

**DESIGNING FOR LEARNING AND SUPPORT:
THE USER-CENTRED CONSTRUCTION AND
EVALUATION OF AN ON-LINE ENVIRONMENT FOR
MALAYSIAN TEACHERS LEARNING
ABOUT DIGITAL GRAPHICS**

by

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the degree of Doctor of Philosophy**

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ABSTRACT

This research focused on the importance of user context in designing learning and support in an online learning environment since the increase of the use of online learning environment had produced several problems and perceptions among students. Therefore, user support system is a significant element in designing an online learning system. The study involved the processes of designing, developing, implementing, and evaluating the online learning environment and a corresponding support system for a digital graphics domain, based on a user-centred construction. In addition, the focus was on supporting the students in dealing with learning problems and technical difficulties during the online learning session.

The research consisted of three stages. The first stage involved the process of gathering information regarding the user needs and their points of view toward the designs of the online learning system. Most recent models on web development only focus on tools development and learning theories without emphasising on the learner's points of view and user centred approach. Therefore, in this study, a user-centred design was used to involve the learners in the design process. In doing so, the SUNA (Scenario User Needs Analysis) and Activity Theory frameworks were used in identifying learner needs in their particular context and implementing them into the system.

The second stage of the study provided the framework to support the iterative process of designing and evaluating the user's needs. The online learning system was duly developed, based on the outcomes of the iterative design process. Two cycles of iterative process were implemented in order to validate the user needs and to test the system functionality. Finally, the modification process was made and the final system was produced.

The third stage involved the implementation and evaluation of the system through online distance learning students in Malaysia. The aim was to investigate what the students had learnt from the system, how the students learnt using the system, how they made use of the tools for learning and the contribution of the system and support to their learning outcomes. The Activity Theory framework was used to analyse the interaction between the learners and their learning environment. The outcomes of the analysis were presented as case studies to determine the interaction of the students with their surrounding artefacts such as tools, community, rules and division of labour.

The results of the study indicated that the system was effectively design in catering different learners' perspectives in the online learning environment. This finding is interesting, as it highlighted the system capability in fulfilling the learners' needs within their context. The case studies revealed that every student had different learning strategies and patterns of usage of the tools, when exploring the system. The meaningful interaction of the students in the case studies revealed that the system successfully helped the learners to understand the basic concept of digital graphics. The findings of the research also suggested that the learners have achieved their learning objectives by integrating their knowledge into the course assignments. It also suggested that the system and the support system had contributed to their learning by providing the students with various scaffolding facilities. The major contributions of this research are: a) the design provides effective learner support in an online environment b) the design provides evidence that it fulfils the learner's needs in the context of learning digital graphics.

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ABBREVIATIONS

ADDIE	-	Analysis, Design, Develop, Implementation, Evaluation
ARCS	-	Attention, Relevance, Confidence and Satisfaction
SUNA	-	Scenario Used Needs Analysis
PKPG	-	Program Khas Pensiawazahan Guru (Special Programmes for Teachers)
UTM	-	The University of Technology Malaysia
SQL	-	Structured Query Language
MySQL	-	My Structured Query Language
RDBMS	-	Relational Database Management Systems
CMS	-	Content Management System
OS	-	Operation System
PHP	-	Hypertext Preprocessor
CD-R	-	Compact Disk Recordable
CD-RW	-	Compact Disk Rewritable
CD-ROM	-	Compact Disk Read Only Memory
VLE	-	Virtual Learning Environment
LMS	-	Learning Management System

Chapter 1

Aims and Background

1.0 Introduction

The use of the Internet in education has been introduced many years ago. With the advancement of Internet technology, especially e-learning, many universities all over the world now make use of these facilities to deliver their online courses for students. Most of the e-learning portals were developed in order to provide the student with easy access to the course content and promote interaction in the community. In addition, this gives the students flexibility in accessing the content at anytime and anywhere. As a result, many researchers or instructional design experts have suggested a variety of methods and theories about designing an effective online learning environment. For instance, several models such as Analysis, Design, Develop, Implementation, Evaluation (ADDIE) by Molenda et al. (1996); Analysis, Design, Develop, Implementation, Evaluation (ASSURE) by Heinich et al. (1993) and Attention, Relevance, Confidence and Satisfaction (ARCS) by Keller (1983) have been adopted in order to provide effective guidelines to the designer to develop e-learning courseware. For example, the ARCS model stresses motivational factors as an aspect of designing the software. It provides four motivational factors that should be integrated into the design process including attention, relevance, confidence and satisfaction. However, most of these models only focus on target groups, learning theories and tools development without an emphasis on the learner's point of view and their context. Most of the models do not emphasise the value of the user, their needs, participation and requirements, in the context of development. As discussed above, I have explained that the current model of instructional design is lacking in user context. For example; the ARCS model only stresses motivational factors. Therefore, at this stage I will try to narrow down the topic to the importance of the user's point of view and their needs and context. The next paragraph explains the learner's perspective and the appropriateness of the user-centred approach in dealing with this issue.

Learner perspectives are a significant element in designing courseware. User centred design is one of the appropriate approaches that includes the learners' participation and point of view in designing the system. It provides a practical way for designing a specific type of product and service, mainly in understanding user needs and requirements and then transforming this information into the design of the product (Pollard & Blyth, 1999). Livari (2006) emphasises the importance of user participation in the design process. He suggested that to create a good and effective system, the designer should understand the users, their work and tasks in depth. In addition, Maguire (2001) agreed that active participation of the user is the key element in designing the system. This is because the users have the knowledge and experience in relation to the context where the system will be applied. Without user participation in the design process, we cannot acquire the genuine input of users in relation to their viewpoint and experience (Blythe, 2001).

For this reason, this research was carried out in particular to focus on the users' point of view and was designed around their needs and requirements. In addition, students' learning was evaluated based on the framework of Activity Theory in order to examine the effectiveness of the system. Therefore, I take into account the weaknesses of the current instructional design model as discussed above, to design and evaluate the online learning courses in the Malaysian context. This is important since the development of ICT in Malaysia has a big impact on the Malaysian Education System itself.

1.1 The Malaysian Context

The development of ICT in the Malaysian Education System has progressed rapidly in recent years. The Ministry of Education has introduced several ICT applications in teaching, learning and education management (Foong-Mae, 2002). These include:

- a) ETMS (English for Teaching of Maths and Science)
- b) EMIS (Education Management Information System)
- c) Information Technology Subject in School

ETMS was introduced into Malaysian schools in early 2004. Every Science and Mathematics teacher was provided with laptops and LCD projectors as a teaching aid (Ministry of Education Malaysia, 2007). Besides that, the courseware for Science and Mathematics subjects were also provided by the Educational Technology Unit (Malaysian Educational Technology Division, 2007). Apart from all these, the teachers were also encouraged to develop their own educational software for these subjects. However, not all the teachers have the relevant knowledge of ICT and how to use the equipment and the software in the classroom or to develop their own software for teaching.

Another ICT application introduced by the Ministry of Education is EMIS. EMIS is an ICT application for the management of information systems in schools and it was introduced in 1997 (Malaysian Educational Technology Division, 2007). Every teacher has to manage their students' data in terms of examination results and demographic data. A specialised teacher in ICT is appointed to ensure the data input is accurate and updated at all times. However, in order to use the system, a knowledge of ICT is needed in order to use and manage the system. Information Technology (IT) was introduced as one of the subjects in Malaysian schools in 2001. The addition of this subject in the curriculum gives a new challenge for teachers to teach this subject in schools. The teachers should have a high level of ICT knowledge and must be well prepared to teach the IT subject. Therefore, there is a need to provide teachers who are IT experts in order to fulfil the Ministry of Education's aims.

Due to the drastic implementation of ICT in schools, most universities in Malaysia have introduced a new curriculum or new programmes in relation to ICT especially for teachers. As a result, many universities introduced a new curriculum for their Bachelor of Education programme. The aim is to train and prepare the teachers with a knowledge of ICT so that they can utilise it in the learning and teaching process. For instance, the University of Technology Malaysia, one of the higher institutions in Malaysia, offers an ICT paper in all their courses. The undergraduate degree programme takes about four years to complete. Every student is required to take about seven subjects that are related to ICT during their study. The aim is to provide the student with the knowledge and skills to teach ICT in

secondary schools. One of the ICT subjects is digital graphics. This course introduces the student to the theory and practice of the technical aspects of graphics. At the end of the course, students should be able to apply their knowledge of graphics when developing multimedia courseware. One of the requirements for undergraduates in the Bachelor of Education programme is to enrol for ICT papers in their subjects, which includes students for the Program Khas Pendidikan Guru (Specialised Programme for Teacher Education programme; Hassan, 2001) and the Distance Learning programme. This was chosen as a research area because the course is significant for the students, allowing them to develop multimedia and web based courseware. This is a recent development for ICT in Malaysian schools. I would say that this development brings a lot of concern to the teachers. For example, lack of IT knowledge is the main problem when using ICT applications in schools. This is one of the reasons why most Malaysian universities changed their curriculum to include the ICT subject in the teacher training programme. It is purposely to prepare teachers with ICT knowledge in preparation for teaching in school. Some of the higher institutions offer the Bachelor of Education with IT and multimedia purposely to train teachers with ICT knowledge.

For these reasons, I have taken this opportunity to carry out research to provide teachers with ICT knowledge, by designing and evaluating the online learning system and support for learning digital graphics. Therefore, the rationale is to prepare the online student with a system that meets their needs and requirements in their particular context, as mention in the paragraph above.

1.2 Aims of the Study

This research focuses on designing and implementing an online learning environment based on a user-centred approach. Therefore, the design is focused around user needs and requirements. In addition, this study also emphasises the evaluation of students' learning using the system and support system. Some questions will be raised about how the system was designed, what the user's points of view were and how the system was extracted from the users, how the user's needs were implemented and evaluated during the design process

and how student learning was evaluated. These sets of questions were brought together as the aims of the study. The research presents a study of the design and evaluation of the online learning course and support system for the distance learning course in digital graphics. Thus, the aims of the research in particular are as follows:

a) to design both an online learning and support system for a digital graphics course using a user-centred approach. The design process was focussed on the user's needs and point of view, with their particular context as a significant aspect. In addition, an iterative design approach was used to model and evaluate the system during the design phase.

b) to evaluate student learning when using the system. In particular, the evaluation of students' learning takes into account several aspects such as different learner perspectives in learning, use of the system, their learning outcomes, students' learning processes and the mode of users' interaction in the learning process using the system. Finally, the evaluation of students' learning also focuses on the contribution of the system and support system to the students' learning.

1.3 Research Objectives

The main objectives of this research are divided into two phases; the design of the online learning course for the digital graphics course and the evaluation of the students' learning. The main objective of the design phase is to design the online learning system for the digital graphics course using a user-centred approach. Therefore, in order to achieve the aims of the study, the objectives of the research for this phase are:

- a) to design an online learning course for the digital graphics course in relation to the users' point of view, their needs and requirements, specifically in their context, and translate these into a design solution.
- b) to evaluate the online course during the design process through an iterative design process.

The second phase of the main research objective is to evaluate students' learning using the online learning system for the digital graphics course. In order to achieve this, some research objectives have been addressed. The objectives of the research are:

- a) to examine different learner perspectives in learning to use the system.
- b) to explore students' learning processes and their learning outcomes.
- c) to investigate the mode of users' interactions in the learning process using the system.
- d) to identify the contribution of the system and support system to learning.

1.4 Summary of the Chapters

Chapter 1 explains the aims and background of the study and the research objectives.

Chapter 2 offers a review of related literature, such as problems with online learning, user support, an approach to learning, a review of the user centred approach, literature about design methodology, short reviews on current virtual learning products and the user centred approach. The literature is also focused on the foundations for the design of the system and design principles of the online environment.

Chapter 3 illustrates the theoretical framework in relation to the design of the system. It also discusses Activity Theory, SUNA (Scenario User Needs Analysis) and an approach to design in relation to these theories and approaches.

Chapter 4 contains the research methodology of the study including the research questions. It also discusses the overall design and evaluation process of the whole study which is divided into three stages, namely the First Stage (User Scenario), Second Stage (Iterative Design) and Third Stage (Evaluation).

Chapter 5 explains the SUNA process in practice, corresponding to the user scenario and function hierarchy. This chapter also presents the results from the pilot test, iterative design and evaluation. It also demonstrates how the system was developed using the open source (Phpnuke), Apache server and MS SQL (database).

Chapter 6 explains the evaluation of the system, including the methods used, such as the monitoring programme, the online interview and user tracking.

Chapter 7 includes all four case studies and the rationale for the data analysis. This chapter answers all the research questions for the evaluation phase.

Chapter 8 explains the conclusions of the study in relation to different learner perspectives, the implications for design methods and the contribution of the system and support to learning. Finally, this is followed by suggestions for future work and the limitations of the study.

Chapter 2

Literature Review

2.0 Introduction

Chapter 2 reviews the significance of the learner's point of view in designing the online learning environment since a) the majority of the research in designing online learning environments is mainly about teachers, technology, instructional and institutional issues but the learner's voice and point of view is not examined in detail, b) there is an emerging consensus that user-centred approaches are more effective in educational contexts (Squires & Macdougall, 1994) and c) interactive approaches to pedagogy are needed with an emphasis on on-line collaboration (Dillenbourg, 1999).

Therefore, this chapter will explain the literature on students' problems and support in online learning, scaffolding, a review of other user centred design approaches, virtual learning environment products in use, iterative design and my approach to designing the system using a user-centred design.

2.1 Student Problems with Online Distance Learning

The main issues concerning students' problems with online learning can be divided into two sections, technical and pedagogical issues. Many researchers have identified technological problem as an issue. Questions arise, as to what kind of technological problems students have and their impact. Based on the literature, I have classified this problem into two parts as follows:

- a) Lack of knowledge in using the ICT facilities in relation to Internet technologies as reported by Hara and Kling (1999), Wegner *et al.* (1999), Ward and Newlands (1998), Arif (2001) and Stokes (2000).

b) Problems with hardware and facilities (Valentine, 2000). For example, many students had difficulty accessing course materials due to technical complications (Valenta *et al.*, 2001).

