'. The output and analysis of the questionnaire guides and determine the objective of this research which is the usefulness and also ease of use of the systems. There were eight students and four teachers involved in answering the questionnaires. Sample of the questionnaire is in Appendix A. The analysis is done using the Statistical Package for Social Science (SPSS) and Microsoft Excel 2003. The SPSS and Microsoft Excell were used to derive the frequencies for each of the questions using the cross tabulation procedure. These have greatly helped the process analyzing the data efficiently.

7.5.2.5.1 Student Perceived Usefulness

This section analyzes the perceived usefulness of the CETLs system. The respondents were required to answer and evaluate the CETLs based on 5 criteria such as "Strongly Agree", "Agree", "Neutral", "Disagree" and "Strongly Disagree". There were 8 questions involved and mainly asking about how the system is being accepted by the students. Table 7.8 until Table 7.16 is the results analysis from the student's feedback on each question in this part.

Table 7.8: Case Processing Summary (Student)

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Respondent for B1	8	100.0%	0	.0%	8	100.0%
Respondent for B2	8	100.0%	0	.0%	8	100.0%
Respondent for B3	8	100.0%	0	.0%	8	100.0%
Respondent for B4	8	100.0%	0	.0%	8	100.0%
Respondent for B5	8	100.0%	0	.0%	8	100.0%
Respondent for B6	8	100.0%	0	.0%	8	100.0%
Respondent for B7	8	100.0%	0	.0%	8	100.0%
Respondent for B8	8	100.0%	0	.0%	8	100.0%

N = No. of Respondents

Table 7.8 represents the table of *Case Processing Summary* for students. The table is created to list out the respondent that responds to each of the questions. Each of the questions is representing by number. Based on the table above, all the students (100%) have successfully answered each of the questions.

Table 7.9: Respondent for B1

		B1					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0 (0.0%)	1 (12.5%)	3 (37.5%)	3 (37.5%)	1 (12.5%)	8(100%)
Total		0 (0.0%)	1 (12.5%)	3 (37.5%)	3 (37.5%)	1 (12.5%)	8(100%)

Based on the questions *"I think that using CETLs would improve my time management"* shows that 12.5% students choose strongly agree, 37.5% students choose agree, 37.5% students choose neutral, 12.5% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.9.

Table 7.10: Respondent for B2

		B2					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0	0 (0.0%)	0 (0.0%)	6 (75%)	2 (25%)	8(100%)
Total		0	0 (0.0%)	0 (0.0%)	6 (75%)	2 (25%)	8(100%)

Based on the questions "*I feel that CETLs help me to improve my skills & knowledge to use computer & internet"* shows that 25% students choose strongly agree, 75% students choose agree, 0.0% students choose neutral, 0.0% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.10.

Table 7.11: Respondent for B3

		B3					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0(0.0%)	0 (0.0%)	0 (0.0%)	4 (50%)	4 (50%)	8(100%)
Total		0(0.0%)	0 (0.0%)	0 (0.0%)	4 (50%)	4 (50%)	8(100%)

Based on the questions "*I find that 'Download Notes' & 'Download & upload Assignment' are very useful"* shows that 50% students choose strongly agree, 50% students choose agree, 0.0% students choose neutral, 0.0% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.11.

Table 7.12: Respondent for B4

		B4					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0(0.0%)	1 (12.5%)	4 (50%)	2 (25%)	1 (12.5%)	8(100%)
Total		0(0.0%)	1 (12.5%)	4 (50%)	2 (25%)	1 (12.5%)	8(100%)

Based on the questions "*I find that the 'instant messaging' part is very interesting (TPS).*" shows that 12.5% students choose strongly agree, 25% students choose agree, 50% students choose neutral, 12.5% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.12.

Table 7.13: Respondent for B5

		B5					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0	0 (12.5%)	0 (37.5%)	3 (37.5%)	5 (12.5%)	8
Total		0	0 (12.5%)	0 (37.5%)	3 (37.5%)	5 (12.5%)	8

Based on the questions "*I think that the chatroom module is interesting.*" shows that 12.5% students choose strongly agree, 37.5% students choose agree, 37.5% students choose neutral, 12.5% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.13.

Table 7.14: Respondent for B6

		B6					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0 (0.0%)	0 (0.0%)	3 (37.5%)	5 (62.5%)	0 (0.0%)	8(100%)
Total		0 (0.0%)	0 (0.0%)	3 (37.5%)	5 (62.5%)	0 (0.0%)	8(100%)

Based on the questions "*I think that getting the marks online is very exciting.*" shows that 0.0% students choose strongly agree, 62.5% students choose agree, 37.5% students choose neutral, 0.0% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.14.

Table 7.15: Respondent for B7

		B7					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0 (0.0%)	0 (0.0%)	2 (25%)	5 (62.5%)	1 (12.5%)	8(100%)
Total		0 (0.0%)	0 (0.0%)	2 (25%)	5 (62.5%)	1 (12.5%)	8(100%)

Based on the questions "*Overall, I find that CETLs is useful in learning activity (Notes, Assignment, Marks, Discussion*)" shows that 12.5% students choose strongly agree, 62.5% students choose agree, 25% students choose neutral, 0.0% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.15.

Table 7.16: Respondent for B8

		B8					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	2 (25%)	3 (37.5%)	3 (37.5%)	0 (0.0%)	0 (0.0%)	8(100%)
Total		2 (25%)	3 (37.5%)	3 (37.5%)	0 (0.0%)	0 (0.0%)	8(100%)

Based on the questions "*CETLs is lack of face-to-face communication. Do you think this will reduce your attention during learning session?,"* shows that 0.0% students choose strongly agree, 62.5% students choose agree, 37.5% students choose neutral, 37.5% students choose disagree and 25% students choose strongly disagree, as shown in Table 7.16.

7.5.2.5.2 Teacher Perceived Usefulness

This section analyzes the perceived usefulness of the CETLs system. The respondents were required to answer and evaluate the CETLs based on 5 criteria such as "Strongly Agree", "Agree", "Neutral", "Disagree" and "Strongly Disagree". There were 7 questions involved and mainly asking about how the system is

been accepted by the Teachers. Table 6.17 until Table 7.24 is the results analysis from the teacher's feedback of each question in this part.

Table 7.17: Case Processing Summary (Teacher)

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Respondent for B1	4	100.0%	0	.0%	4	100.0%
Respondent for B2	4	100.0%	0	.0%	4	100.0%
Respondent for B3	4	100.0%	0	.0%	4	100.0%
Respondent for B4	4	100.0%	0	.0%	4	100.0%
Respondent for B5	4	100.0%	0	.0%	4	100.0%
Respondent for B6	4	100.0%	0	.0%	4	100.0%
Respondent for B7	4	100.0%	0	.0%	4	100.0%

N = No. of Respondents

Table 7.17 represents the table of *Case Processing Summary* for teachers. The table is created to list out the respondent that responds to each of the questions. Each of the questions is representing by number. Based on the table above, all the teachers (100%) have successfully answered each of the questions.

Table 7.18: Respondent for B1

		B1					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0(0.0%)	0(0.0%)	0(0.0%)	1(25%)	3(75%)	4(100%)
Total		0(0.0%)	0(0.0%)	0(0.0%)	1(25%)	3(75%)	4(100%)

Based on the questions *"I think that using CETLs would improve my time management."* shows that 75% teachers choose strongly agree, 25% teachers choose agree, 0.0%, teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.18.

Table 7.19: Respondent for B2

		B2					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0(0.0%)	0(0.0%)	0(0.0%)	2(50%)	2(50%)	4(100%)
Total		0(0.0%)	0(0.0%)	0(0.0%)	2(50%)	2(50%)	4(100%)

Based on the questions *"I feel that using CETLs would improve my skills & knowledge about using computer & internet."* shows that 50% teachers choose strongly agree, 50% teachers choose agree, 0.0%, teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.19.

Table 7.20: Respondent for B3

		B3					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0(0.0%)	0(0.0%)	0(0.0%)	4(100%)	0(0.0%)	4(100%)
Total		0(0.0%)	0(0.0%)	0(0.0%)	4(100%)	0(0.0%)	4(100%)

Based on the questions *"I find that 'Notes Management' & 'Assignment Management' module are very useful.",* shows that 0.0% teachers choose strongly agree, 100% teachers choose agree, 0.0%, teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.20.

Table 7.21: Respondent for B4

		B4					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0(0.0%)	0(0.0%)	1(25%)	1(25%)	2(50%)	4(100%)
Total		0(0.0%)	0(0.0%)	1(25%)	1(25%)	2(50%)	4(100%)

Based on the questions *"I find that the communication part (Chat room) is effective for teaching."* shows that 50% teachers choose strongly agree, 25% teachers choose agree, 25%, teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.21.