The technological problem provides a negative impact on the student during the learning process. The most popular research regarding this issue is reported by Hara and Kling (1999). They identified that the negative impact of a lack of technological skills will result in the student being frustrated and depressed. This finding was supported by Ward and Newlands (1998) and Stokes (2000). They reported that due to this problem, the students were not showing an interest in online learning. In addition, research by Riviera and Rice (2002) on learners satisfaction show that one of the aspects that diminish student interest in online learning is technological problems. It is clear that this problem is the main problem in online learning. Attitudes towards distance learning are also problematic; with new advancements in technology, more complex tools will be developed, which are more difficult to use (Valentine, 2002). Therefore, students must have the technological skills and confidence to use all of the web technology devices in order to be truly effective in using the web for learning.

Hardware problems can also have a major impact on the effectiveness of online learning, and when these occur, the entire course may be affected until they are resolved (Valenta *et al.*, 2001). Therefore, to prepare the student for online learning, this problem must be avoided in order to produce a quality learning environment.

I believe that this issue should be taken into consideration in designing the online learning environment since by giving support to the student this problem can be minimised. Several researchers have suggested some guidelines to resolve this problem. One is to prepare the students with ICT skills before enrolling onto the course (Lupo and Enrich, 2002). In contrast, research by Hilshiem (1998) on the students of Walden University showed that one of the criteria for online student to be successful in their learning was mastering ICT technologies in relation to Internet skills.

Another problem in online learning is lack of feedback from an instructor. This occurs because when the students are online they are isolated from their friends and course tutors. Therefore, feedback from the course tutor is important to avoid demotivation. This issue had been addressed by Wegner *et al.* (1999), Hara and Kling (1999), and Ward and Newland (1998). A survey conducted by Wegner on online learning students showed that most of the students were not getting feedback and direction from the course tutor during their learning sessions. In addition, the interviews carried out by Hara and Kling (1999) proved that one of the reasons why the students felt frustrated was that they were not receiving feedback from the course tutors. One of the student stated that this lack of immediate help made her web searching difficult and she felt isolated in the learning session.

Self management is also one of the problems in online learning, as identified by Stoke (2000). Most online students had difficulty managing themselves in the online learning environment, for instance finding time to spend on the coursework and learning to work independently in constructing knowledge.

In pedagogical issues, Hara and Kling (1999) emphasised that the design of the website should be clear and understandable to avoid confusion when using it. The problem raised by Hara and Kling (1999) was the ambiguous instructions on the web site that bring about frustration among students. The confusing and vague instructions in designing the web site could be interpreted in many different ways by the student.

Another issue is lack of social interaction with other students, such as face-to-face interaction, in an online learning environment (Hara & Kling, 2000). This circumstance produces depression and frustration (Hara & Kling, 1999).

The biggest problems reported by students were loss of contact with staff and with other students, lack of access to computers and technical frustrations (Ward & Newlands, 1998; Valenta *et al.*, 2001). These concerns imply that most of them need support from instructors and technical administrators in order to achieve their learning outcomes.

The design of online learning should consider the learners problems as a vital aspect before any design is made. Therefore, in this research, the design will take into account the students' problems in the online learning environment. The following section will discuss how user support can minimise the students' problems with online learning.

2.2 User Support

The significance of user support in the online learning environment was discussed by many researchers. Some of them gave several suggestions as to how to solve these problems. Robinson (1995) considers that one of the most important elements in online learning is how to support the learner. He summarises this point by stating that learner support includes interaction between the learner and instructor, such as learning activity feedback, personal contact and peer contact. Tait (1995) questions what the student needs in an online learning environment. He suggests that peer group support and feedback regarding assessment and progress are among the student's basic needs in learning. Based on the literature (Tait, 1995; Lewis, 1995; Robinson, 1995; Willis & Dickinson 1997; Weston *et al.*, 1999; Stokes, 2000; Arif, 2001; Scrum & Hong, 2002; Kling, 2002; Song *et al.*, 2004; Motteram & Forester, 2005; Kim *et al.*, 2005), I conclude that the type of support can be categorised into several elements such as the design of the online courseware, students' preparation towards online learning in relation to their knowledge of ICT, motivation and interaction with online activities.

From the perspective of the design of online learning, Motteram and Foresster (2005) and Song *et al.* (2004) suggested that the design should implement the user centred approach. For instance, Song *et al.* (2004) suggested that by providing a good instructional design website with a clear objective for the modules, student can focus what they want to learn. In fact, the design should consider the technical requirements of the student, should provide the student with online help, including technical and academic support and offer a step-by-step guide on how to use the online modules (Motteram & Foresster, 2005).

Some researchers recommended the active participation of students in learning to increase interaction with the tutors and other students and the role of the course tutor in monitoring the online environment (Kim *et al*, 2005 & Kling, 2002) in order to minimise problems due to lack of feedback. At this point, the interaction between learner and teacher is beneficial to providing meaningful learning (Laurillard, 1993). Therefore, this research strongly stresses that high level interaction should be provided to discuss students' problems during the learning session.

From the discussion above, I conclude the issue on the online learning problems that have a negative impact on the students. In this research, the main agenda is to design an online learning environment with learner support aspects using the user-centred approach.

Therefore, I believe that the role of interaction is necessary in assisting the student to deal with their problems. I also believe that preparing the platform and facilities for the student to interact can diminish this problem, particularly avoiding lack of immediate feedback and technological problems. This thesis suggests that the role of meaningful interaction and scaffolding elements should be implemented in the system design in order to minimise student problems in the online learning environment, as discussed above.

2.3 Learning Digital Graphics

The literature shows that the basic subject of a computer graphics course is geometry, lighting, perspective and 3D viewing and navigation. Most of the graphics students are from technical subjects such as computer science, engineering, maths or science (Hitchner & Sowizral, 2000). However, for student teachers, the computer graphics curriculum is more focussed on the theory, basic concept and its application in developing multimedia and online learning courseware. Therefore, the curriculum of the computer graphics was slightly different between the technical students and the student teachers. There is very little research about learning digital graphics from the literature especially from the student teacher perspective.

The curriculum of digital graphics courses was designed by the Faculty of Education in the University of Technology Malaysia in relation to the needs of the student teachers who enrolled in the Bachelor of Education programme. The aim of the course is to give an exposure to the student and prepare them with the skills of digital graphics in order to help them to develop the multimedia courseware in a web-based platform and stand alone CD-ROM. This course gives an experience to the students on the theory and basic concept of digital graphics. The discussion is focussed on graphics categories, graphics quality, type of graphics, software, hardware and graphics format. This course is a prerequisite course of other multimedia courses called Multimedia Development.

The following paragraph explains the literature on teaching strategies for the computer graphics course at university level. Although, it is slightly different from the student teacher context, the strategies could be useful in designing the online learning courses for the subject. In learning digital graphics, numerous approaches have been suggested by researchers. In the traditional classroom, Taxen (2004) suggested problem based learning methods and emphasized the teacher-learner interaction in group activities, for promoting higher order thinking among the students. However, with the advancement of Internet technologies, many course tutors used the online learning environment for teaching digital graphics. For example, Pan *et al.* (2005) implemented several learning strategies such as interaction with and the presence of other learners, collaboration, and communication in the learning process for learning digital graphics. It promotes a higher user interaction in the learning session. For instance, the user can receive immediate feedback from the system and contact the other users who are enrolled in the course. These strategies are in line with this research in terms of the use of the teacher-learner interaction in receiving feedback and giving a response, as suggested by Laurillard (1993).

Shabo *et al.* (1997) suggested that two aspects of support should be implemented in designing the digital graphics software. The supports are a) coaching, which allows the learner to build the artefacts and b) eliciting articulation which allows the learner to share their knowledge in discussion groups.

From the discussion above, I summarised several learning strategies that are appropriate to be implemented in the design of online learning in this research. Some of them are a) promoting active engagement in group activities, b) sharing their knowledge in discussion groups, c) interactive learning, d) promote active learning among the students and e) coaching the learner to build knowledge. These aspects are actually suitable for the concept of ZPD in this research that is engaging the students to learn the digital graphics curriculum by providing meaningful interaction and teachers are involved in coaching and guiding learners.

2.4 Approaches to Learning Design

Designing online learning includes using hypertext and hypermedia technology, since these are the two important elements. However, learning in the hypertext and hypermedia environment can be complex and complicated. Some of the problems are understanding navigation, access and making sense of what is provided. Hammond and Allison (1989) identified four problems associated with hypertext and hypermedia in learning including disorientation, lack of understanding, access problems and ineffective learning strategies. In fact, these problems give a challenge to the designer to provide the effective use of hypermedia and hypertext in their courseware. Dunlap (1997) emphasised that the use of hypermedia and multimedia applications would lead to a complex learning environment and could leave users feeling confused and frustrated. Therefore, Dunlap (1997) suggested the need for user support in designing hypermedia learning environments. The support included providing the users with navigation tools to help them to access information in hypermedia and multimedia applications. In this research, this support should be taken into consideration in designing a user-centred system. Therefore, by providing support and scaffolding in learning using hypertext and hypermedia, I believe that it can minimise a students' problems in learning using these elements.

In this research, scaffolding is used for assisting and preparing the students with the support and help for them to learn through a self-driven approach. In order to support the student dealing with the problem, several types of supports have been provided throughout the system such as asynchronous, synchronous tools and FAQ's. For instance, for assisting the

students to manage technological problems, scaffolding offers a platform for them to interact with the technical assistant using a chat session and forum. In the virtual learning environment, the effective design of hypermedia and hypertext will provide the learner with easy navigation and access to the content. Therefore, the system should be designed in a user-friendly environment with a complete navigation system and clear cut instructions. For the process of knowledge building, the research emphasises the interaction process between course tutors and students as an important element in learning. Therefore, the system will provide support such as asynchronous and synchronous tools for promoting high level interaction in building knowledge of digital graphics.

2.5 Design Methodology

The Waterfall Model was the first design model. However, there are many problems regarding the waterfall model such as a) user contact in the design process is too little and b) not many iterations in the design process. From the weaknesses of the waterfall model, some new models were introduced that emphasised the high involvement of the user in the design process, such as the Rapid Prototyping Model and iterative design methods. For example, the rapid prototyping model emphasised the collaborative design between the user and designer and involved extensive formative evaluation throughout the design and development process (Trip & Bichelmeyer, 1990; Jones & Richey, 2000; Jones *et al.*, 1992). Another model of development that combined the waterfall and prototyping models is Boehm's Spiral Model. This model represents the development process as a spiral and supporting the iterative approach in the design process. However, this model does not allow change to occur in the process of development. The advantages of the Boehm's Spiral Model are that the evaluation process is considered as part of an iterative design and it also stresses the user-centred approach.

For this reason, on the basis of the weaknesses of the waterfall model and the advantages of the Rapid Prototyping model and Boehm's Spiral Model, I decided to use the iterative design model in the research. Clearly, these two models are concerned more on learner

involvement and their point of view in the design process. In fact, these models have the benefit of supporting iteration. Literature from the Rapid prototyping Model shows that user involvement and point of view are important in the design process. In the research, the role of the user is providing feedback about the design, user interface and instructional strategies in their particular context through the iterative process of design and evaluation.

2.6 A User-centred Approach

Most of the instructional design models do not emphasise the user context in the design process. This is important due to the user context representing user needs and requirements in designing the system.

In the ADDIE model, Molenda *et al.* (1996) suggested that the development process must go on with a number of stages such as Analysis, Design, Development, Implementation and Evaluation. According to them, one of the parts in the design process is needs analysis which emphasises learner characteristics, learning style and learner needs. Molenda *et al.* (1996) stated that learners need to determine the objectives and content in designing the educational software. I agree that the ADDIE model emphasised the importance of learner needs in designing the system. This is because at one stage the ADDIE model suggested an analysis of the needs of the user. However, the approach is not focussed on the actual context of the learner. For instance, this model did not suggest how to capture the learner's needs in the context of the learner, their point of view and their participation in the design process.

Another model which has been used but did not emphasise the user context is the ARCS model. The ARCS model is a motivational model and was introduced by Keller (1983). Duscastel (1997) adopted the ARCS model in designing the online learning environment. This model gives a guideline to design the system to increase the motivational factor of the learners. For example, several strategies must be implemented to increase learner motivation such as gaining attention, relevancy of the material, confidence

and satisfaction. However, this model is more focussed on the learning strategies but does not emphasise the user context and participation in the design.

Again, for this reason, I adopted the user-centred approach for development of the online learning environment. The reason is simple; I believe that most of the models have less emphasis on user context, their involvement in the design process and their point of view. Therefore, to meet the aims of this research, which is to design and evaluate an on-line course, I used a user-centred approach in the design and evaluation process. The following section will discuss previous work on user centred design methods.

2.6.1 User-centred Design

User centred design is one process that has helped the design of software that fulfils users' requirements by actively involving real users in the design process (Abrams *et al.*, 2004). Consequently, this approach involves users' active participation in the design process, particularly focusing on human-centred design.

Participatory Design

Such participatory design is one of the approaches that places an emphasis on active participation of the user in the design and in the development of the product. It also stresses the significance of group involvement (Sanoff, 2007) and design collaboration of the user (Carroll & Rosson, 2007; Luck, 2007). This aim is to ensure that the end product, will more effectively meet user needs and requirements. Users have very close links with the designer in order to define the problem and focus the idea to provide a solution (Davies, 2007).

In many cases, this process involves a variety of participants in different groups such as the management team, people who work their area and others (Davies, 2007) but who have tacit knowledge of the context. Nowadays, participatory design methods have been applied to several design domains such as software development, architecture (Luck, 2007), informatics systems (Carroll and Rosson, 2007), computer hardware design (Lindgaard &

Caple, 2001), virtual reality (Davies, 2004) and virtual learning environments (Carrol *et al.*, 2000).

However, this approach can bring some weaknesses e.g. resulting in a lack of clarity in the design process (Pilemalm *et al.*, 2007) and too much time being spent and with a high amount of effort from every user during the design process (Lindgaard & Caple, 2001). In fact, people who are highly involved in the design process may reduce their enthusiasm during the many workshop sessions.

In brief, although the participatory design approach is similar to other user centred approaches, it places an emphasis on the high involvement of the user in the design process, and this brings differences from other approaches to design different from the others.