Table 7.22: Respondent for B5

		B5					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0(0.0%)	0(0.0%)	0(0.0%)	3(75%)	1(25%)	4(100%)
Total		0(0.0%)	0(0.0%)	0(0.0%)	3(75%)	1(25%)	4(100%)

Based on the questions *"I think that the online assessment & evaluation are practicable.",* shows that 25% teachers choose strongly agree, 75% teachers choose agree, 0.0%, teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.22.

Table 7.23: Respondent for B6

		B6					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0(0.0%)	0(0.0%)	1(25%)	3(75%)	0(0.0%)	4(100%)
Total		0(0.0%)	0(0.0%)	1(25%)	3(75%)	0(0.0%)	4(100%)

Based on the questions *"Overall, I find that CETLs is useful in completing my job. (Notes, Assignment, Marks and Discussion).",* shows that 0.0% teachers choose strongly agree, 75% teachers choose agree, 25%, teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.23.

Table 7.24: Respondent for B7

		B7					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	1(25%)	2(50%)	1(25%)	0(0.0%)	0(0.0%)	4(100%)
Total		1(25%)	2(50%)	1(25%)	0(0.0%)	0(0.0%)	4(100%)

Based on the questions *"CETLs is lack of face-to-face communication. Do you think this will influence your effectiveness of your work?.",* shows that 0.0% teachers choose strongly agree, 0.0% teachers choose agree, 25%, teachers choose neutral, 50% teachers choose disagree and 25% teachers choose strongly disagree, as shown in Table 7.24

7.5.2.5.3 Student Perceived Ease of Use

This section analyzes the perceived ease of use of the CETLs system. The respondents were required to answer and evaluate the CETLs based on 5 criteria such as "Strongly Agree", "Agree", "Neutral", "Disagree" and "Strongly Disagree". There were 2 questions involved and mainly asking whether the system can be easily used or not. Table 7.25 until Table 7.27 is the results analysis from the student's feedback of each question in this part.

Table 7.25: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Respondent for C1	8	100.0%	0	.0%	8	100.0%
Respondent for C2	8	100.0%	0	.0%	8	100.0%

N = No. of Respondents

Table 7.25 represents the table of *Case Processing Summary* for students. The table is created to list out the respondent that responds to each of the questions. Each of the questions is representing by number. Based on the table above, all the students (100%) have successfully answered each of the questions given in the questionnaires.

Table 7.26 Respondent for C1

		C1					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0 (0.0%)	0 (0.0%)	2(25%)	5(62.5%)	1(12.5%)	8(100%)
Total		0 (0.0%)	0 (0.0%)	2(25%)	5(62.5%)	1(12.5%)	8(100%)

Based on the questions *"CETLs would make my learning activities easier because I can do my work virtually.(Notes, Assignment, Marks, Discussion",* shows that 12.5% students choose strongly agree, 62.5% students choose agree, 25% students choose neutral, 0.0% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 6.26.

Table 7.27: Respondent for C2

		C2					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0 (0.0%)	0 (0.0%)	3(37.5%)	3(37.5%)	2(25%)	8(100%)
Total		0 (0.0%)	0 (0.0%)	3(37.5%)	3(37.5%)	2(25%)	8(100%)

Based on the questions *"CETLs is simple to use in terms of uploading & downloading notes, assignment, and handling marks distribution & join 'collaborative activities' (chat)",*shows that 25% students choose strongly agree, 37.5% students choose agree, 37.5% students choose neutral, 0.0% students choose disagree and 0.0% students strongly choose disagree, as shown in Table 7.27.

7.5.2.5.4 Teacher Perceived Ease of Use

This section analyzes the perceived ease of use of the CETLs system. The respondents were required to answer and evaluate the CETLs based on 5 criteria such as "Strongly Agree", "Agree", "Neutral", "Disagree" and "Strongly Disagree". There were 3 questions involved and mainly asking whether the system can be easily used or not. Table 7.28 until Table 7.31 is the results analysis from the teacher's feedback of each question in this part.

Table 7.28: Case Processing Summary (Teacher)

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Respondent for C1	4	100.0%	0	.0%	4	100.0%
Respondent for C2	4	100.0%	0	.0%	4	100.0%
Respondent for C3	4	100.0%	0	.0%	4	100.0%

N = No. of Respondents

Table 7.28 represents the table of *Case Processing Summary* for teachers. The table is created to list out the respondent that responds to each of the questions. Each of the questions is representing by number. Based on the table above, all the teachers (100%) have successfully answered each of the questions.

Table 7.29: Respondent for C1

		C1					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0 (0.0%)	0 (0.0%)	1(25%)	3(75%)	0 (0.0%)	4(100%)
Total		0 (0.0%)	0 (0.0%)	1(25%)	3(75%)	0 (0.0%)	4(100%)

Based on the questions *"CETLs would make my job easier because I can do my work virtually. (Notes, Assignment, Marks, Discussion)",*shows that 0.0% teachers choose strongly agree, 75% teachers choose agree, 25% teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.29.

Table 7.30: Respondent for C2

		C2					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0 (0.0%)	0 (0.0%)	0 (0.0%)	3(75%)	1(25%)	4(100%)
Total		0 (0.0%)	0 (0.0%)	0 (0.0%)	3(75%)	1(25%)	4(100%)

Based on the questions *"CETLs is simple to use in terms of uploading & downloading notes, assignment, and handling marks distribution & join 'collaborative activities' (chat)",* shows that 25% teachers choose strongly agree, 75% teachers choose agree, 0.0% teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.30.

Table 7.31: Respondent for C3

		C3					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0 (0.0%)	0 (0.0%)	2 (50%)	2 (50%)	0 (0.0%)	4(100%)
Total		0 (0.0%)	0 (0.0%)	2 (50%)	2 (50%)	0 (0.0%)	4(100%)

Based on the questions "*CETLs can reduce the tension & stress in completing my job. (Notes, Assignment, Marks, Discussion)"*shows that 0.0% teachers choose strongly agree, 50% teachers choose agree, 50% teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.31.

7.5.2.5.5 Student Behavioral Intentions

This section analyzes the student's behavioral intentions to use the CETLs system. The respondents were required to answer and evaluate the CETLs based on 5 criteria such as "Strongly Agree", "Agree", "Neutral", "Disagree" and "Strongly Disagree". There were 3 questions involved and mainly asking whether the students have the intentions to use the CETLs system or not. Table 7.32 until Table 7.35 is the results analysis from the student's feedback of each question in this part.

Table 7.32: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Respondent for D1	8	100.0%	0	.0%	8	100.0%
Respondent for D2	8	100.0%	0	.0%	8	100.0%
Respondent for D3	8	100.0%	0	.0%	8	100.0%

N = No. of Respondents

Table 7.32 represents the table of *Case Processing Summary* for the students. The table is created to list out the respondent that responds to each of the questions. Each of the questions is representing by number. Based on the table above, all the teachers (100%) have successfully answered each of the questions given in the questionnaires.

Table 7.33: Respondent for D1

		D1					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0 (0.0%)	0 (0.0%)	1(12.5%)	4(50%)	3(37.5%)	8(100%)
Total		0 (0.0%)	0 (0.0%)	1(12.5%)	4(50%)	3(37.5%)	8(100%)

Based on the questions *"If the school provides CETLs, I intend to perform my learning activities. (Notes, Assignment, Marks, Discussion)",* shows that 37.5% students choose strongly agree, 50% students choose agree, 12.5% students choose neutral, 0.0% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.33.

Table 7.34: Respondent for D2

		D2					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0 (0.0%)	0 (0.0%)	0 (0.0%)	5(62.5%)	3(37.5%)	8(100%)
Total		0 (0.0%)	0 (0.0%)	0 (0.0%)	5(62.5%)	3(37.5%)	8(100%)

Based on the questions *"I intend to use CETLs because it is very interesting to use.",* shows that 37.5% students choose strongly agree, 62.5% students choose agree, 0.0% students choose neutral, 0.0% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.34.

Table 7.35: Respondent for D3

		D3					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Student	0 (0.0%)	0 (0.0%)	3(37.5%)	3(37.5%)	2(25%)	8(100%)
Total		0 (0.0%)	0 (0.0%)	3(37.5%)	3(37.5%)	2(25%)	8(100%)

Based on the questions *"I intend to use CETLs frequently.",* shows that 25% students choose strongly agree, 37.5% students choose agree, 37.5% students choose neutral, 0.0% students choose disagree and 0.0% students choose strongly disagree, as shown in Table 7.35.

7.5.2.5.6 Teacher Behavioral Intentions

This section analyzes the teacher's behavioral intentions to use the CETLs system. The respondents were required to answer and evaluate the CETLs based on 5 criteria such as "Strongly Agree", "Agree", "Neutral", "Disagree" and "Strongly Disagree". There were 3 questions involved and mainly asking whether the teacher have the intentions to use the CETLs system or not. Table 7.36 until Table 7.39 is the results analysis from the teacher's feedback of each question in this part.