Contextual Design

Contextual design is another of the user-centred design approaches that have been used. It emphasises the importance of people working in the context and how they work (Beyer & Holtzblatt, 1999). It also relies on customer needs in collecting and interpreting data that reflect their requirements. Hence, the process in contextual design involves determining peoples' needs, what the system has to perform in order to service them and finally how the system needs to be structured (Beyer & Holtzblatt, 1999). Specifically, the techniques in contextual design (Beyer *et al.*, 2004) require the designer to do the following steps:-

- a) Contextual inquiry – understanding the users by analysing how they work in the particular context.
- b) Work modelling – provide the individual work and transform into the diagrams.
- c) Consolidation – identify the needs of the user by collecting data from the individual.
- d) Work redesigned – the process of integrating technology to improve work based on consolidation data.
- e) User environment design – show how the system supports the user's needs and what the system can do for the user.
- f) User's mock-up test – testing with the user for verification and validation of the system.

In contextual design, people are also involved in the design process but it is the designer who needs to understand the user first. However, it provides a systematic approach for collecting a users needs, but again time and effort are the major issues in using the contextual design approach. It actually requires several experts, consumes much time and financial resources (Kallio & Kekäläinen, 2004) in the design process. Therefore, there is a need for a design approach which is easy to conduct and apply, which is systematic, reduces development time and also focuses on the user context, their needs and requirements.

In a Malaysian scenario, designing e-learning using the user-centred approach is appropriate but requires the involvement of many teams from different fields such as teachers, students and administrators. The design must meet criteria that fulfil their needs. For instance, in the context of learning, the design must be appropriate and fit with the students learning environment. This should offer flexible learning, which is learner-centred and provides tools that can foster meaningful learning. At the same time, students have to be provided with support for their learning and technical help in order to enhance their understanding. This brings a great challenge for choosing the best user-centred design approach that can meet their wants, needs and requirements.

As discussed above, contextual and participatory design are methods of user-centred design that are widely used in designing the product. However, both of them require a high commitment of involvement from the experts, need much time and can be very costly to implement. Therefore, taking this into account, I decided to use an alternative method called SUNA. SUNA is focused on the user's context and brings clarity to the design process, is economical on effort but focuses on the user's needs by engaging them in the design process.

SUNA

Scenarios is a practical method to obtain, analyse and communicate users' needs (Chin & Rosson, 1998).By getting a feel from the users, the designers can then try to guess what

they will need to doⁱⁿ their tasks and eventually implement their thoughts through the development of the system. Carroll (1999) described scenarios from many different perspectives. He concluded that scenarios are stories which contain an agent and actor, which can help the designer to understand people and their activities. Scenario-based design takes account of the principle that human characteristics and needs should be considered in the design of tools and artefacts (Rosson & Carroll, 2002; Carrol *et al.*, 1998). According to this idea, SUNA used the user scenario as a vital element in the design process. The principle of scenario is adaptation, involving the users writing, validating and eliciting the scenario in the design process. SUNA is one of the methods for software development in imagining, clarifying and refining the ideas from groups of people (Helvert & Fowler, 2003). It is a collaborative method for picturing the scenario with a concentration given to user needs and adapting them to the technologies. According to Helvert and Fowler (2003), SUNA consists of several features, including a) narrative – containing the story and the structure, b) collaboration - collaborative activity, c) dialogue – communication among team mates, d) flexibility – a flexible process, e) user focused – the user is the main focus and f) compatibility with existing design methods. Gardner *et al.* (2003) proposed the SUNA method in associating technology and pedagogy in designing an e-learning system. It involves several simple stages such as a) scoping and writing of key scenarios, b) scenario validation, c) eliciting needs and d) use-case description and storyboards.

The idea of SUNA actually involves the learners in high order participation in the design process. For example, the design process can be broken down into four major steps; setting the scene, writing scenarios, extracting user needs and mapping technologies to needs (Helvert & Fowler, 2003). The first two processes involve the learners in writing the scenario and discussing the needs in groups. At this stage, the learner participates in producing their needs regarding their context and situation and it places the users at the centre of the process. In this process, the user scenario is considered as a design tool.

SUNA is systematic approach from user scenario but the other user centred methods do not have this. Other system methods are costly and need a high involvement of the user in the

design process while SUNA only stresses scenario which represents user needs. This can reduce the development time. In fact, other design methods are not appropriate to implement in this research due to their high costs and high time consumption which is a major barrier to implement in the research. In summary, the main justifications for choosing SUNA were:-

- a) It uses a systematic approach in identifying user needs in other particular contexts but does not require as many phases in the design stage as contextual design approaches.
- b) It provides a practical approach in organising the outcomes of the scenario as user needs are known, and in mapping user needs to the technology.
- c) It saves time and effort when used as a design tool.
- d) It requires the student to write the scenario and the designers to extract their needs from their particular context. It will reduce time therefore for the user to identify their needs within the design process.
- e) It employs economy of user involvement in the design process.

SUNA gives a practical approach to extracting user needs by presenting the activity, action and operation as a function hierarchy and this helps the designer to structure their system based on user needs. Therefore, SUNA provides a practical design approach compared to other design approaches such as contextual design and participatory design.

2.7 Foundations for the Design of the System

In the Zone Proximal Development (ZPD; Vygotsky, 1978), the student development process, the guidance can be achieved under collaboration with a competent and knowledgeable person (Schutt, 2003). In this situation the notion of ZPD is inline with the human interaction between the learner and the teacher. For example, in learning, using guidance, knowledge can be gathered from the teacher or experts. This kind of interaction can occur through the collaboration and personal interaction between the student and their teachers (Chen, 1995). Therefore, at this point, scaffolding can also be understood as a meaningful interaction between humans in the learning process. In this case, McLoughin,

et al. (2000) states that scaffolding is used to describe a type of support which students receive in their interactions with the tutor, who is an expert in developing new skills, concepts and levels of understanding. In fact, this study is built around the idea of a zone of proximal development. However, scaffolding uses the metaphor of ZPD to show how learners can be supported and guided in their learning. Scaffolding also involves using the tutor or peers to support the development of the learner (McLoughin, *et al.*, 2000). In the online learning environment, the support system can provide scaffolding to assist learners to attain new skills and knowledge.

This study emphasises the role of course tutors in providing assistance to students. The type of scaffolding is more about coaching and mentoring the student in dealing with learning problems. However, the online support facilities are also important features in embedding the scaffolding in the online learning environment. Thus, the following section will discuss the various online support facilities for the design of the online learning environment.

2.7.1 Design Principles for the Online Environment

The literature shows the importance of scaffolding in the online learning environment. However, in this study scaffolding is focussed on human interaction and various online support facilities. Many researchers have adapted the Vygotsky learning approach to the online learning environment. For instance, Hung (2001) suggested twenty one web design considerations in relation to Vygotsky's thoughts. From seven Vygotskian thought principles, Hung (2001) elaborated twenty one design considerations for the web based learning environment. Some of the design considerations particularly explained the significance of learner support such as a) creating a scaffolding in the online environment, b) embedding with facilitating tools for involvement in the activities, c) allowing high level interactions among the students with the collaborative process. d) providing personalised content for the user in the context of activities, e) tracking the user profile and progress for the student and f) preparing the independent learning on a must-know and need-to know basis.

According to Hung (2001), the design of web based learning should have this element in order to support the learner. The use of web tools such as forum, user tracking, chat and concept maps are strongly recommended for implementation. From the literature, I categorize several aspects to support the student in the online learning environment as follows:

a) Learning Strategies

Learning strategies are one of the vital elements in online learning. Huang (2002) summarised the design principles of online learning in relation to the constructivist learning environment, including interactive learning, collaborative learning, facilitating learning, authentic learning, learner-centred learning and high quality learning. With these types of learning, students will be actively involved in the learning session and this will help them to solve problems or build their own knowledge.

Conole (2004) suggested that online learning should emphasise student centred activities and their engagement which can promote an active learning environment. Therefore, the role of expertise is important to support and guide the student for participating in the activities.

b) Coaching and Mentoring

Rovai (2004) emphasised the course tutor and student role in constructing the learning environment, ~~the on/web~~, for instance, the role of the course tutor as collaborator, tutor, facilitator, encourager and community builder. The role of the student is changed to be active and self-monitoring, a collaborator and constructor of knowledge (Rovai, 2004). Therefore, the constructivist web-based learning environment should be provided with the tools that can support topic-based discussions, peer critiques and role-playing.

Schutt (2003) stated the significance of scaffolding through the virtual interaction between the teacher and student. He claimed that the user interface environment should be designed

to support students' interaction and proposed several principles of design such as organising the information in chunks, coaching, incorporate modelling and providing mentoring.

c) Providing Good Design for the Website

McLoughin and Marshall (2000) divided learner support into two main categories. The first category is supporting the skills to learn and the second one is supporting the learning process through the design features. In order to support the skills to learn, they listed a few design principles as follows: a) support student interaction with goal setting, b) support the student with independent study strategies, c) promote reflection and self monitoring and d) encourage self regulation through the task design. In this article, they provided the use of web features that can support this element such as a forum, web resources and students' journal. To support student development, they propose an online module about how to learn online, with a study timetable and guidelines to set a goal plan. Students can also make use of the online journal in order to formulate reflection by recording their progress and difficulties, and report their strategies in the learning task.

d) Creating Meaningful Interaction

Laurillard's approach (Laurillard, 1993) to learning emphasized the role of dialogue and the interactions between teacher and student in the activity. Her model also highlighted the importance of feedback from the teacher for student conceptions and tasks. She also proposed that the characteristics of effective teaching can be classified as discursive, adaptive, interactive and reflective (Laurillard, 1993). For discursive characteristics, her view stated that teachers must offer an environment for the student to learn, build and receive feedback that is associated with the course objectives. Interactive means that students have to perform to gain the task goal and teachers should provide feedback for them on their actions. Reflection indicates that the teacher has to support reflection on goal-action-feedback. In the learning process, she proposed that it must be composed from dialogue between teacher and student. Her approach was actually suitable with ZPD

because it described how teachers structure learning according to student responses and it captured the dynamics of interaction between teacher and student.

e) A Rich Resources Environment

Wilson and Lowry (2000) have introduced three core principles for the effective use of the web for learning: a) provide access to a rich sources of information, b) encourage meaningful interactions with content, and c) bring people together to challenge, support, or respond to each other. The first principle emphasises the importance of the web as a digital library for the student. Besides that, the second principle stresses the significance of meaningful interactions with the content. For example, the use of concept maps and hypertext are one of the approaches to increase the meaningful interactions with the content. The final principle explains about student involvement to generate an effective web based learning environment. Tools such as a forum, chat and email can be used to support higher order engagement among the students.

Through the web atmosphere, the learner can actively seek and explore a rich resource environment (Huang, 2002). In fact, web technologies can provide support for online learning, with the use of hypertext links and a hypermedia ability to help the learner to be actively engaged in constructing their knowledge.

f) Good Learner Control

McLoughin and Marshall (2000) also emphasised the importance of learner control in the online learning environment. They claimed that good learner control could support the learner through the design principle. This could be done by providing good navigational tools in presenting the course content (Mishra, 2002).

g) Technological Support

As discussed in Chapter One, technological support is one of the significant aspects in online learning. Therefore, McLoughin and Marshall (2000) suggested that technological support can be created from the hyperlinks resources. Weston *et al.* (1999) emphasise that students should have the prerequisite of computer literacy skills (including online social conventions) in order to succeed in this type of instruction. They should also have the ability to use the web technology effectively, or be provided with proper training.

Stokes (2000) and Sayenye *et al.*, (2001) suggest that preparing students to take online courses involves more than teaching technical skills. In addition, they should be provided with online technical training to ensure that they have the skills to use web tools such as discussion boards, electronic mailing lists, sending attachments, downloading software, searching for data, managing e-mail and web resources and publishing their work to the web. In order to help students overcome their technological discomfort, support resources should be provided, for instance, to guide them through the online environment by using CD and video tutorials before they begin the course (Scrum & Hong, 2002).

In the present study, the learning environment will allow students to complete their tasks through group activities and discussion. The support system contributes to the learning process and scaffolds the learner in developing competencies and confidence in social interaction. Students will use the support tools such as synchronous and asynchronous tools such as scaffolding in their learning environment. For instance, when the student is having problems communicating with their instructor using e-mail because of lack of skills or familiarity with the e-mail system, the support tools will provide them with a platform to discuss the problem with the appropriate person.

2.8 Implications of the Design

Based on the literature, in order to design an effective online learning environment, I have summarised several design considerations as follows:

No.	Design Principles	Tools	Literature about the Design of Learning and Support
1	Provide high interaction among students	Forum Helpline Chat sessions Private messages Who is online	Motteram and Forester (2005); Hung (2001)
2	High learner control	Concept maps Hypermedia and hypertext Printer-friendly version Who is online	Song <i>et al.</i> (2004); Wilson and Lowry (2000); Mishra (2002); McLoughin and Marshall (2000)
3	Provide immediate feedback to students	Helpline Chat sessions Private messages	Kim <i>et al.</i> (2005); Motteram and Forester (2005); McLoughin and Marshall (2000)
4	Provide the student with computer literacy and web technology knowledge	Online training	Motteram and Foresster (2005); Song <i>et al.</i> (2004); McLoughin and Marshall (2000)
5	User friendly design with user context elements	Theme	Hara and Kling (2001)
6	Clarify the role of learners	Student page	Kling (2002); Rovai (2004)
7	Provide the student with a rich resources learning environment	Weblinks Hyperlinks	Wilson and Lowry (2000)
8	Create an independent learning environment that can encourage the student to manage themselves in the online learning environment	Navigation concept maps	Schutt (2003)
9	Provide an environment where the students can	Asynchronous tools Synchronous tools	Huang (2002); Mishra (2002)

	share their problems and help each other to solve them		
10	Design the learning with goal setting and guidance for the student	Course objectives Course guidelines Course activities	Arbaugh (2004); Song <i>et al.</i> (2004); McLoughin and Marshall(2000);
11	An exploratory learning approach	Search engine Hyperlink Weblinks	Mishra (2002)
12	Peer support for the student	Helpline Technical assistant Moderator	Tait (1995); Lewis (1995); Song <i>et al.</i> (2004); Motteram and Forester (2005); Schutt (2003); McLoughin and Marshall (2000)
13	Provide guidance on using the system	Online training FAQ's	Motteram and Forester (2005)

Table 2.1: Design Principles of the System

Table 2.1 above indicates the design considerations discussed in the previous section. Design principles are a key component of any online learning package. A good design element can help students to achieve their learning objective, thus increasing the effectiveness of the system. Therefore, the list of design principles, as shown in Table 2.1, were used for designing the final system. The next section will discuss the reviews on other virtual learning environments in use.