Table 7.36: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Respondent for D1	4	100.0%	0	.0%	4	100.0%
Respondent for D2	4	100.0%	0	.0%	4	100.0%
Respondent for D3	4	100.0%	0	.0%	4	100.0%

N = No. of Respondents

Table 7.36 represents the table of *Case Processing Summary* for the teachers. The table is created to list out the respondent that responds to each of the questions. Each of the questions is representing by number. Based on the table above, all the teachers (100%) have successfully answered each of the questions given in the questionnaires.

Table 7.37: Respondent for D1

		D1					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0 (0.0%)	0 (0.0%)	0 (0.0%)	1(25%)	3(75%)	4(100%)
Total		0 (0.0%)	0 (0.0%)	0 (0.0%)	1(25%)	3(75%)	4(100%)

Based on the questions "*If the school provides CETLs, I intend to use it to do my work. (Notes, Assignment, Marks, Discussion)",*shows that 75% teachers choose strongly agree, 25% teachers choose agree, 0.0% teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.37.

Table 7.38: Respondent for D2

		D2					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0 (0.0%)	0 (0.0%)	0 (0.0%)	4(100%)	0 (0.0%)	4(100%)
Total		0 (0.0%)	0 (0.0%)	0 (0.0%)	4(100%)	0 (0.0%)	4(100%)

Based on the questions "*I intend to use CETLs because it makes my job easier",* shows that 0.0% teachers choose strongly agree, 100% teachers choose agree, 0.0% teachers choose neutral, .0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.38.

Table 7.39: Respondent for D3

		D3					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Respondent	Teacher	0 (0.0%)	0 (0.0%)	1(25%)	2(50%)	1(25%)	4(100%)
Total		0 (0.0%)	0 (0.0%)	1(25%)	2(50%)	1(25%)	4(100%)

Based on the questions "*I intend to use CETLs frequently",* shows that 25% teachers choose strongly agree, 50% teachers choose agree, 25% teachers choose neutral, 0.0% teachers choose disagree and 0.0% teachers choose strongly disagree, as shown in Table 7.39.

7.5.2.6 Questionnaire Results Discussion

This section is to analyzes and discusses the data result which is consist three category namely 'Perceived Usefulness', 'Perceived Ease of Use and 'Behavioral Intentions. The table shows the analysis was done by the students and teachers. The results stated that for criteria Strongly Agree and Agree were counted as "Agree" Strongly Disagree and Disagree were counted "Disagree" and Neutral as "Neutral". Table 7.40 shows the 'Perceived Usefulness' results overview and Figure 7.34 until Figure 7.46 shows the comparisons between students and teachers based on the question given in the questionnaire.

7.5.2.6.1 Perceived Usefulness

Table 7.40: Perceived Usefulness Results Overview

Category	Questions	Respondent	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Perceived Usefulness	B1	Teacher	0.0%	0.0%	0.0%	25%	75%
		Student	0.0%	12.5%	37.5%	37.5%	12.5%
	B2	Teacher	0.0%	0.0%	0.0%	50%	50%
		Student	0.0%	0.0%	0.0%	75%	25%
	B3	Teacher	0.0%	0.0%	0.0%	100%	0.0%
		Student	0.0%	0.0%	0.0%	50%	50%
	B4	Teacher	0.0%	0.0%	25%	25%	50%
	B5	Student	0.0%	12.5%	37.5%	37.5%	12.5%
	B5	Teacher	0.0%	0.0%	25%	75%	0.0%
	B6	Student	0.0%	0.0%	37.5%	62.5%	0.0%
	B6	Teacher	0.0%	0.0%	25%	75%	0.0%
	B7	Student	0.0%	0.0%	37.5%	62.5%	0.0%
	B7	Teacher	25%	50%	25%	0.0%	0.0%
	B8	Student	25%	37.5%	37.5%	0.0%	0.0%

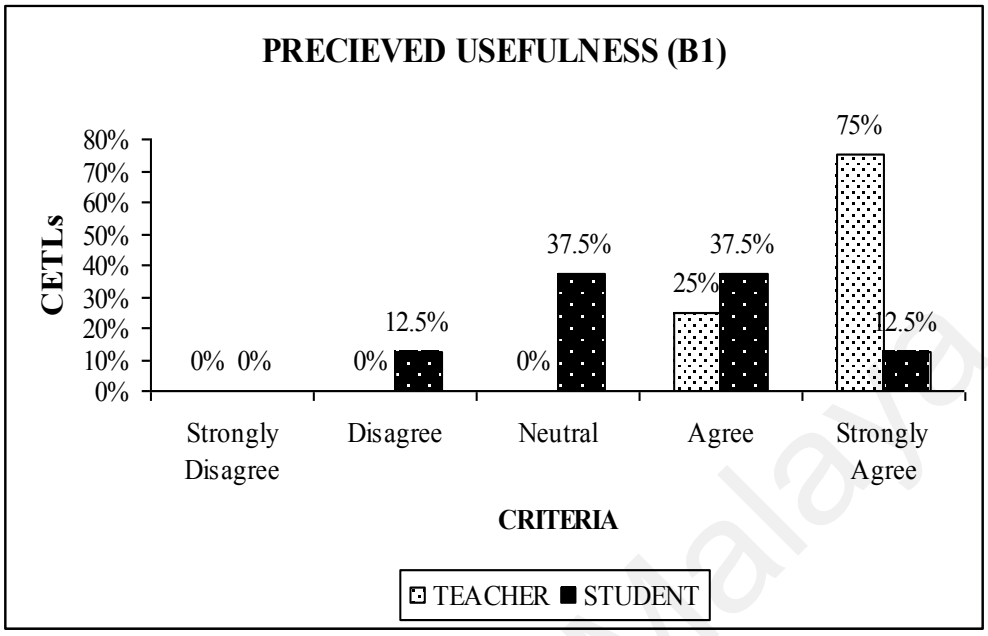


Figure 7.34: Comparison between Student and Teacher for B1

Comparison No.1

Figure 7.34 shows the comparisons for Question B1-"*I think that using CETLs would improve my time management"*, indicate that students and teacher agreed that the CETLs improves their time management. The results show 87.5% of the students and 100% of the teacher choose to agree. The teachers feel that using CETLs helps them in their work in terms of organizing the student's activities since everything is done in online. As for the students, the results show they feel that the time management will improve their learning skills since the CETLs is accessible anywhere making their learning process a lot easier.

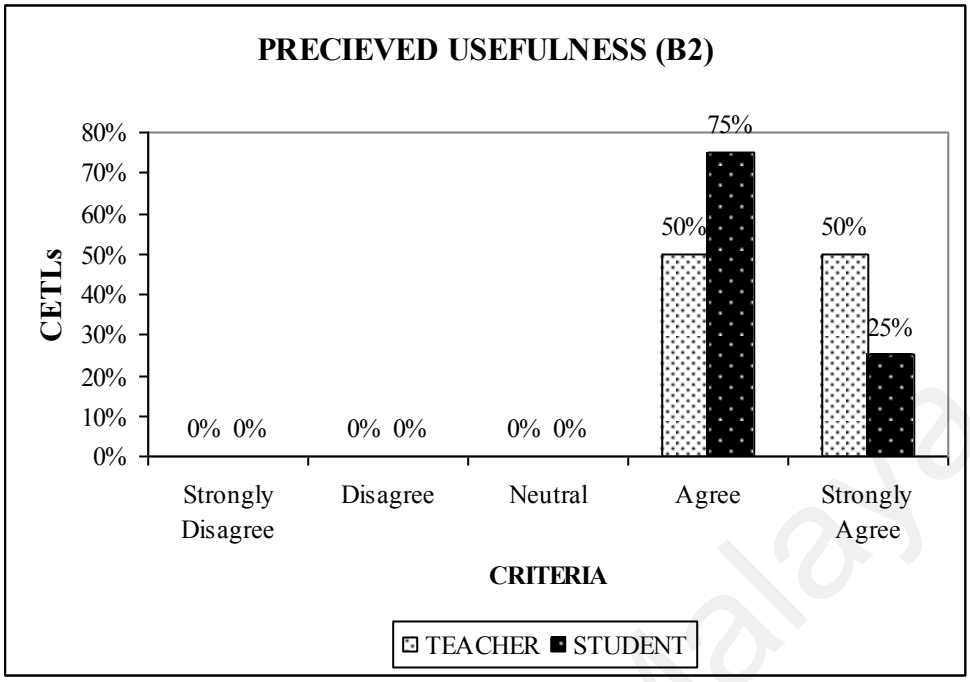


Figure 7.35: Comparison between Student and Teacher for B2

Comparison No.2

Figure 7.35 shows the comparisons for Question B2 - *'I feel that CETLs help me to improve my skills & knowledge to use computer & internet.*' In order to obtain such skills & knowledge with ICT, people have to experience and practice it on their own on daily basis. Some people may have general knowledge through reading which can be categories it as a theory, but theory and practical are two different thing. Those who are good in theory may necessarily process the required skill to implement the theory as a real practice. The result for question B2 has proven it, in 100% of the teachers and student has agreed that the CETLs can help them to improve their skills and knowledge using the computer and internet.