2.9 Short Reviews on other Virtual Learning Products

Nowadays, the use of a Learning Management System (LMS) such as WebCT, Blackboard, FirstClass and Moodle offer the greatest value to administrators and teachers in preparing an institution to deliver course materials to students (Bean, 2003). However, many LMS products have disadvantages in relation to a failure to take into account user needs in the design and interface confusion as reported by Siemens (2004). The next sections will

discuss the reviews of other commercialised and non-commercialised virtual learning environment products including Moodle, WebCT and FirstClass.

Moodle

Moodle is free e-learning courseware designed to aid the teacher in building an effective virtual learning environment (Moodle, 2007). The design of Moodle stresses some pedagogical principles including constructivism, social constructivism, and connected and separated constructionism (Moodle, 2007). It also offers some interactive features for the student to contribute and share their knowledge together such as forums, resources, quizzes, blogs, encyclopaedias, surveys, chats, peer assessments and glossaries.

Although, Moodle has some features that prompt the users to construct their knowledge and engage in the web activities, it still has a very static graphical user interface. The course developers have to design their course content with the Moodle interface without having the flexibility to add and create their own features and this creates some inflexibility in design. The design itself does not emphasize or accommodate the students' opinion and point of view in the design process. For instance, if the students feel that the interface is not suitable for them, Moodle does not have the flexibility to change it on the basis of the students' suggestions. Therefore, the design may be narrowly focused. This is important because the system should be designed by involving the user in the design process, to ensure that it can fulfil the users' needs.

WebCT

WebCT was developed in 1995 by Goldberg (1997) and recognised as the first commercial set of e-learning tools. Web CT is an e-learning application that allows the teachers to add their learning materials online and is supported with the interactive tools such as discussion boards, mail systems and live chat. Nowadays, WebCT has been used by over 10 million users in 80 countries (WebCT, 2007).

Although, WebCT is a world leading e-learning application, it still has been the subject of criticism due to the browser incompatible problems, heavy java application, and limited flexibility (WebCT, 2007). It also requires some high development time for new courses (Dunn & Lingerfelt, 2004). However, in design perspectives, WebCT is not created for student involvement since it is only focussed on helping the teacher to prepare their online course materials.

First Class

FirstClass is a high level communications system that integrates several communication features in one package and is widely used in virtual learning environments all over the world (FirstClass, 2007). It provides the user with a highly interactive communication service and promotes the sharing of information and knowledge among the users through email, conferencing, directories, individual and shared calendars and online chats (FirstClass, 2007). It also allows the user to communicate in different platforms such as mobile phones, telephones, personal computers, web browsers and personal digital assistants. The design of FirstClass was focussed on the collaborative interaction among the users. However, the tools were built for easy communication but not created for the development of large scale course materials.

Many virtual learning environment products do not emphasise user needs and their requirements during the development stage. As a result, the user interface and facilities including tools and the system itself, may not properly fulfil the students' needs in their learning context. This is due to the fact that the aims of development of the product may focus on the teacher but not give opportunities for the student to design the course features based on what they want.

Taking this into consideration, the system that was designed in the research takes a more student-centred approach. It takes into account the student needs and gives flexibility for the student to design their own e-learning system in relation to their needs and

requirements. However, as discussed above, the other virtual learning environment products do not emphasise this facility and are more focused on teacher-centred design.

As discussed above, the design of LMS^s is focus^{ed} on the needs of the designer and administrator rather than the system's end user such as students (Siemens, 2004). He suggests that LMS vendors should redesign the systems to reflect the needs and requirements of the end user. For instance, the Blackboard system is based on a teacher centred model (Winter, 2006) rather than being student centred. Morgan (2003) reported that the design of LMS brings no autonomy to the instructor's teaching and diminishes student learning. The design of LMS is heavily structured and makes the staff feel that they have low control in their teaching. Instructors reported that some of the features of LMS are difficult to use and it is unsuitable to be used for particular disciplines. On the behalf of the student, many of them feel that they had poor technology skills in using the system and were unmotivated to use the system (Morgan, 2003). In addition, findings from the research by Lassila and Pöyry (2007) show that one of the barriers of LMS is a lack of interface design. Therefore, the design consideration must emphasis the user needs in the design process in order to overcome this problem. From the disadvantages of the LMS, the main concern is how to provide the^a system that emphasises user needs and requirements in their particular context in designing the Virtual Learning Environment. Other Virtual Learning Environment products are not suitable in this project due to:

- a) LMS is a more teacher centred approach (Winter, 2006) whereby a student's point of view and needs are not addressed in the design of the learning environment.
- b) Lack of user needs in terms of the design of recent LMS and less focus on the end user including students (Siemens, 2004).
- c) The importance of user needs and their context is not the focus in designing the VLE.
- d) The design is heavily structured (Morgan, 2003) and there is low control in implementing user needs into the design.

Taking the above points into consideration, I intended to design and build my own system in the research, that focuses on user needs and their context. It gives me a greater control in

implementing user needs into the system design (course materials and system features) which other VLEs cannot perform. In addition, the system will be designed using the criteria outlined in Table 2.1 above as a theoretical underpinning.

2.10 Conclusions

This chapter discusses the need for learner support in online learning environments. Numerous issues have been discussed including technical issues, pedagogical issues and the digital graphics curriculum. From the background of the issue, I consider the use of scaffolding in supporting the learner and teacher-learner interaction approaches before developing a user centred approach system. Scaffolding is an appropriate approach for supporting students in learning using the system. In addition, teacher-learner interaction is important in assisting the students to understand the concept of digital graphics. In order to promote the interaction, the system offers synchronous and asynchronous tools in helping the teacher provide and receive feedback from the students.

The question will be raised as to what approach is suitable for designing the system. Therefore, an iterative design approach has been adopted since this approach has some advantages and is quite useful in designing a user-centred system. The strength of iterative design can be seen in the recent model of development such as the Rapid Prototyping Model and Boehm's Spiral Model. In the Rapid Prototyping Model, the iterative method is used for evaluation of the first prototype, including usability testing for the system and a redesign process based on user needs. It helps me to design the online learning environment from the users' point of view and context and therefore fulfil the aim of the study.

Finally, the final section discusses the theoretical underpinning for the design with the support from the literature and short reviews of other virtual learning products and justifications on why I chose to develop my own system in this research.

Chapter 3

Theoretical Framework

3.0 Introduction

There is a need to study the virtual learning development in context since it can help the designer to understand the problem and real situation in a structured way. Therefore, I propose to use Activity Theory as a theoretical framework for the design of an online learning environment since it gives a practical approach to understanding human activity. In addition, we will use SUNA as a practical method in a) organising and eliciting user needs and b) mapping the user needs to the technology.

Chapter 3 explains the use of Activity Theory and SUNA as the theoretical framework for designing the online learning environment for the digital graphics domain. It provides an explanation of my approaches in designing the system using this method.

3.1 Activity Theory

Activity Theory is a realistic framework that provides a concept and techniques in analysing and understanding human activity with technology in their contexts (Kutti, 1995; Mwanza, 2000; Kaptelinin & Nardi, 1997). It was developed from the ideas of Vygotsky and Leont'ev. From the use of Activity Theory, the designer can gain some understanding about how users employ computers in the context of real activity and then use it as tool in extracting their needs from the real system. An Activity System is a useful framework for analysing, describing and evaluating the context and dynamic interactions since it gives an ^{framework} outline to describe the interaction between a subject and their environment. The various components of Activity Theory can provide a basic understanding of work analysis and tool design. Activity Theory has been used in a range of contexts that make use of digital technologies, as the following brief review shows.

The CANDLE (Cooperative and Network Distributed Learning Environment) project is a European e-learning project (Earle & Stevenson, 2000). According to Batlogg *et al.* (2000), the objective of the Candle project is 'to use the Internet to improve the quality and reduce the cost of ICT teaching in Europe by using web and multimedia technology, and to enable co-operation between universities and industry in creating and reusing learning materials and improving the quality of delivery' (Batlogg *et al.*, 2000). The Candle project also emphasises three importance aspects in order to achieve the high quality of the system. It includes technology, pedagogy and assessment (Batlogg *et al.*, 2000). In the design perspective, CANDLE is built around a cultural-historical Activity Theory (Earl, 2002; Wetterling & Collis, 2002). This theory was used in the CANDLE project by examining the activities that are carried out by the subject using the learning materials in the system as a benchmark to understand its relationship (Sharma, 2003).

Scalon and Isroff (2005) studied the evaluation of learning technologies using the Activity Theory framework to explain and understand learning episodes. They found the activity system useful for examining the interaction between rules, communities and the division of labour and for studying the importance of the reciprocity between features of the learning situation in influencing difference outcomes.

Many researchers (Tweddle *et al.*, 2000; Bottino *et al.*, 1999; Lim and Hong, 2003; Scalon and Isroff, 2005; Lim and Chai, 2004; Vanderberg, 2005; Mwanza & Engestrom, 2005; Jonassen & Murphy, 1999; Quek & Alderson, 2002) apply the Activity Theory framework in order to understand the user context in certain situations. Lim and Chai (2004) used the Activity Theory approach to look at the integration of ICT in Singaporean schools by providing the students with higher order thinking activities. The findings from these two case studies show how the activity system (ICT-based lesson) reflects the role of the teacher in supporting learner autonomy to encourage reflection on learning activities.

Bottino *et al.* (1999) used the Activity Theory approach to design and report on research related to the use of the computer in education and training both in primary schools and technical enterprises. The analysis was based on the relationship between activity (object-

activity), subject (activity-object) and subject and community. Tweddle *et al.* (2000) used the Activity Theory framework as a guideline in analysing website evaluation data for learning about cancer. The analysis focused on individual perspectives, purposes and outcomes in the activity system. The method successfully evaluated the nature of the engagement of those using the website, as well as their objectives and outcomes. Mwanza and Engestrom (2005) applied the Activity Theory framework in managing content in an e-learning environment. The project called Lab@Future was focused on the use of technological tools such as virtual reality, 3D and mobile technologies to produce innovative tools for supporting teaching and learning for selected high schools in the EU (Mwanza and Engestrom, 2005).

Activity Theory is not only used for understanding the student context but is also applied to system development. Uden and Willis (2001) applied this method to the design and evaluation of a tourist information kiosk. The ideas and issues surrounding Activity Theory were useful in examining the interaction between the subject (student) and their environment.

From the literature, I conclude that there are several advantages of using Activity Theory for development of the system as follows:

- a) It provides an approach to understanding the complexity of interaction in context, for example the relationships between humans, activities and communities.
- b) It helps the designer to understand the context in computer supported activities during the design and evaluation process.

In this research, the framework of the Activity Theory was also used to analyse the data in the evaluation of the students' learning. This is because Activity Theory also provides a systematic approach in understanding the interaction between the subject and their environment. The analysis of the evaluation data using this approach enabled me to identify the meaningful interactions and therefore to examine the outcomes of the study. In more detail, every interaction, for example the interaction between subject and tools were

analysed and the relationship between these interactions with the outcomes were more accurately determined.

I argue that the Activity Theory framework can give a practical approach in two ways, especially in designing a virtual learning environment. Firstly, it can give the idea of understanding human activity in context. At this stage, the interaction between the subjects and their surroundings such as rules, tools, communities and division of labour provide an in depth study of activities in their particular context. Secondly, Activity Theory can help the designer to organise the outcomes of the users' needs from the gathered scenarios. I claim that the concept of hierarchical structure of activity, including actions and operations, offers a practical approach in organising the users' needs as a useful checklist before the development of the learning system.

3.2 Activity Theory and SUNA

Figure 3.1 illustrates the links between Activity Theory, SUNA, user scenarios and function hierarchy. In order to explain this figure, I divided the discussion on Activity Theory, SUNA and the design outcomes to show the combination of these approaches.