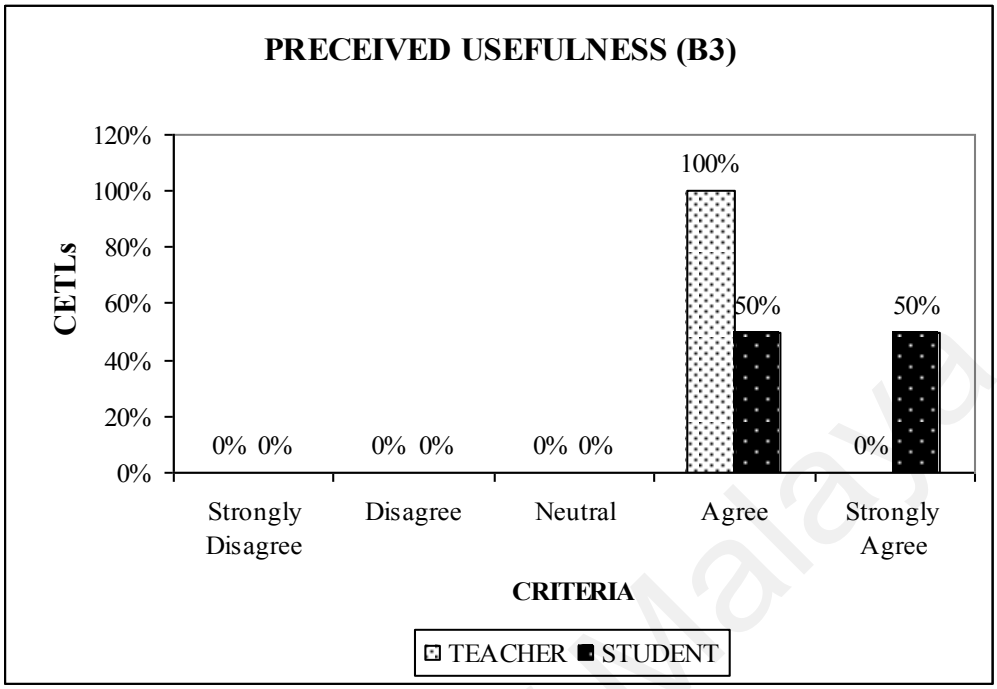


Figure 7.36: Comparison between Student and Teacher for B3

Comparison No.3

Figure 7.36 shows the comparisons for Question B3 – (Student) '*I find that 'Download Notes' & 'Download & upload Assignment' are very useful'*; 50% of the students choose strongly agree and 50% agree and Question B3 – (Teacher) '*I find that 'Notes Management' & 'Assignment Management' module are very useful'*; teachers 100% agree.

According to the result above, both student and teacher find that the tools provided in CETLs are very useful to them. Student can simply download notes and assignments or even submit their assignment via online. This provides flexible time to do their course work from any place as long as the internet is available. As for the teachers, it is easier for them to provide notes and assignment and distribute the data to student online and does not require a meeting with students just for the same purpose. Since teachers can manage their work online with flexible timing, they can also organize their time more effectively.

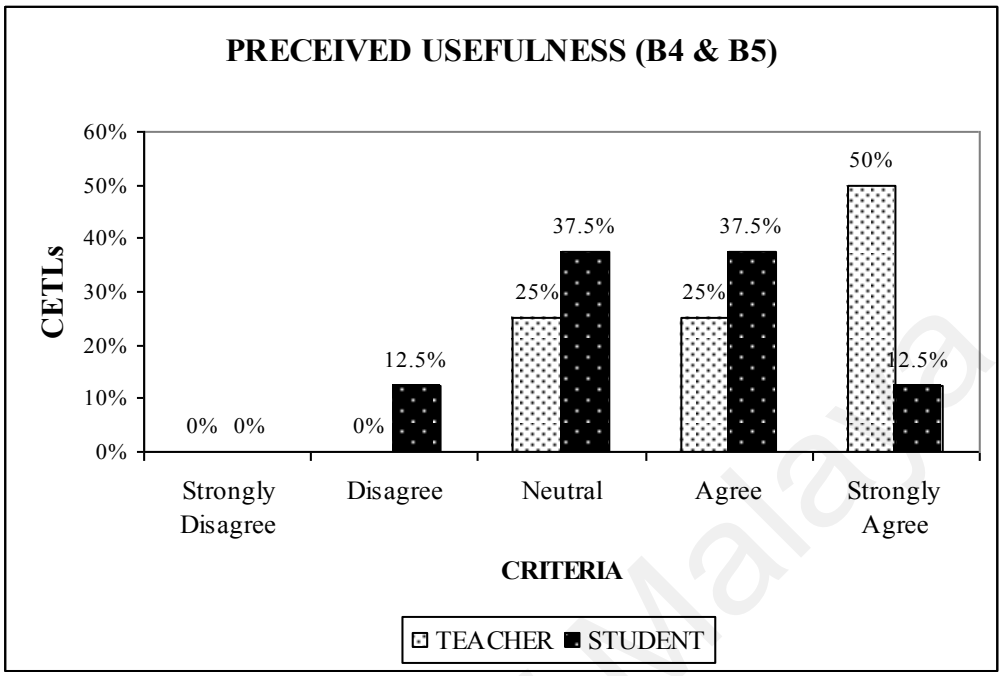


Figure 7.37: Comparison between Student and Teacher for B4 & B5

Comparison No.4

Figure 7.37 shows the comparisons for Question B4 - (Teacher) *'I find that the communication part (Chat room) is effective for teaching'*; 25% of the teachers choose neutral, 25% agree and 50% strongly agree and Question B5-(Student) *'I think that the chat room module is interesting.'*; 12.5% of the students disagree, 37.5% neutral, 37.5% agree and 12.5% strongly agree.

The purpose of the question above is to find out more about the 'Chat room' from the teacher and students point of view. From the teacher perspective, it can be concluded that even though 25% of them were not sure whether the communication part is effective, 75% of them has agreed that it is effective as part of a learning process. Chat room is a synchronous communication tool where the user can communicate in real time with prompt

respond. Teacher and student can have a learning activity with out an actual class (face-to-face) and not necessarily at the same place or time. This is one the reason why most the teacher voted to agree with the question. However, from the students' point of view only 50% of them agreed that the chat room is interesting, 37% of them were not sure and 12.5% disagreed. Even though chat room is a real time communication, there is a possibility to overwhelmed the chat room with text conversation and it will be like a fast text rolling up through the computer screen if too many chatter participated at the same time. Reading and typing text may take some time, so if the students do not have the skill in typing or reading; this may be one way to help them to do it faster. Students may feed that the chat room is not very interesting.

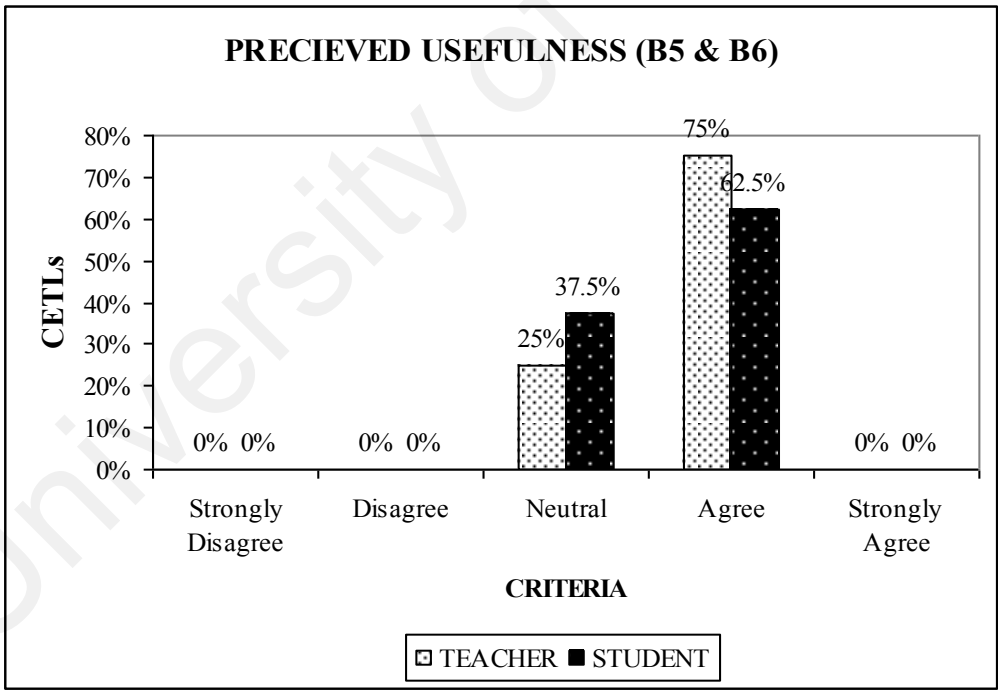


Figure 7.38: Comparison between Student and Teacher for B5 & B6

Comparison No.5

Figure 7.38 shows the comparisons for Question B5 – (Teacher) '*I think that the online assessment & evaluation are practicable.';* 25% of the teachers choose agree and 75% strongly agree and Question B6 – (Student) *'I think that getting the marks online is very exciting.';* 37.5% of the students choose neutral, 62.5% agree.

The analysis result above shows that both teacher and students find the assessment using CETLs system practicable and interesting. They just need to seat in front of the computer or lap top to complete with the assessment via online. The hassle of phototasting assignment or question papers and distributing them to students will not be an issue for the teachers anymore. This can also be an opportunity for schools to save cost and for teachers to spend more time on other activities. It is not necessary for students to send their assignment by hand or allocate a certain time for quizzes conducted by teachers, since all this assessments can be done via online. It is more practical for the students, if they have a personal laptop with internet access and gives them benefits to allocate a specific time or place to get their assignment done.

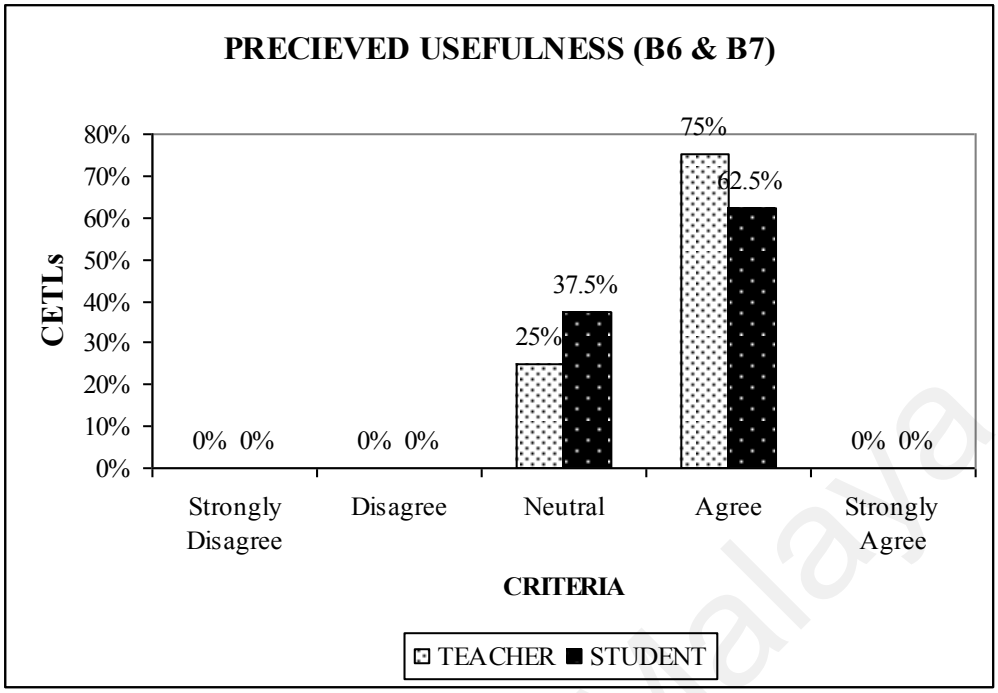


Figure 7.39: Comparison between Student and Teacher for B6 & B7

Comparison No.6

Figure 7.39 shows the comparisons for Question B6 – (Teacher) *'Overall, I find that CETLs is useful in completing my job. (Notes, Assignment, Marks and Discussion)'*; 75% of the teachers choose agree and 25% strongly agree and Question B7 – (Student) *'Overall, I find that CETLs is useful in learning activity (Notes, Assignment, Marks, Discussion)'*; 37.5% of the students choose neutral and 62.5% agree.

As claimed by the results above and based on the questions given, teachers and students agreed that CETLs is the best solution to organize assessment and learning activities. During a direct discussion in class, normally not all students actively participate on giving their opinion or make an effort to answer the questions raised by teachers. Most of the students prefer to stay passive and just listen to what ever the teacher say. They could be dreaming instead of listening to the teacher's speech and easily get bored. Some students

are shy and lack the confidence to speak or expressed their ideas through face-to-face class. But that not be the case when they participate in CETLs. Through this collaborative learning system, all students are required to participate in with all activities. No one will be excluded. Students who are shy and not sure with themselves can change their modes. They will more assertive and self-assured because instead of talking, they need to type and read in the text conversation. The teacher's, job will be less tedious on providing notes and assignment. It makes the job easier for them in order to make records and give remarks to the students.

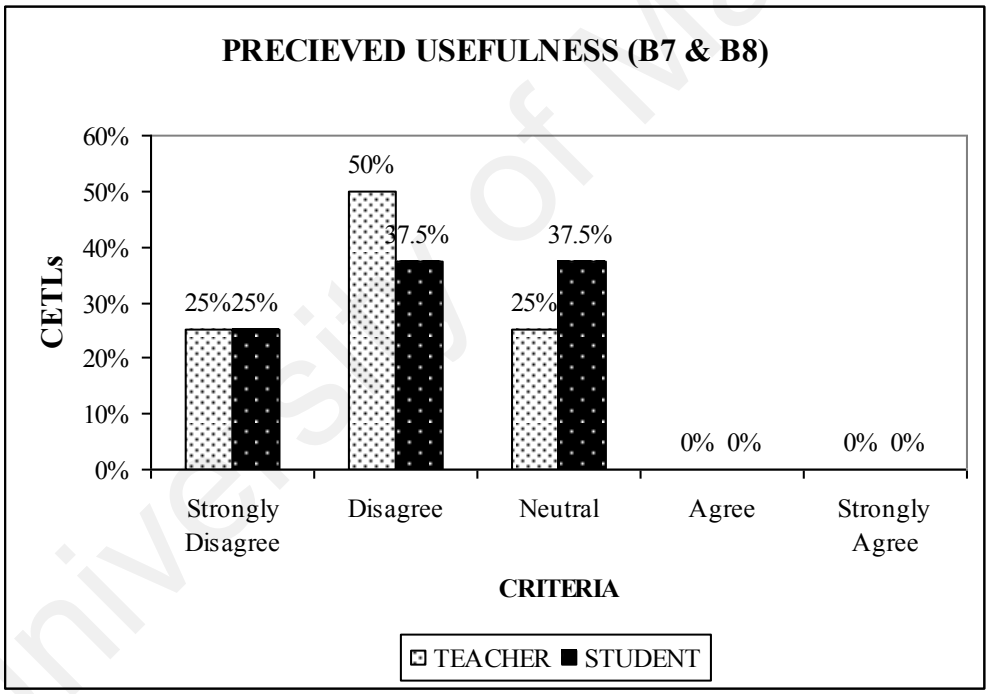


Figure 7.40: Comparison between Student and Teacher for B7 & B8

Comparison No.7

Figure 7.40 shows the comparisons for Question B7 – (Teacher) *'CETLs is lack of face-to-face communication. Do you think this will influence your effectiveness of your work?'*; 25% of the teachers choose strongly disagree, 50% disagree, 25% neutral and

Question B8 –(Student) *'CETLs is lack of face-to-face communication. Do you think this will reduce your attention during learning session?'*;25% of the students choose strongly disagree, 37.5% disagree and 37.5% neutral.

The purpose of above questions is to study how CETLs lack of face-to-face communication will effect and downgrade the teacher-student performances. Both teacher and student have responded to disagree with the questions that lack of face-to-face will effect to reduce their performance. The actual fact is that the CETLs is purposely designed to increase their performance in the educational field and provide a practical learning activities. Those who tested and had an experience with the system had given their approval by answering the questions stated above.

7.5.2.6.2 Perceived Ease of Use

Table 7.41 shows the 'Perceived Ease of Use' results overview and Figure 7.41 until Figure 7.43 shows the comparisons between students and teachers based on the question given in the questionnaire.