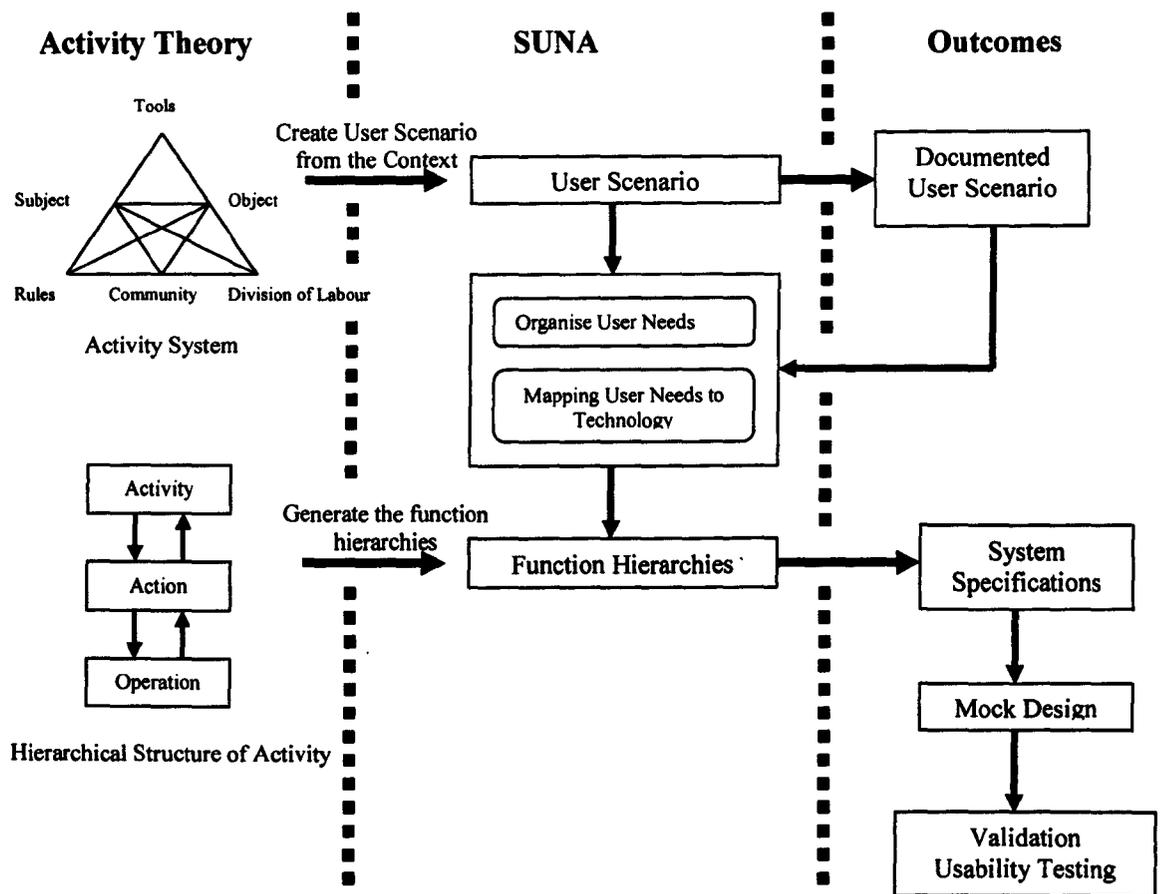


Figure 3.1: The Relationship between Activity Theory and SUNA

The scenario actually represents the user context ^{and} but what is the best practice/approach to:

- extracting the user needs from the scenario
- mapping the user needs from the scenario to the technology
- evaluating the user needs iteratively in order to meet the users requirements.

SUNA gives a practical approach in extracting the users' needs from the scenario and then mapping it with the technology. The function hierarchy that is provided in SUNA was used in order to help the designer to organise the needs and map it with technology. As discussed above, we used the concept of a hierarchy structure of activity i.e. activity, actions and operations in organising the needs and transforming them to the function hierarchies. Then finally, the system was developed according to this function hierarchy.

We argue that the function hierarchy represents the user needs that have been extracted from the scenario and the hierarchical structure of activity provides the framework for function hierarchies and it is related to the Activity Theory again and SUNA in particular, which gives the design approach of how scenarios can be created and organised.

In summary, it is the combination of Activity Theory, SUNA, user scenario and function hierarchies that offer effective design methods to design a virtual learning system that emphasises the user context. Firstly, an Activity Theory framework acts as a foundation to create the function hierarchy based on the multilevel structure of activity. Secondly, SUNA enables me to manage the user scenario to transform into the function hierarchies. Thirdly, the set of function hierarchies provides tools for me to design the system based on user needs and requirements.

In order to design the online learning environment, Activity Theory will:

- a) Use an understanding of the user context. (the activity system – subject, tools, rules, division of labour, community)
- b) Organise outcomes from the user scenario (hierarchical structure of activity – activity, actions and operations)

This was done by analysing their interaction with i.e. the community, rules, division of labour and tools in order to examine the role of the user in that particular context. Then, the scenario was created from the outcomes of the human activity and from the analysis of the activity triangle. The scenario actually represented the user context, and SUNA is used to extract the user needs from the scenario, mapping the user needs from the scenario to the technology and finally to produce the function hierarchy from the idea of hierarchical structure of activity.

The following paragraphs explain in detail about the connection between Activity Theory, SUNA, user scenarios and function hierarchy, to the rationale of the design methods that have been used in the research.

3.3 Application of the Activity System

Activity Theory allows me to pursue the aims of this research by helping me to understand the complexity of interaction in the users' environment. It also helps me to define the users with their different individual features and therefore use it as a practical approach to develop the tools. It also aids me in understanding the real context of the subjects (people) who are involved in the system especially their activity, their environment and the tools involved in the activity system. In order to explain how I have applied this theory for the Malaysian context, Figure 3.2 demonstrates the complexity of interaction in the Activity Theory triangle. The subjects of the activity in the present research are the online learners and the tutor, who is partially involved in the system. The context of the research is the Malaysian online learners and a tutor who is enrolled in distance-learning courses in Malaysia. The subjects are in-service teachers, working in Malaysia's secondary schools and at the same time being part-time university students. Most of them have between 5 and 10 years' teaching experience with very minimal qualifications, for instance the Malaysian Certificate of Education. These student teachers, mostly females, generally range in age between thirty and late 40s.

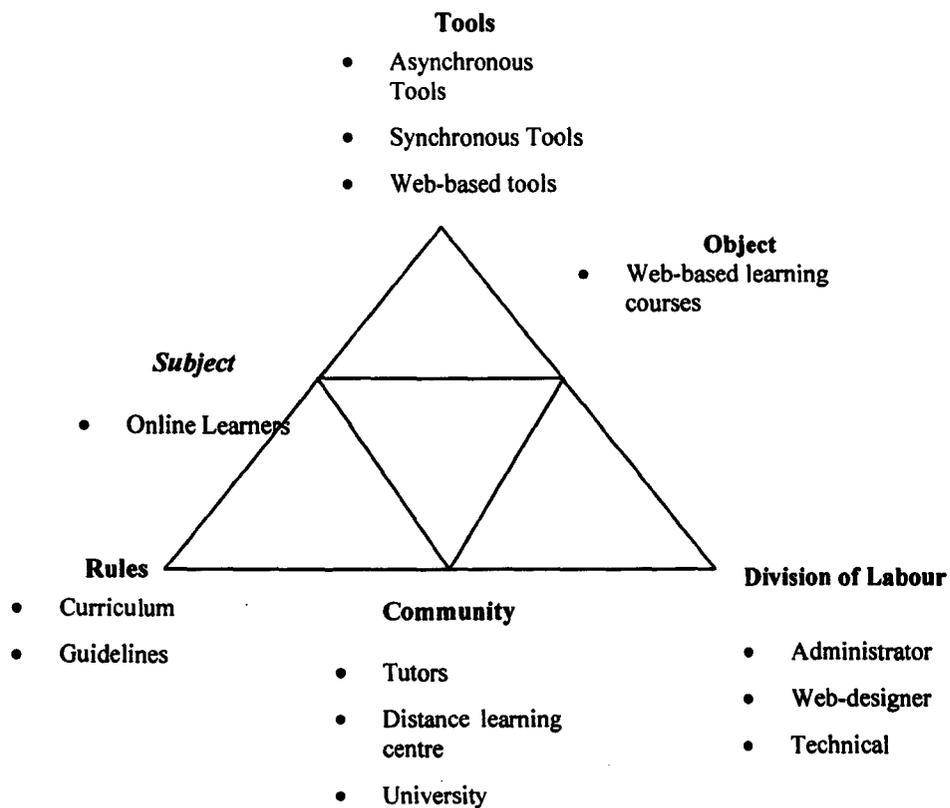


Figure 3.2: The Activity System in the Research

In this triangle, 'rules' refer to the relationship between the subject and the communities in which they participate. In this research, the web-based model, curriculum, procedures or methods were applied as the rules in the activity system. It is also important to examine the community in which the subjects work, the social interaction among participants and the values that have an impact on the activity. In this situation, the agents in the community are the online learners, which define the main character of the system. The community also involves the online learning tutor, the distance learning centre and the university itself, in a Malaysian context. Each of these communities has its own set of norms, principles, roles and perspectives. In order to describe in detail the Activity Theory framework, I used a systematic guideline that has been suggested by Mwanza (2001) in relating the activity system and user context. The Eight-Step Model (Mwanza, 2001) incorporating open-ended questions, was used to represent the various components of the activity system in the research.

Activity System Component	Question	Answer
Activity	What sort of activity am I interested in?	Web-based learning activity
Objective	Why is this activity taking place?	Object: achieve knowledge of digital graphics.
Subjects	Who is involved in carrying out this activity?	Online learners
Tools	By what means are the subjects carrying out this activity?	Asynchronous tools Synchronous tools
Rules and Regulation	Are there any cultural norms, rules and regulations governing the performance of this activity?	Digital graphics curriculum procedures for the activity guidelines
Division of Labour	Who is responsible for what, when carrying out this activity and how are the roles organised?	Web designer – designing the online module as a tool administrator – managing the training
Community	What is the environment in which the activity is carried out?	Online tutors Online learning environment
Outcome	What is the desired outcome from this activity?	Provide a better online learning environment for the students for learning digital graphics.

Table 3.1: Activity System

Table 3.1 shows how the activity system can be used to identify the dynamic interaction between the learners and their environment. In this case, the environment refers to the activity system component. By analysing the relationship between the learner and the component, it helps me to understand what element to consider in designing the online learning system and how the system can cope with the user needs in this particular situation. For instance, the question about ‘What sort of activity am I interested in?’ indicates the type of activity that should be involved in the activity system and web based learning activity is the main activity. In order to design the online learning system, we should know who is involved, what kind of tools will be used, who will participate, what the environment is and finally what is the desired outcome from the activity? Therefore, the activity system framework provides a guideline to the designer to identify the real situation of the subject, their activity and their environment. In this study, the design of the system takes into account these kinds of elements, as shown in Table 3.1.

3.4 The Activity System and User Scenario

The activity system represents human activity that is mediated with and supported by, the tools and other artefacts. Therefore, in order to analyse the human activity in a virtual learning environment, the activity system is used to examine these relationships.

Subject and Tools

The subjects involved in the activity were the online learning students, and software tools are a physical element that can be used as a mediator in achieving the learning objectives. Students use the tools to perform their learning activities in the virtual learning environment and at this stage, tools including synchronous and asynchronous tools are considered as a mediator for the subjects in order to perform their learning activities.

Subject and Rules

The rules in the activity system are the course content and the curriculum. In the virtual learning environment, the subjects are bound by rules and regulations in which the activity is carried out. Therefore, activity rules are involved in the course content and curriculum which influence the whole activity.

Subject and Community

Community plays important role in the activity system and in a virtual learning environment, the community is the course tutors, online students and technical assistants who are involved in the learning session.

Subject and Division of Labour

A division of labour component refers to the distribution of responsibilities with regards to the tasks in the activity system. In this research, the division of labour relates to the role of

course tutors and technical assistants in dealing with the students' problems during the learning sessions.

Division of Labour and Community

The community and a Division of Labour are interrelated. Community represents the whole population in the activity and the division of labour embodies the people who have the responsibility and authority in delivering their tasks. Therefore, in a virtual learning environment the course tutors for example can play a role in achieving community objectives (e.g. user satisfaction) within a division of labour framework.

In this research, we show how a combination of Activity Theory, User Scenario, SUNA and function hierarchy are used in a systematic and practical approach to design the virtual environment.

From Activity System to User Scenario

Activity Theory provides a practical framework in examining human activity in context (Mwanza, 2000). In designing the system, the clarification about what sort of activity is involved in the system was examined. Web-based learning activities were the main focus in the system. The user scenario was created by understanding human activity in the particular learning context and the interactions between the student and the surrounding learning environment. The hierarchical structure of activity is shown in Figure 3.3 below.

3.5 Hierarchical Structure of Activity

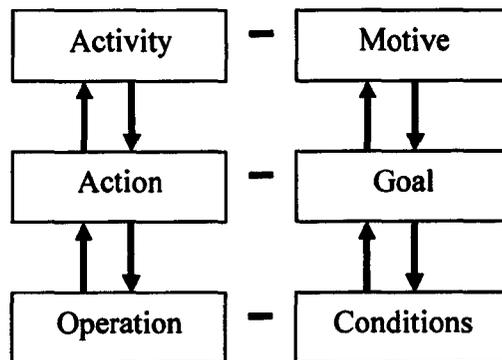


Figure 3.3: Hierarchical Structure of Activity

The hierarchical structure of activity consists of three levels including activity, actions and operations and originating from Leont'ev (Kutti, 1996) as shown in Figure 3.3. The principle of Activity Theory shows a hierarchical structure of activity which includes actions and operations to support the activity. An activity has a motive and actions are carried out to obtain the goal. Operations are performed in order to accomplish the Conditions required to achieve the goal. Action and Operation are the main elements required in order to achieve the goal of the activity. Activities are related to users' intentions and Motives to achieve the goal and Actions show what the user must do in relation to the goal, while the operation involved in the Actions describe the functionalities in the software that must be available to the learner to achieve the actions and activities (Kutti, 1996).

From the Hierarchical Structure of Activity to Function Hierarchy

The function hierarchy is a list of the user's needs and requirements that are generated from the user scenario. In this research, we use the concept of a hierarchical structure of activity to extract the user needs from the scenario and argue that ~~by~~ using the set of user needs or so called function hierarchy as a checklist for development purposes, can help the designer to organise the specific requirements of the system before the actual development

phase. From the outcomes process of SUNA, the users will provide scenarios as illustrated in Figure 3.1. The user scenario contains the unstructured needs and requirements that can be extracted from the user. However, a scenario is difficult to interpret since it comes with a mixture of views of users. Therefore, hierarchical structure of activity is useful for analysing and organising these user needs from the scenario. It is also useful because it turns the system hierarchy into a more dynamic description, and is beneficial as a checklist for evaluation purposes such as usability testing for system functionality and provides a practical way to manage the set of activities in redesign. At this level, a designer can look back at the flow of the development process to determine the weaknesses of the system.

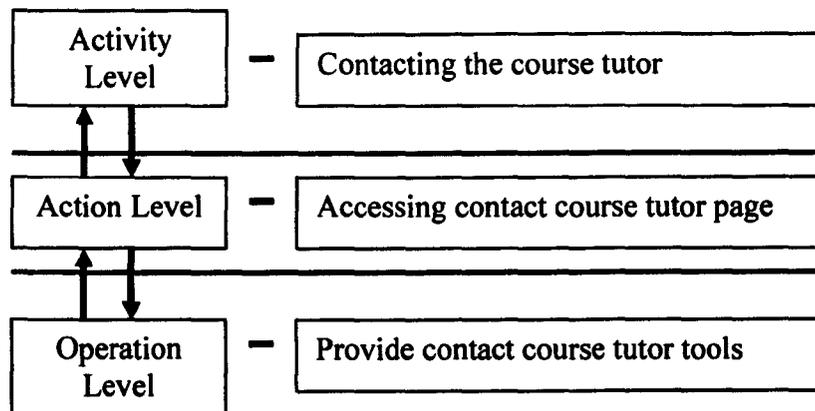


Figure 3.4: An Example of the Activity

In order to develop the system, the activity was formed and then followed by an action and operation analysis (Kutti, 1996). The function hierarchies was developed mainly using the concept of Activity Theory and the approach of SUNA which is the hierarchical structure of activity, actions and operations. The activity structure is added to organise the outcomes of the SUNA process into a systematic framework of practical categories.