Table 7.41: Perceived Ease of Use Results Overview

Category	Questions	Respondent	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Perceived Ease of Use	C1	Teacher	0.0%	0.0%	25%	75%	0.0%
		Student	0.0%	0.0%	25%	62.5%	12.5%
	C2	Teacher	0.0%	0.0%	0.0%	75%	25%
		Student	0.0%	0.0%	37.5%	37.5%	25%
	C3	Teacher	0.0.%	0.0%	50%	50%	0.0%
		Student	-	-	-	-	-

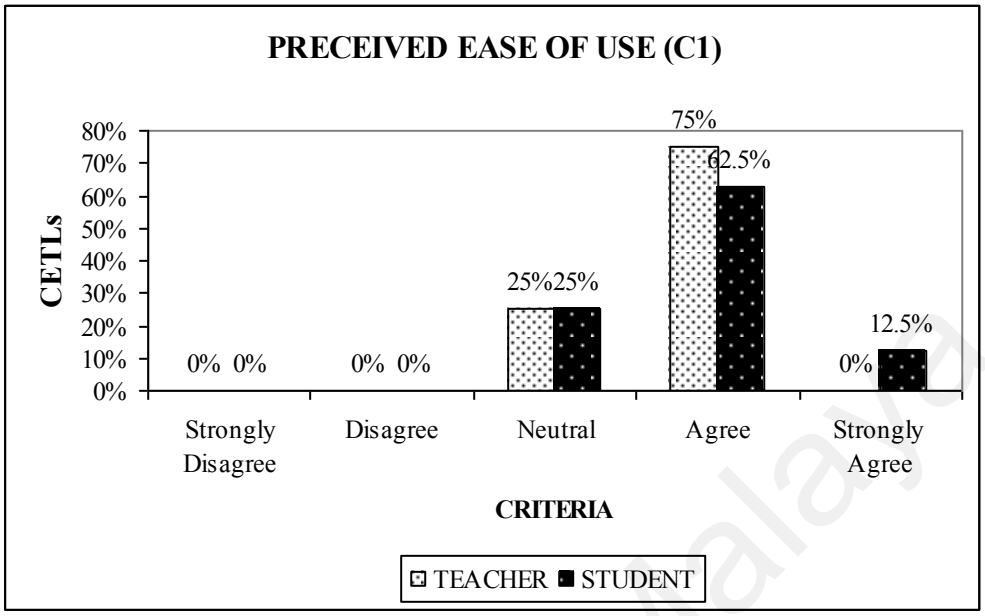


Figure 7.41: Comparison between Student and Teacher for C1

Comparison No.1

Figure 7.41 shows the comparisons for Question C1 – (Teacher) *'CETLs would make my job easier because I can do my work virtually. (notes, Assignment, Marks, Discussion'*; 25% of the teachers choose neutral and 75% agree and Question C1 – (Student) *'CETLs would make my learning activities easier because I can do my work virtually. (notes, Assignment, Marks, Discussion)'*; 25% of the students choose neutral, 62.5% strongly agree and 12.5% agree

The analysis results above show that, it is easier for them to plan a learning activities virtually using CETLs system. With functions such as notes, assignment management and discussion, the teachers and students prefer to do these tasks online. The results shows both of the users choose agree with the higher percentage, this indicate that they have a flexible time to organize their job and study.

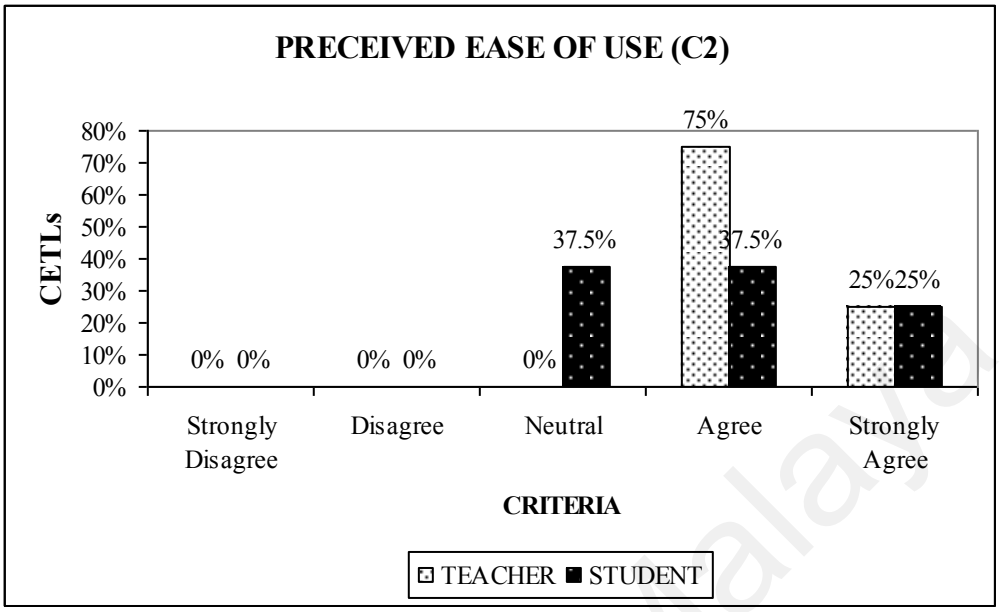


Figure 7.42: Comparison between Student and Teacher for C2

Comparison No.2

Figure 7.42 shows the comparisons for Question C2 – (Teacher) '*CETLs is simple to use in terms of uploading & downloading notes, assignment and handling marks distribution & join 'collaborative' activities (chat)'*; Teachers choose 75% agree and 25% strongly agree. Question C2 – (Student) *'CETLs is simple to use in terms of uploading & downloading notes, assignment and handling marks distribution & join 'collaborative' activities'*; Students choose 37.5% neutral, 37.5% agree and 25% strongly agree.

The results above indicate that both teacher and student find that, CETLs is very user friendly and easy to use. The system is designed to facilitate teacher-student to collaboration. They agreed that CETLs is simple to use in terms of uploading & downloading notes, assignment, and handling marks distribution & join 'collaborative activities' (chat). Most of them ticked on "strongly agree" and "agree" columns. The

interface of the system is created as simple as possible to ensure the user does not have a problem using it. Complicated interface would only be a cost of the user losing their interest.

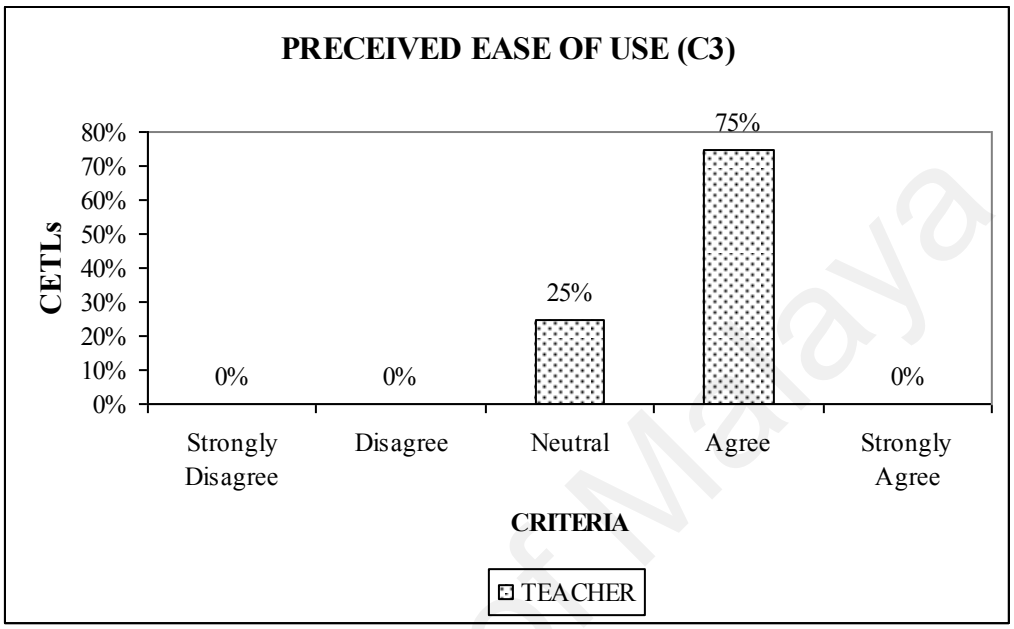


Figure 7.43: Comparison between Student and Teacher for C3

Comparison No.3

Figure 7.43 shows the comparisons for Question C3 – (Teacher) *'CETLs can reduce tension & stress in completing my job (Notes, Assignment, Marks, Discussion)'*;50% of the teachers choose neutral and 50% agree.

As a teacher, there are a lot of task to handle which is time consuming. This could add to their stress level. When their task and time management are organized efficiently with the CETLs system, the tension and stress can be greatly reduce. However, only half of the teachers agreed with the question and the other half were not sure. Perhaps they feel that it is more convenient for them to use the traditional way, especially those teachers who are lack of experience in ICT technology.

7.5.2.6.3 Behavioral Intentions

Table 7.42 shows the 'Behavioral Intention' results overview and Figure 7.44 until Figure 7.46 shows the comparisons between students and teachers based on the question given in the questionnaire.