Figure 3.4 illustrates an example of the online activities in the support system. The activity is 'contacting the course tutor'. In order to achieve this goal, the subject (student) needs to complete an action, which is 'accessing the contact course tutor page'. The system will

therefore provide the 'provide contact course tutor tools' (operation) which can be used by the student to communicate with the instructor.

3.6 Conclusions

Chapter 3 explains the theoretical framework and foundation of the design of the online learning courses. The systematic approach of Activity Theory and SUNA will aid me to meet the aims of the study for designing and evaluating the online learning environment based on a user-centred approach. This chapter summarises a key part of my approach in analysing, describing and evaluating the context in the dynamic interaction.

Chapter 4

Methodology

4.0 Introduction

This chapter explains the research questions and methodology used in the study. It also discusses the justifications for choosing the methods in relation to answering the research questions. The chapter also describes the three main stages of designing and evaluating the system. At the end of the chapter, the conclusions for the whole chapter are described. Building on the framework developed by SUNA and Activity Theory in the previous chapter, I will now explain the aims of the study and the research questions.

The aims of the study are to design both an online learning and a support system for a digital graphics course using a user-centred approach. The aims of the study are also to observe the different learner perspectives in learning, using the system, and to see how the system and support contribute to the learning outcomes. The study also identifies students' learning process and the mode of users' interactions during the learning session. Finally, the study examines the student learning outcomes at the end of the learning sessions.

4.1 Research Questions

The research questions in the study are divided into two categories: namely, design and evaluation which reflect the aims of the thesis.

a. Design

The design phase is focused on the methods and processes of developing the system. Therefore, in order to explore the users' needs and requirements, the research addresses the following issues:

1. What are the elements in relation to user needs and requirement in designing the learning and support system?
2. How should the system be designed, based on a user-centred approach, including user context, needs and requirements?
3. What modifications are made to the iterative evaluation process?

The research questions in this section emphasise the design stage of the system. This contains the approach of designing the system and the iterative process of the development of the system.

b. Evaluation

The evaluation phase involved a study of the student using the system for learning.

Therefore, the research focuses on the following questions:

1. What do students learn from the system?
2. How do students learn using the system?
3. How do students make use of the tools in the system?
4. How do students interact with other users during the learning sessions?
5. How do students get support during the learning sessions?
6. What is the contribution of the system to the learning outcomes?
7. What is the contribution of the support to the learning outcomes?

The second phase of the research questions are focused on the teacher-learner interaction in developing the conception of digital graphics (Laurillard, 1993) and the role support and scaffolding during the learning process. The result of the process will be reflected to the students' learning outcomes. Therefore, in order to answer this part of the research questions, an Activity Theory framework has been used as an approach to analyse the interaction of the learners with the environment within the activity.

4.2 Methodology

In order to explain the methodology of the study, Figure 4.1 gives an overview of the entire design in the present research. The overall design of the whole study is divided into three

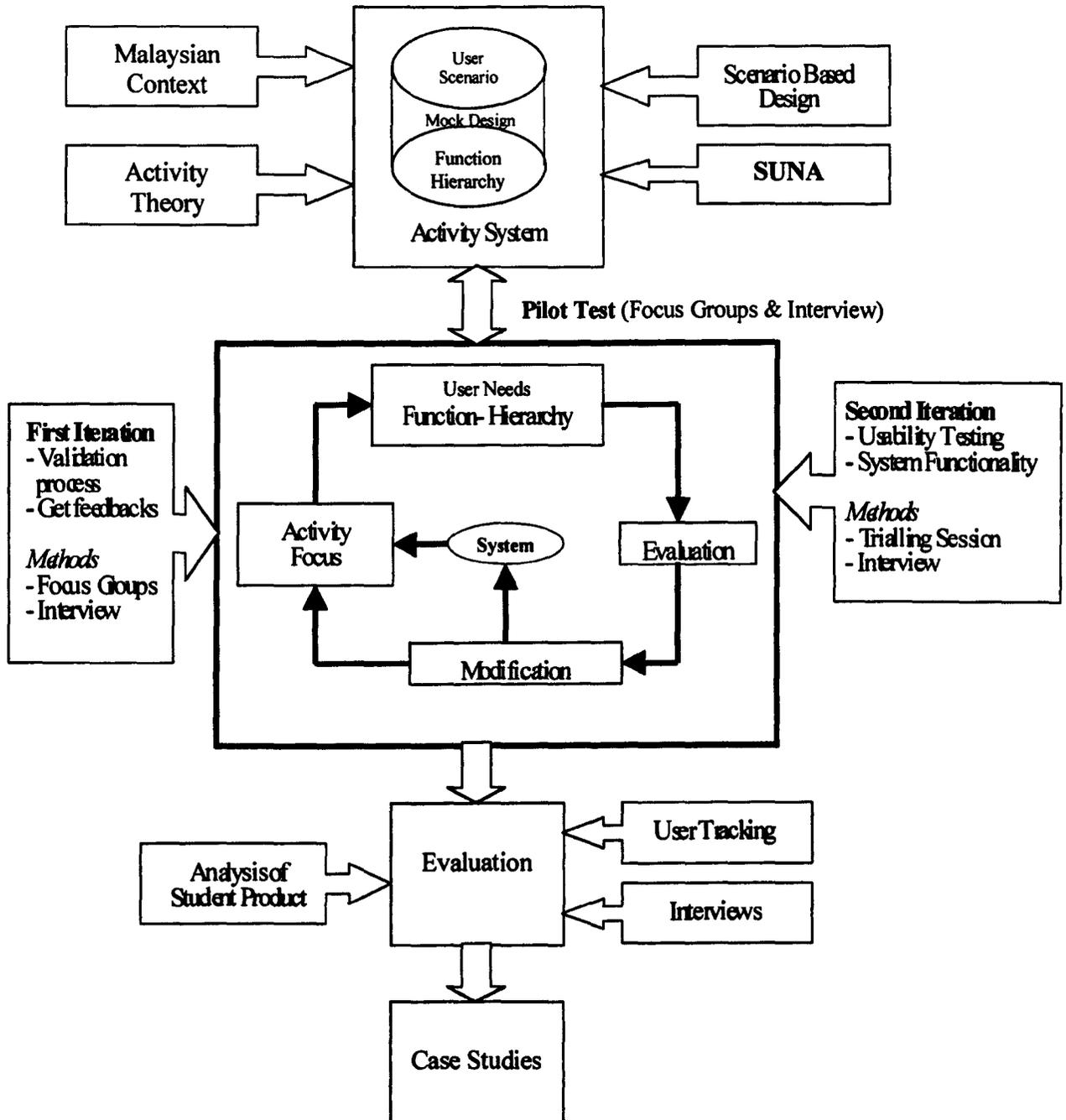


Figure 4.1: Overall Structure of the Research

stages, namely: First Stage (User Scenario), Second Stage (Iterative Design) and Third Stage (Evaluation). Every stage has its own purpose.

The first stage of the study is defining the user scenario from the Activity Theory framework in the Malaysian context. In order to examine the complexity of interactions within the context, Activity Theory framework is applied since it is an effective method to understand the user and its context. Scenario based design is design tools which involve the user highly in the design process. The benefit of using scenario as design tools will give an effective method for designing the user-centred system. Therefore, SUNA implements this idea to provide user involvement and give a method of capturing the user needs and requirements. As shown in Figure 5.1, these approaches are related to each other particularly in the Malaysian context. Then, the user scenario is created based on the users' context with their surrounding environment. From the user scenario, user-need will be extracted and the process of mapping user needs to the technology will come out with function-hierarchy. Then, the mock design will be created from the function hierarchy. The first stage will answer the research question in design phases especially research questions one and two. The main issue of the research question is to identify the user needs and their context and what approach is used in designing the user-centred system. Therefore, this stage demonstrates my approaches in providing practical ways to describe and design the system. Several approaches have been rationalised such as Activity Theory framework, SUNA and Scenario based design.

The second stage of the study provides the framework that supports an iterative process of designing, implementing and evaluating the users' needs and requirements for the online learning environment. Iterative design allows the designer to test, analyse and refine the work in progress based on the cyclic process. In order to obtain feedback, suggestions and comments, the user scenario and mock design will be demonstrated to the student and course tutors. Two methodologies will be implemented such as Focus Groups and Interview. The findings will be transcribed and the key issues in relation to the users' needs and requirements will be identified for design purposes. Next, the justifications and

modifications will be made for identifying the system requirements based on the user context. Finally, the system will be developed. This process is called the first iteration. For the second iteration, usability testing for the system functions will be conducted, after the system has been developed. Two methodologies are chosen including a trialling session and interview. Again, the justifications will be made based on the data from the interview and usability testing. Then, a re-design process will be made and finally the final system will be produced. This stage is going to answer the research question in the design phase particularly research question 3. Research question 3 is focused on the iterative process of the design, including the usability testing and validation stage in the design process.

The third stage of the study consists of the evaluation methods of the system that involve three methods including user tracking, interview and analysis of student product. A user tracking method is used to track student interactions with the course tutor, technical assistants and other students. The interview method will be implemented to gather feedback about learning strategies and student learning outcomes. The analysis is derived from the Activity Theory framework since this framework gives an approach to examine the interaction between the learner and their environment. The outcomes of the process will show the contribution of the system to the learning. The results of the analysis will come out with the case studies. Possibly, each case study will have a different pattern of interaction since it will analyse the context of the learner in their environment. This stage will answer the second set of questions in the evaluation phase. The research question in the evaluation phase will focus on the dynamic interaction between the learners and their environment, specifically learning digital graphics. Therefore, to answer the research question, several methods will be applied including user tracking, interviews and analysis of student product. The following section will explain the three stages of the design and evaluation process.

4.3 User Scenario

The aims of the study are to design and evaluate the online learning courses of the distance-learning student in Malaysia. As a result, it is important to understand the real perspective

of the students, especially in Malaysia, before the system can be designed. In order to do this, I will explain the first part of Figure 4.1 which contains an activity system, and its relationship with the Malaysian context, SUNA and Activity Theory.

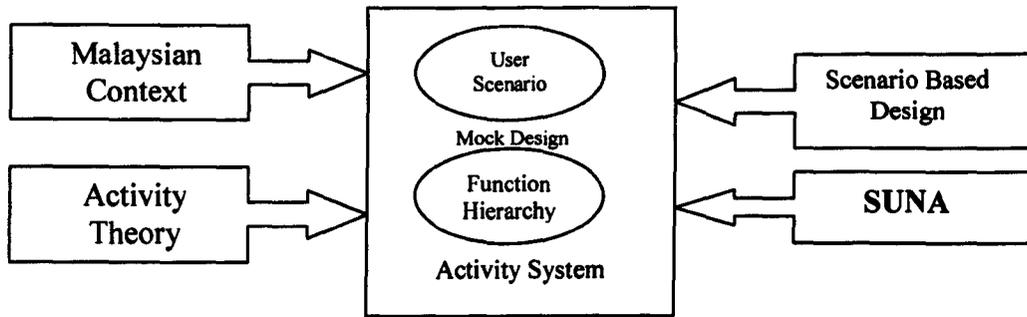


Figure 4.2: First Stage (User Scenario)

To implement this approach, I will use the activity system framework to examine the user context and their interaction with the environment. This process will start with the literature in the Malaysian context since the introduction of ICT as a subject in schools compels new teacher training to be introduced. Therefore, to understand this context better, Activity Theory will examine the subject and its environment. As discussed in the previous chapter, the outcome of the activity is to provide a better online learning environment for the students for learning digital graphics. Therefore, it is important to know with which artefacts the subjects interact and what is the purpose of the interaction. For instance, this framework consists of a set of artefacts surrounding the learner. Therefore, to discover this context, I am going to use the Eight-Step Model (Mwanza, 2001) which includes the set of questions representing the various components of the activity system in the research.

After getting the components of the activity system, I will write the user scenario based on the literature and the Malaysian context. The scenario will be written based on the components in the activity system and from here we can see the interaction between the learner and their environment. The next step will involve SUNA as a design method to involve the user as an element in the design process. The approach from SUNA will be

used to capture the user needs from the scenario and then transform it into the function hierarchy. Function hierarchy consists of a set of hierarchical structures of activity including activity, actions and operation. From here, SUNA will give a detailed explanation on how to map the user needs with technology and therefore provide a set of function hierarchies. The outcomes of this process will provide the group activity, action and operation. This set of activities will be used to draft the mock design of the system. In theory, the mock design represents the user needs and requirements. However, at this stage, the actual needs of the Malaysian users are yet to be implemented into the system since the user scenario is developed based on the literature. As a result, the focus groups and interviews will be conducted in Malaysia in order to clarify their needs and their context. The focus groups and interviews are one of the methods to involve the learner in the design process through the mock design.

From the scenario several key activities will be identified that learners have to carry out with the system for example selecting course activities or doing the user registrations. In order to complete the activities, every learner should carry out the group of actions including reading the course content or selecting a forum. Finally, the operations will be provided by the system in order to complete the actions and eventually complete all the key activities from the beginning. For example, the operations can be creating the chat session and producing the helpline.

The combination of these components is called a function hierarchy. It will help me to design, develop and analyse the key elements especially learner activities in the design process and give a thorough description of the system specifications.