Table 7.42: Behavioral Intention Results Overview

Category	Questions	Respondent	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Behavioral Intention	D1	Teacher	0.0%	0.0%	0.0%	25%	75%
		Student	0.0%	0.0%	12.5%	50%	37.5%
	D2	Teacher	0.0%	0.0%	0.0%	100%	0.0%
		Student	0.0%	0.0%	0.0%	62.5%	37.5%
	D3	Teacher	0.0.%	0.0%	25%	50%	25%
		Student	0.0.%	0.0%	37.5%	37.5%	25%

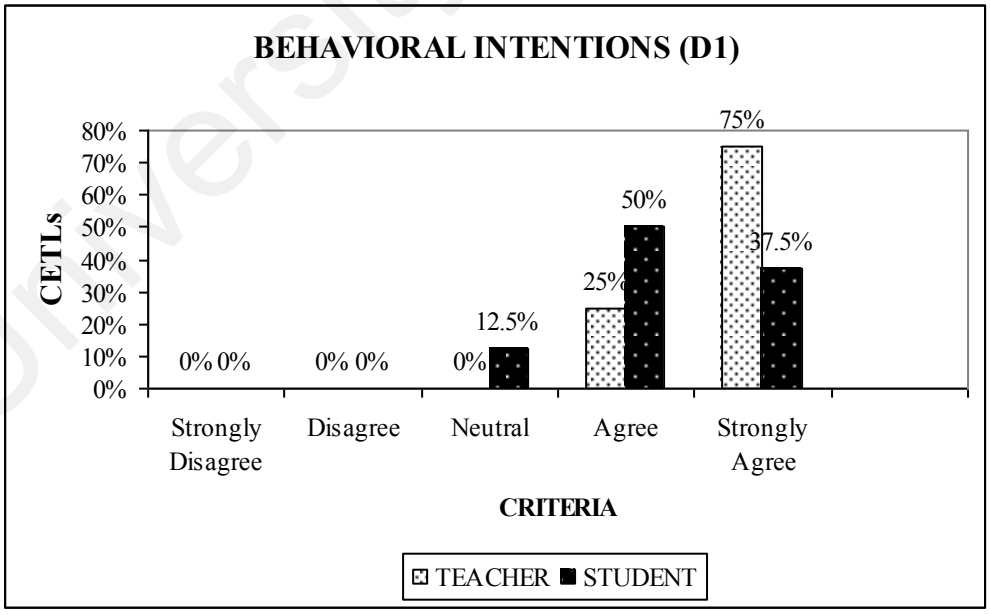


Figure 7.44: Comparison between Student and Teacher for D1

Comparison No.1

Figure 7.44 shows the comparisons for Question D1 – (Teacher) *'If the school provides CETLs, I intend to use it to do my work. (Notes, Assignment, Marks, Discussion)'*; 25% of the teachers choose agree and 75% strongly agree and Question D1 – (Student) *'If the school provides CETLs, I intend to perform my learning activities. (Notes, Assignment, Marks, Discussion)'*; 12.5%of the students choose neutral, 50% agree and 37. 5% strongly agree.

The results from the question above show that most of the teachers and students have shown a keen interest to use the CETLs system if their school provides the system as a learning tool. Both parties have given a good respond toward the implementation of CETLs as new approach. This is seen clearly as 100% of the teacher agreed and 87.5% student has agreed.

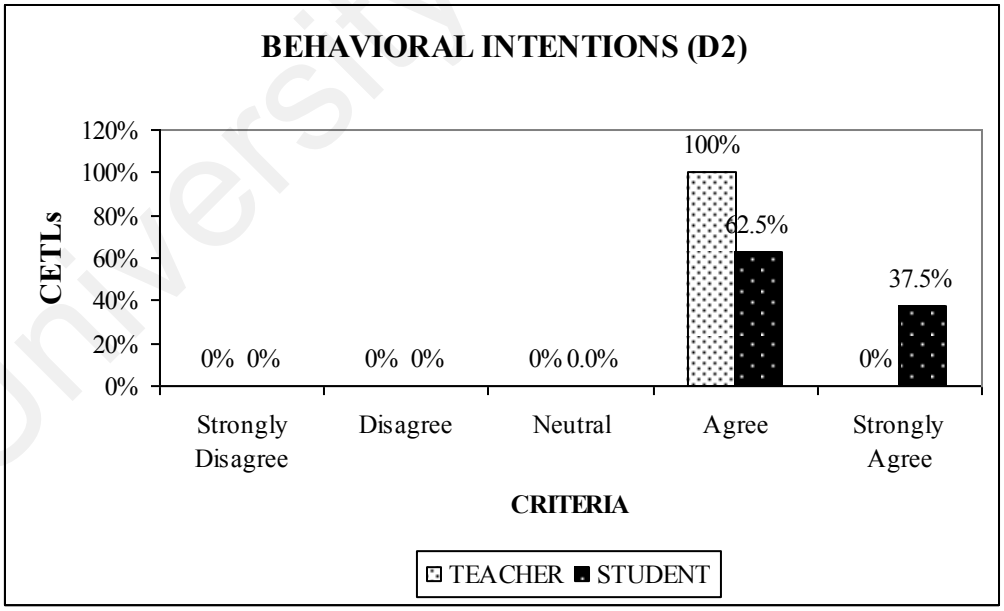


Figure 7.45: Comparison between Student and Teacher for D2

Comparison No.2

Figure 7.45 shows the comparisons for Question D2 – (Teacher) *'I intend to use CETLs because it makes my job easier'*; 100% of the teachers choose agree and Question D2 – (Student) *'I intend to use CETLs because it very interesting to use'*; 62.5% of the students choose agree and 37.5% strongly agree.

With reference to the results analysis above, CETLs has received a full vote from teacher and student in term of easiness and interest to use the system. Both of the user found out that CETLs would make their job easier and interesting to use. This indicates that both parties glad to use the CETLs system if they were given the opportunity to do so.

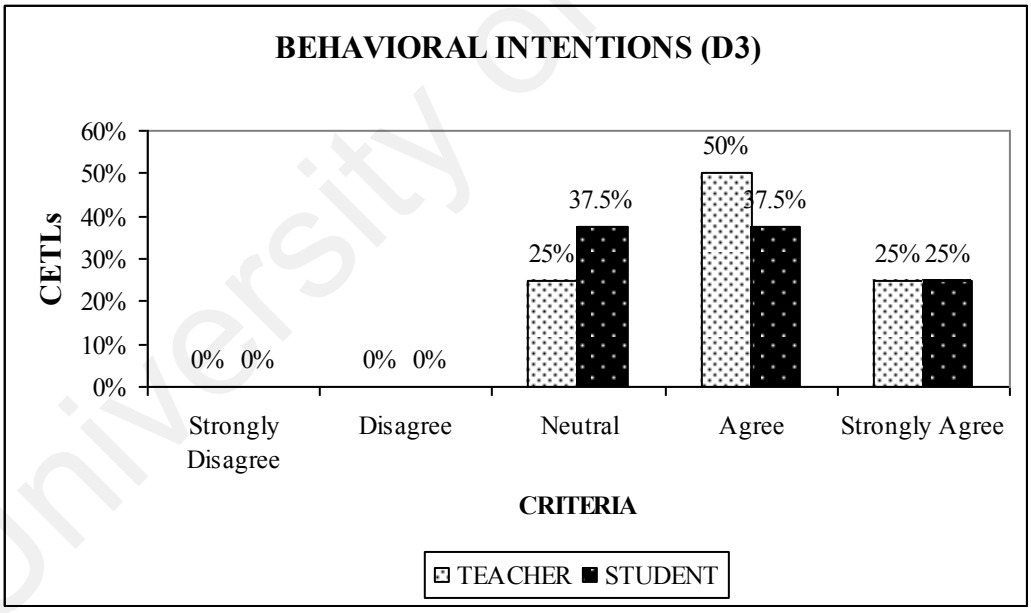


Figure 7.46: Comparison between Student and Teacher for D3

Comparison No.3

Figure 7.46 shows the comparisons for Question D3 – (Teacher & Student) *'I intend to use CETLs frequently';* 25% of the teachers choose neutral, 50% agree and 25% strongly agree and 37.5% of the students choose neutral, 37.5% agree and 25% strongly agree.

Question above tries to find out whether both teacher and students aim to use CETLs frequently if the school has decided to employ the system. Apparently most of them had agreed that they will use CETLs frequently. Even though 25% of the teachers and 37.5% of the students choose to be neutral, this is not an indication that the do not want to use CETLs. This maybe due to the fact that most of them do not have the facility or were not be able to use the system frequently.

7.5.2.6.4 Lesson Learned

Generally, teachers and students have a good respond with CETLs. They agreed that the system is beneficial and able to upgrade their performance in educational field. However from the 3 analysis categories, 2 of them are crucial in order to determine whether the system is accepted by the user. They are 'perceived usefulness' and 'perceived ease of use'. Perceived usefulness is to analyze how CETLs been accepted and usefulness to the user as a learning tool. Can CETLs make teacher and student learning be more convenient? Can CETLs boost the user performance efficiently? Perceive ease of use on the other hand is to analyze whether the system is user friendly. Is the interface of the system is easy to understand or complicated? From the analysis and comparison that

has done and also based on the data gathered, CETLs has met its purpose of usefulness and ease of use and can clearly be seen in the massive support for CETLs.