4.4 Pilot Test

A pilot test was conducted before doing the data collection in Malaysia. The purpose of the pilot test is to a) validate the instrument that has been used in the evaluation b) establish the interview and focus groups protocol c) gain experience before conducting the evaluation in Malaysia. The stage of the pilot test is as follows:

Pilot Test	Method	Goals	Reflection on the System Hierarchy
1	Focus group	<ul style="list-style-type: none"> • Validating the focus group protocol • Establishing the focus group protocol • Gaining experience before conducting the collection of data 	<ul style="list-style-type: none"> • Activity and actions
2	Interviews	<ul style="list-style-type: none"> • Validating the interview protocol • Establishing the interview protocol • Gaining experience before conducting the collecting of data 	<ul style="list-style-type: none"> • Validation of the activity and actions of students

Table 4.1: The Purpose of the Pilot Test

Two methods were used in the pilot test of the protocol: the focus groups and the interview. The subjects were the international students that enrolling for the Master of Art in ICT in Education from the School of Education, Leeds University. A set of interview protocols were designed to gain feedback about the system and support. Some questions were asked during the interview session including the general view about the system, system features and overall design of the system. The rationale for asking the question is to validate the interview protocol and it was used in the first iteration. The interview was also conducted to gain experience before collecting data in Malaysia.

The purpose of the focus group session is to validate the protocol and establish the focus group protocol. Some questions were asked regarding the system, features (interface, instructional strategies and support) and system improvement. The intention of asking this question is to gain feedback and suggestions from the students about the system. Thus, the experience of conducting the pilot study assists me in rationalising the focus group question during the data collection.

4.5 Iterative Design

Iterative design is the design methodology, which highlights the repeated and revisited process of analysing, testing and evaluating the product, especially in software development. Many instructional design models use this approach as a method for designing the software such as rapid prototyping and Boehm's Spiral Model. In the design purpose, this process can give me a practical approach to test the system for the target user and then modify the design based on the feedback and suggestions from the users. The process of iterative design will be explained as follows:

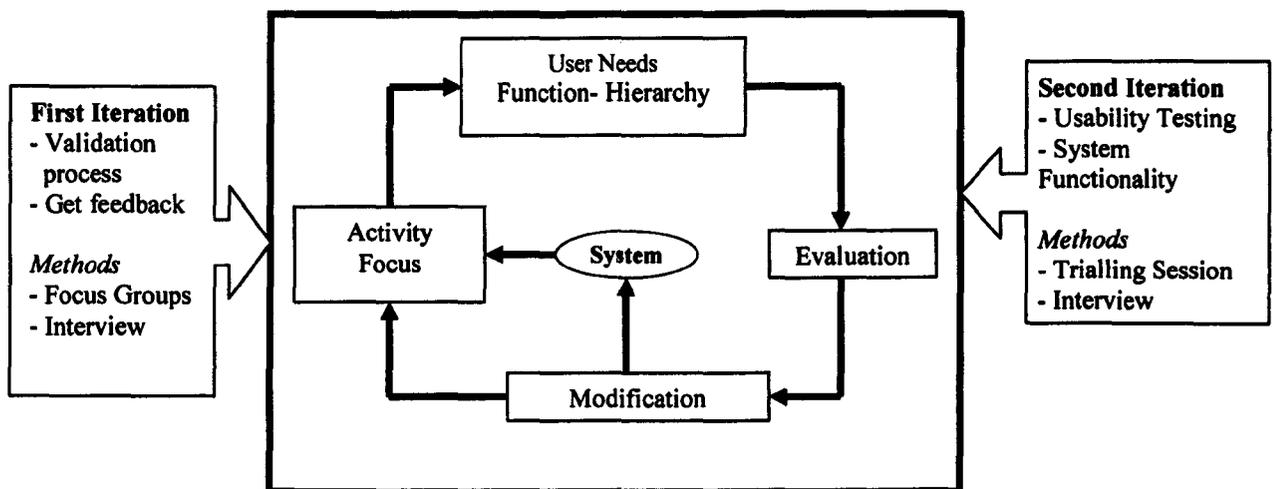


Figure 4.3: Second Stage (Iterative Design)

a) Activity Focus

This is the first stage of the evaluation. At this level, I will decide what the objectives of the evaluation are and what the impact to the design is. The focus of the first and second iteration will be clarified at this stage.

b) User Scenario

The user scenario is a design tool in this process. Therefore, at this stage, the user scenario

will be created from the Activity Theory framework and the function hierarchy will be presented as described from the first phase of the structure.

c) Evaluation

In this cycle, the second stage is the evaluation phase. The first and second iteration will be administered at this stage. The next step is modification of the design.

d) Modification

Modification will be made from the results of the first iteration and second iteration. Some changes will be made in the function hierarchy in relation to the actions and operations of the system.

e) System

The first prototype of the system will be developed after modification and justification are made from the cycle of the iteration. Figure 4.3 above, shows the process of designing the web-based learning environment. After the scenario is created from the activity system, the mock design from the system hierarchy will be presented to the learners. The purpose of the first iteration is to get feedback from the users about the system in relation to their needs and the validation process of the system. The validation process means that at this stage, the features, button and support tools in the mock design will be explained and presented to the learners. Their views and feedback will be recorded and analysed. The findings from the first iteration will give a set of system specifications for the prototype from the learner's point of view. A modification process will be performed, based on the results of the first iteration.

The second iteration will be conducted after the prototype of the system has been developed. The aim of the second iteration is to carry out the usability testing of the system

in order to verify the system functionality. Two type of evaluation will be organised including a trialling session and interviews.

The following section will discuss in detail the methods for the first and second iteration.

4.5.1 First Iteration

The aim of the first iteration is to obtain feedback, comment and suggestions about the system from the students and course tutors. From the first iteration, data will be gathered regarding the feedback about the design, instructional strategies and support from the mock design. In addition, the comment on the mock design is important to identify the issue about what is missing and what should be added into the system. At this point, the validation process of the mock designs will be made in order to capture the user needs and requirements based on the user context. The suggestions and opinions are useful for system improvement in the next iteration. The purpose of the first iteration stage is as follows:

Iteration	Method	Purpose	Reflection on System Hierarchy
1	Focus group	<ul style="list-style-type: none"> • Getting the user needs and requirements from the students • Gaining reflective feedback, comments and suggestions about the system from the mock designs 	<ul style="list-style-type: none"> • Activity and actions
2	Interviews	<ul style="list-style-type: none"> • Getting user needs and requirements from the tutors • Gaining reflective feedback, comments and suggestions about the system from the mock designs 	<ul style="list-style-type: none"> • Validation of the activity and actions of tutors.

Table 4.2: First Iteration

The first iteration of the evaluation will be conducted in Malaysia. This is important because the system was developed on the basis of the Malaysian context. During the data collection process, several methods will be implemented in order to obtain reliable data from the participants. Two data collection methods will be integrated: focus group interviews and one-to-one interviews.

The Focus Group

Focus groups are a form of group interview (Cohen *et al.*, 2000) and moderated meeting that involve people discussing their view and experience in educational activities (Gibbs, 1997). One of the advantages of this method is that the interaction in the focus groups allows respondents to give their point of view on the issue in relation to their experiences and understandings (Gibbs, 1997). A focus group is the best approach to discuss an important issue and why it is important. Indeed, focus groups can give a large amount of data in a short period of time from a group of people (Cohen *et al.*, 2000; Gibbs, 1997). However, focus groups also have some disadvantages. It may be hard for the moderator to manage and control the discussion group and spot an individual message.

In the present research, the main purpose of the focus group is to draw upon users' feelings, beliefs, experiences, opinions, ideas and reactions in a way which would not be feasible using other methods such as observation, one-to-one interviewing, or questionnaire surveys (Cohen *et al.*, 2000). Focus groups can bring out user's spontaneous reactions and ideas in designing the system and enable me to acquire the specific information about the particular issue. In the present study, the rationale for using this method is based on a few factors such as:

- a) The focus groups sessions provide a practical and efficient way to gather information from the groups of students about their perceptions, opinions and feedback of the system. In this case, it may help me to obtain some useful data (feedback and comments) from the students who are involved in the activity system. In particular, the group of students in the activity system can provide their needs and requirements,

which can allow me to acquire useful feedback in designing the system. Therefore, the findings will represent the data from the group of people especially in their context.

- b) It also provides me with a potential problem that might arise in designing the system and the way to improve it. For instance, the focus groups allow students to give their opinion about the structure of activity in the function hierarchy. It may be particularly useful when the students in the group share their views and decisions about what is appropriate and inappropriate in the structure of activity and suggest the solution to improve it.

In this research, the purpose of focus groups is to: a) obtain the user needs and requirements from the students and b) gain reflective feedback, comments and suggestions about the system from the mock designs.

The focus group session will be conducted in the first iteration only, since it will provide the feedback from the first stage of design. However, the interview session will be performed in both iteration processes.

Subject

All the students were registered at the School of Professional and Continuing Education, University of Technology, Malaysia, also known as the distance learning centre. The University of Technology Malaysia is located in the southern part of Malaysia. The UTM has 2 campuses; the main one is at Skudai, Johore, which is about 18 kilometres from the city of Johor Bahru. A branch campus is situated at Jalan Semarak, Kuala Lumpur. The students were mainly native Malay speakers of different races, such as Malay, Chinese and Indian. The participants were Malaysian undergraduates enrolled in a digital graphics course. All of them were part-time students and most were teachers with at least 5 years' teaching experience.

The first focus group evaluation was held at the University of Technology, Malaysia, Kuala Lumpur Branch. In order to make the research more reliable, the arrangements for this session were discussed with the lecturer who handled the class. With his agreement, I decided to take over the class and carry out my evaluation at the end. This session involved the 11 students who attended the class and took about 45 minutes at the end of the class. The aim of the evaluation was to obtain the students' perceptions, opinions and feedback on the existing online learning interface.

The data from three different groups of students, all enrolled in second year Multimedia Technology (digital graphics) courses, were used in this study. The groups consist of 11 distance learning students (age range 21-45 years) enrolled at the University of Technology, Malaysia.

The second session of focus groups was undertaken at the University of Technology, Malaysia, on 3rd January 2004. About 15 students were involved in the study. The students were mainly native Malay (Malaysian Language) speakers and the evaluation was conducted in Malay. I implemented the same methodology as used in the previous session, but with different participants.

The third session involved 8 distance learning students from the University of Technology, Malaysia. The class was composed of students from several distinct backgrounds, with different ages and teaching experiences.

Procedure

In the focus group session, three sessions were involved. The session was conducted in order to gain the data from three different groups of students; all enrolled in digital graphics courses.

Before the session started, some brief information about the research was given to the participants. The session took place in the classroom and lasted about 45 minutes. The

sessions began by encouraging and directing the students to answer the questions. To spur everyone to speak up, the session was conducted in an informal situation.

Some instruments were used during the focus group session including a focus group interview protocol, video camera, tape recorder, LCD projector and notebook. The interview and focus group interview protocol were developed and tested during the pilot study. The discussion sessions were recorded using a video camera and tape recorder. The display devices were used for displaying the mock design of the system.

Focus Group Protocol

A set of open-ended questions was administered and used in the focus group session. These questions consist of the question about user's feedback about the system. They include:-

a) **The general view of the system**

The rationale for asking this question is to gain feedback in relation to the system including the Graphical User Interface (design, screens, presentation, menu, icons) and features (content, asynchronous and synchronous tools). The purpose for asking this question is to gather feedback and then transform it into their needs and requirements for the design modification.

b) **Features of the online course and the support in detail**

The question about this issue is important for me to gather their opinion about the system and the support. The finding will be revised to their needs and requirements. At this stage, students will be asked in detail about the asynchronous and synchronous tools. For example, the chat session and helpline.

c) System improvement

This question is to tackle the problem in the proposed system and how to improve it. Some of the feature in the system may not be appropriate to the students. At this stage, it will give me a picture about what should be added and what should be rejected in the development phase. Therefore, the findings will lead me to gather their needs and modify the system based on their needs and requirements. The set of focus group sessions is shown in Appendix 1.

Interviews

Robson (1993), Cohen *et al.* (2000) and Bailey (1978) emphasised that interviews can bring flexibility to the subject as the interviewer can repeat the questions and explore more specific answers from respondent. For this reason, I could record spontaneous answers and ensure that the questions were completely answered by the subject. The interview sessions were conducted to gain specific data about the system. The findings from the interviews could also provide some valuable data about the design and instructional strategies and therefore allow me to re-design the system in a user-centred version.

During the iterative design process, interviews were conducted to get immediate feedback from the subject in the activity system. In the first iteration, the focus was to get the users' needs and requirements from the tutors. However, in second iteration, the interviews were conducted after the trialling session.

The purpose of the interviews sessions was to: a) obtain the users' needs and requirements from the tutors b) gain reflective feedback, comments and suggestions about the system from the mock designs. In this session, the mock design of the system and its functionality were demonstrated and this was followed by the open-ended questions.

Subject

The subjects of the interviews were three lecturers from the Department of Educational Multimedia, Faculty of Education, University of Technology Malaysia. The subjects were the online learning tutors as they were one of the community and division of labour in the activity system. The results of the interview were divided into several categories which included the system, support system, instructional strategies and the user interface.

Procedure

As usual, before the session started, the course tutors were given some brief information about the study. The interviews were conducted in an informal session in order to minimise the gap between the interviewer and the subjects. The first session of the interview was held with the teaching staff at the university who had more than four years experience in teaching digital graphics.

The interview protocol was developed and tested during the pilot study and was used as an instrument during the session. The discussion sessions were recorded using a video camera and tape recorder.

Interview Protocol

The focus of the interview in the first iteration was to get the users' needs and requirements from the course tutors. This is important to gather feedback about the graphical user interface, features and instructional strategies. However, in the second iteration, the interviews were conducted for usability testing and after the trialling session.

In the first session of the interview the questions to be addressed were as follows:

a) General views about the system

The reason for asking the question about general views was to obtain information about the system including the Graphical User Interface (GUI), features and instructional strategies from the perspective of the course tutor. This was to provide data about their needs and requirements in the particular context.

b) System features in detail

This question was to examine the features of the system including instructional strategies and the functionality in the system. The rationale for the question is to identify the user needs from the course tutors perspectives and views. Therefore, the system could be modified and redesigned based on their views.

c) System improvement

The purpose of the question for system improvement was to obtain some feedback about the additional problems related to the proposed system. At this level, the learners' needs could be extracted to the modification and redesign stage.