7.6 SUMMARY

The purpose of the trial implementation is to ensure the new system is available and well prepared before full implementation to the users. For the CETLs, the implementation focuses on the backbone of the system which is the coding program. The coding only takes 3 important modules. They are the Think-Pair-Share modules. During the implementation, the execution of the CETLs from different user's points of view is noted. This is to make sure that the user really understands the flow of the system. The system's flow is represented by the activity diagram. The testing is to ensure that each of the units in the system is tested without any error. Many types of testing are involved in the development process but for the CETLs, the unit testing and user acceptance testing was chosen. The unit testing is involved in individual components or modules. It requires detailed knowledge of the internal program design and code, whereas the user acceptance is the testing that verifies that the system meets the user specified requirements. The user must do this testing to determine whether to accept the application. During the testing, the system tests some of the parts of the CETLs. The major part that needs to be tested is the collaborative part, where the user (teacher and students) take part in the utilization of the system. After the testing, the students and teachers must answer the questionnaire given. Certain units such as class management and timer for students to answer the specific questions may need to be improved but overall, the system functionality work proficiently and is accepted by both the teacher and students.

CHAPTER 8
CONCLUSION

8.1 INTRODUCTION

The final chapter reviews the main objectives outlined in the earlier chapters in this research. This chapter highlighted the advantages and limitations of the CETLs to the students and learning activities. This chapter ends by making some conclusions and recommendations for future research.

8.2 REVIEW OF OBJECTIVES

Again, it would be very useful to review the main objectives discussed earlier in the Chapter 1 to give a better understanding of how these objectives are accomplished through the development of CETLs. Stated below are the main objectives of this research:

8.2.1 To identify collaborative learning techniques and apply it in a collaborative learning environment framework.

In order to develop the collaborative system, the framework or the backbone of the system must be defined. A number of frameworks were studied from which the skeleton of the development process was chosen. This objective has been achieved during the research conducted and the framework by Dimitracopoulou (2005) was selected as a reference. Using this framework it enabled us to develop our own framework so that it is suitable for the school requirements and the research conducted in Chapter 2. Generally, the framework of the collaborative learning system shows CMC tools and the functions are designed and implemented to support the students' activities process. The interaction of the individual learner

and the other learner uses the Think-Pair-Share technique. The framework shows the new arrangement that is suitable with the development of the Collaborative Learning application. The CL is divided by three groups which are individual student, pair group and teacher. Details explanations of the adjusted framework are discussed in Section 3.3

8.2.2 To develop a web based collaborative learning using think-pair-share technique.

The second objective is to develop a web-based collaborative learning using the think-pair-share technique. This objective was achieved with the development of the system called the Collaborative Environment for Teaching and Learning Science (CETLs). This system is divided into two major users which are the student and the teacher. CETLs consist of a student module and a teacher module that support the students' and the teacher's activities accordingly. CETLs also educate the student to be more active and participate during the learning process rather than to be a passive learner. This is because, CETLs are designed to support students group activities and have to solve problems within the time given. This technique encourages the students to be more disciplined and confident since they have to communicate frequently using the system to gain the knowledge. The development of this system has been translated using the use case diagram by recognizing the major requirements, input, output and the processes needed for CETLs. The flow of CETLs, is presented in the activity diagram in Section 7.3.4 and execution of the system from the student's point of view also being explained in Section 7.4.

8.2.3 To evaluate the usefulness and ease of use of the system.

CETLs were evaluated on this category – evaluate the 'usefulness' and 'ease of use' of the system. Students participated in the evaluation of the system by using the questionnaires given. During the evaluation, the student is required to answer the questions after they have tested use the system. From the results stated in most of the students agreed that CETLs is useful and user friendly to them as a new approach of learning. They agreed that CETLs can enhance their learning performance in a new virtual environment. This objective has been achieved based on the testing result stated in Section 7.5.2.6. The results show that students react positively towards this technology and very keen interest if the CETLs being implemented in their school.

8.3 ADVANTAGES OF CETLs

This section begins by addressing the advantages of the CETLs. The advantages of CETLs can be viewed in terms of how the system promotes a better learning environment for the student. The explanations of advantages are represented using a table comparison based on Chapter 2. Table 8.1 represents the comparison of five existing collaborative systems and with the new one system called CETLs. The table shows the suitability of the CETLs system for collaborative learning, and it also exhibits that CETLs has followed the collaborative learning characteristics. Details of the advantages are stated below:

Table 8.1: Comparisons Existing System with CETLs

Collaborative Learning (CL) Characteristics by	System Functionality	Web-Based Collabora-tive Learning (WebICL)	Learning through Collaborative Visualization (CoVis) Project	Virtual Learning Environ-ment (VLE)	Collaborative Multi-Media Instructional Toolkit (CoMMIT)	GREWPtool	Collaborative Environment Teaching &Learning Science (CETLs)
Agent (Student) (Teacher)	Member Login	√	√		√	√	√
	Group formations	√	√	√	√	√	√
	Group Joining	√	√	√			√
	Group Activity		√	√	√	√	√
Necessary tools that support the Computer-Mediated-Communica-tions (CMC)	Chat Room	√				√	√
	Bulletin board		√				√
	Email		√				√
	Forum	√	√		√		
	Video conferencing		√				
Additional tools to support CL	Upload/ download		√	√	√		√
	Search Engine	√	√	√			
	Online Assessment				√	√	√
	Online Supervisor		√	√			
	Visualizer		√	√			
	Working Space		√	√	√	√	√
CL Characteristics	Techniques	N/A	N/A	N/A	N/A	Pair Annotations	Think-Pair-Share

8.3.1 Support Collaborative Group

CETLs support the collaborative group work which provides a useful alternative for the students to learn. During the learning activity, the students are able to present their own ideas and share information with each other. It is an important approach to learning, since collaborative learning provides a way where all the students can give their ideas and opinion to solve a given problem

8.3.2 Support Think-Pair-Share Communications

To support communication with other students, CETLs are developed based on the collaborative learning technique called think-pair-share. This technique is able to support the students' activities, which allows them to think about a question, idea, issue, and opinion and share their thoughts with their partner. This strategy allows students to share their ideas with a range of class members and the opinions of all members of the class are valued.

8.3.3 Provided with CMC Tools

CETLs are provided with CMC tools which help the students and teacher communicate. CETLs are categorized into two types which are synchronous and asynchronous communication tools. The synchronous communication tool uses a real time based environment such as chat and instant messaging whereas asynchronous tools include email and bulletin boards. This function makes the learning process more interesting.

8.3.4 Additional Tools to Support Collaborative Learning

CETLs also provide other tools that support the students' activities including uploading and downloading the notes and assignments. This function is commonly featured in other web-based systems. With this function, it enables the student to retrieve the information easily by downloading all the material or questions that have been posted by the teacher. As a result, the process of learning becomes faster and usage of paper decreases. After completing the task, the students can easily upload to the respective teacher for checking.

8.3.5 New Technology

Newly emerging technology has provided more opportunities to the student for a flexible online learning environment. CETLs have been developed to make the concept of collaborative learning between the student and the teacher more interesting. This technology enables them to access the material or sources at any time and from any place. Generally, CETLs give a new environment that helps the students learn to use the Internet and interact using real time communications.

8.4 DISADVANTAGES OF CETLs

This section begins by addressing the disadvantages of the CETLs. The disadvantages of CETLs can be viewed in terms of how the system promotes a better learning environment for the student. The explanations of disadvantages are stated below:

8.4.1 Lack of Face to Face Communications

Basically, CETLs is an online communication which the interaction between students and teacher are virtually through online. Even implementing CETLs will

not fully change traditional learning but it will cost student and teacher lack of face to face communication. The CETLs interaction based on text communication, no voice can be heard and no face can be seen, it just student or teacher seating in front the computer typing text and waiting respond from other participator. CETLs system definitely makes education institution easy to organized, recorded and monitored students activities but in context of learning process, face to face communication still valid to give more understanding about the subject course, it is because not everything can be clearly explained through the text conversation.

8.4.2 Internet Connection

Practically, CETLs are developed based on web-based systems which mean the users need to have internet connection in order to employ this system. Instead using the facilities provided in computer lab, it is better for student and teacher to have their own ICT facilities to have the flexibility to access the system any time and any where or else the purpose to employ CETLs is not fully effective because the students and teacher still need go to the lab for using the system. The ICT equipment quite expensive for some parent and could cost them to provide the facilities to their children.

8.5 FUTURE WORKS

Concerning the disadvantages discussed previously, several recommendations can be made for CETLs to ensure that the system can be used properly and continuously. The first thing that needs to be improved is to upgrade communication using advanced technology tools like video conferencing and live presentation allowing the student and the teacher to collaborate. Currently, CETLs only provide CMC tools such as email and

chatting. These tools make the students and teachers collaborate together using text-based format and no face to face communication is involved. Perhaps, with the development of advanced technology students can learn effectively and the teacher can monitor the students' activities during the learning process. Secondly, CETLs was developed using basic requirements. With a higher speed of Internet bandwidth, it might be possible to support each of the modules work more efficiently. Thirdly, using forums can be another advantage for CETLs in future works. This asynchronous communication can give more flexibility and personalized education for students. Finally, with these proposed communication tools, it will offer a great opportunity to the students to share their ideas and knowledge in supporting their activities in a collaborative learning environment.

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