Data Analysis

The interview and focus group were transcribed and analysed based on the coding and themes from the users' feedback and suggestions. In the research, the themes were categorised into any key issues about the interface design, instructional strategies, features of the system and system improvements in relation to the system since this is a practical approach to capture user requirements.

4.5.2 Second Iteration

As mentioned earlier, the second iteration was conducted after the prototype of the system had been developed. The findings from the evaluation gave some feedback to me about the usability of the system and system functionality. For instance, the user tracking data via observation, using a monitoring program, showed how the student used the system. Any suggestions and comments from the respondent were reflected in the system functionality, which consisted of the activity, actions and operations.

This topic explains the results of the second iterative evaluation in relation to the usability test in order to evaluate system functionality. All changes and improvements were made before the actual evaluation was conducted. The purpose of this evaluation was to ensure that every function and feature in the system was working perfectly.

The stage of the second iteration of the evaluation is as follows:

Second Iteration	Method	Goals	Reflection on the System Hierarchy
1	Trialling sessions (2 pairs)	Usability testing of the system, testing system functionality	<ul style="list-style-type: none"> • Activity and actions
2	Interview	Validation, getting reflective feedback, comments and reports about the system functionality	<ul style="list-style-type: none"> • Validation of the activity and actions of students
3	Monitoring programme	Observation of student activities	<ul style="list-style-type: none"> • Activity, actions and operations • Providing reflective feedback of the system design

Table 4.3: Second Iteration

Two types of evaluation were organised including trialling sessions and interviews. A monitoring programme was used to record the student activities during the learning session.

Monitoring Programme

The purpose of this method is to examine how students work (activity) with the system and evaluate its usability in relation to track used patterns, errors, navigation paths and time spent on tasks by the users (action).

The iterative evaluation for the second cycle is important for examining the usability of the system and identifying the system functionality. System logging is one method to investigate how the students make use of the system and to see what kinds of errors occur in the session (McAteer, 1998). This method was implemented in parallel with a trialling session.

This method helped me to trace the frequency of errors provided by the students; particularly the levels of activity and actions performed by the students or by the system's operations. For instance, to use the support system, the student needs to explore the system and click on the 'support tools' link when they have a problem. In this situation, I obtained quantitative data from the actual activity when using the system.

An IP Tracking program by Phpnuke was installed in the system. Students using the system were identified and tracked by their usernames. Every interaction by each of the students was recorded by the system itself once the students had logged onto the system. All the data was stored in the database, and could be displayed remotely from the system.

From this evaluation, I obtained data on: a) students' activities and actions while using the system, b) the system's functionality and c) errors performed by the student and the system.

Trialling Sessions

The trial sessions had to be completed by the student before the interviews were conducted. The purpose of the trialling session was to ensure that the students were familiar with the system before I could get their comments and feedback about its functionality. A two-hour session was scheduled, as below:

Schedule	Duration (approximately)
System introduction: <ul style="list-style-type: none"> • introduction to the system • system features • support system 	10 mins.
Students use the system Record all activity and actions on a monitoring programme.	105 mins.
End sessions	5 mins.

Table 4.4: Time Schedule for Trialling Sessions

The sessions were ended with an interview. In the trialling session, my role was as a moderator and technical assistant controlling the synchronous and asynchronous tools. The users were asked to explore and discover the system at their own pace and at the same time log-on to the chat session and send a message to the helpline, discussion group and private message facility. The user was located at different locations and in order to communicate, Yahoo Messenger was used. Yahoo messenger is the software that allows the user to chat and send messages synchronously. An interview was conducted to gain feedback from the students about the usability of the system and the system functionality.

Subject

The study was conducted with Malaysian students who were pursuing their studies in the United Kingdom. Two pairs of students were selected on a voluntary basis. Each of them had experience with an e-learning system, such as Web CT and First Class. They also had a good knowledge of IT.

Interview

The purpose of the interviews with the student was to obtain their views about the design of the system, including system functionality, the usability of the system and the problems encountered when using the system.

The interview protocol used in the interview sessions consisted of a series of open-ended questions, including some about the usability of the system, the drawbacks of the prototype and a request for feedback from users about the system's functionality. The instrument was piloted during the pilot study.

Interview Protocol

In the second session of the interview, questions focused on issues including:

a) **Learner experience of using the system**

The rationale of asking this question was to see the students experience in a try-out session. This gave me some input about what they did during the learning session. It reflected the functionality of the system.

b) **System functionality**

The question was related to the results of the trialling session. It examined the overall system functionality and the problems that the user had during the session.

c) **System improvement**

This question was addressed to gain opinions about how to solve the problems regarding system functionality. However, the findings may have been different and could lead to suggestions to improve the overall system.

The findings from the evaluation will allow changes to be made as a result of the learner's experiences. It will reflect the whole system hierarchy from the learner's experience, learner's actions and learning environment operations. It will be a checklist of the iterative process for modifications before the next iteration.

Data Analysis

The data from the trialling session was analysed using the user log file. From the user log file, every interaction could be identified and examined. The user log was analysed to see how the student used the system and to observe what kind of errors occurred in the session. Finally, the data from the interview were transcribed and analysed based on the theme in terms of the experience of using the system and system improvement.

4.6 Evaluation

In this section, I will explain the final stage of the research. Figure 4.4 illustrates the evaluation stage of the research.

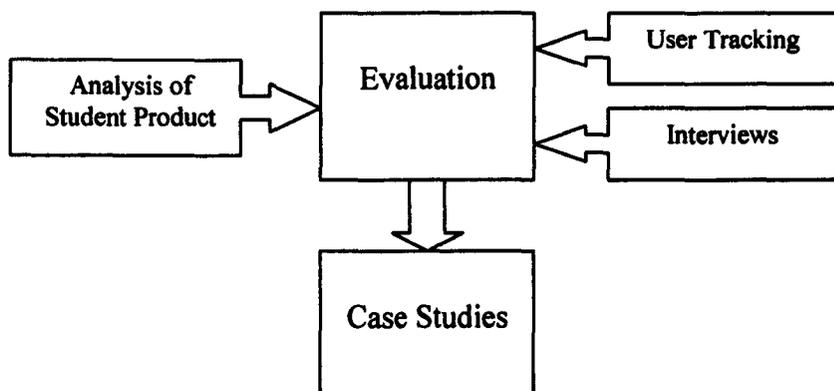


Figure 4.4: Third Stage (Evaluation)

In order to explain in detail this part of the evaluation, let me review again the aims of the study and the literature review in Chapter 2. In the evaluation part, the main goal was to examine the student learning outcomes. In order to examine in detail the outcomes of the students, the vital aspect to understand is their learning process in terms of what they learn and how they learn.

The effectiveness of the design method in implementing a user centred approach can be determined by analysing the student outcomes of learning. If the outcomes of learning are

unsuccessful, it means that the system had failed to provide an effective learning environment for the student. However, if the outcomes are successful, we can consider that the system was designed with an effective approach. The contribution of scaffolding or support to learning was examined by analysing the contribution of the support tools and the system to the student's learning. Finally, in order to examine the interaction between learner- teachers in the learning process, the aspect to analyse was how they communicated with the community and the division of labour in the activity system. This explained the role of the teacher in giving and receiving feedback from the student, as discussed in the literature. All the issues above answered all sets of research questions in the evaluation phase.

In order to determine and answer the issue in the research question, several methods of evaluation have been implemented including user tracking methods, online interviews and analyse of student product. Findings in the user tracking methods clarified the issue about the teacher-learner interaction, the contribution of scaffolding to learning outcomes and the use of a system in learning the digital graphics topic. The results from the interview explained about the learning strategies that the learner used during the learning session and finally the findings from analysing the student product identified the effectiveness of the scaffolding, system, the design and the interaction of the learner-teacher in contributing to the student's learning.

User Tracking

In this research the user tracking method was applied in order to observe learner's interactions with their surrounding artefacts in the activity system. The artefacts are known as the tools, division of labour, community and rules. One of the advantages of using user tracking is that it provides data on the interactions between teacher learners, their feedback and response in the learning session. The result reflects the relationship of the interaction between learners and their environment. This stage answered the research questions in the evaluation phase.

Interview

The online interview session was conducted in order to gain in-depth feedback about the learning experience using the system, including strategies, outcomes and approaches. At this level, learners were asked about their experience during the learning sessions. In fact, the interview sessions provided an overall picture about the effectiveness of the interactions between the teacher and learner. For example, in their learning session, the learner used a number of strategies to gain knowledge about digital graphics and apply it in their assignment. The kind of learning strategies that can be gathered through the interview sessions provide answers about how the student develops their understanding about the conception of digital graphics, how they manage to gain the knowledge and what strategies they use. The major finding from the interview session, answers the research question in the evaluation phase, about how the students learn using the system.

Analysing the Student Product

Analysing the student product is the final stage of the evaluation. digital graphics is a 'hands-on' subject and by giving the student course activities and assignments, measurement of the learning outcomes can be done from this process. The purpose is to examine the outcomes from the learning activities and to determine the contribution of the system and support to the student's learning. At this point, it gave an idea about the effectiveness of the interactions between learner-teacher, learner-learner and learner-other artefacts. In fact, the data from the student product reflects the whole process of learning of the student and the practicality of the design methods used through the development process. In this research, the student was given the course assignment and they needed to complete it at the end of the session. Then, the course assignment was submitted by online. By analyzing the student product, the learning outcome was determined. This answered research questions 1, 6 and 7 in the evaluation phase. This method gives a very viable input about the students work and their learning outcomes. Therefore, from the analysis of the student product, I can measure the student performance based on their assignment.

Data Analysis

As mentioned in Chapter 3, the framework of the Activity Theory will be used to analyse the data from the evaluation, since Activity Theory provides a systematic approach to understand the interaction between the subject and their environment in the system. The rationale of using this approach is that it assists me in identifying and examining the outcomes of the study.

The user tracking data will be analysed using the log-file from the PHPnuke module. From the module, we can observe the user interaction and how to make use of the system. Every activity will be recorded and analysed. The analysis of the user log file consists of the category of interaction such as posting the feedback and problem in discussion groups, participating in chat sessions, selecting the course content, selecting the helpline and using the communication tools. From here, every interaction will be interpreted to the actions done by the students.

Case Studies

The data from the evaluation phase will be analysed using the framework of the Activity Theory. The analysis itself will be divided into five episodes for each case study. The purpose of the case study is to examine the interaction of the subject with their environment such as the artefacts. For instance, from the case studies, the interaction with the community (course tutors and other students) will be identified. The data from the user tracking will be analysed using the content analysis approach. Each interaction will be divided into five episodes including: a) interaction between subject and tools b) interaction between subject and curriculum c) interaction between subject and community d) interaction between subject and labour e) the outcomes of the student's learning. The findings from the interaction will answer the research questions in the evaluation phase.

4.7 Conclusions

Chapter 4 discusses the research question and the research design of the study. This chapter also explains what the research question of the study is and how it will be carried out. The significance of the user scenario and how it is going to be created are also explained. The use of several methods in answering the research question has been discussed in depth in the final section of the chapter.

Chapter 5

System Design

5.0 Introduction

Chapter 5 explains the SUNA process in practice, corresponding to the user scenario and function hierarchy. It also presents the results from the pilot test, iterative design and evaluation as well as the reflection and changes from the results. At the end of the chapter, the implications of the design will be described.

5.1 The SUNA process in practice

The following topic will explain the SUNA process in practice including the user scenario of Malaysian students, the hierarchy structure of activity, the function hierarchy and mock designs.

5.1.1 The User Scenario

An Activity Theory framework approach towards the study of the student scenario in Malaysia allows the researcher to make an in-depth examination of user needs and requirements in the preliminary stages before designing the e-learning system. This gives some guidelines as to how the scenario has been created and is followed by the development of the function hierarchy for every need. Then, the mock design is devised based on the need hierarchy. The entire scenario is created with a combination of the first activity framework and the background of the activity framework in Chapter 3. The whole scenario is shown in Figure 5.1.

A Distance Learning Student

Ali is a distance-learning student at Malaysia's University of Technology. He is working as a teacher at a secondary school, majoring in science and mathematics. He has 10 years' teaching experience at secondary school. He earned a certificate of education from Teacher Training College in 1993. Ali is required to respond to the call from the Ministry of Education to upgrade his teaching development in relation to ICT. However, he is busy not only with his school work as a teacher, but is also overwhelmed by his work as a student. As a teacher and student, he has multiple responsibilities and is extremely busy because of work, school, family and social obligations. He also struggles with the obligations that force choices between family, school and work commitments. Having these pressures imposed upon him tends to give him increased expectations of himself, his faculty and strong desires for accountability from his school programme and tutors. These personal characteristics and situational circumstances can create problems and frustrations for him.

In the present semester he is introduced to a distance-learning programme, which utilises the Internet. This is a new experience for him. However, the main problem for Ali is that he is not computer literate, let alone experienced at using the Internet. Obviously, learning in the new environment is a great challenge for him. All learning aids and assignments are accessed through the Internet. The students are provided with a communication tool to facilitate information. Digital graphics is the subject delivered online, conducted by a lecturer for 15 students. Every week students are required to complete an assignment and discuss it using the communication tool.

Ali logs on to activate his account as a first-time user. While registering, he is required to provide relevant information about himself. The system provides guidelines for user registration to avoid errors during registration. Additionally, the system also provides FAQ's to assist new users. After finishing the registration, Ali is provided with his username and password. In the main menu, the system provides some sub-menus including course content, communication tools, student tools and evaluation tools. The sub-menu of the system consists of the following:

- a) **Course Content** (Syllabus, Content, Glossary and Search)
- b) **Communication Tools** (E-mail, Discussion Groups, Chat Session and Private Messages)
- c) **Student Tools** (Student Web-pages, Student Presentations, Student Learning Resources)
- d) **Evaluation Tools** (Course Activity and Student Assignments)
- e) **Support Tools** (Contact, Chat Sessions, Private Messages, Online Training, the Helpline and Troubleshooting database)

To retrieve information about the weekly topic, Ali has to go to the Course Content menu. From this menu, he can select the topic to be learned independently for each week. The menu includes the topics to be covered for every week. In order to communicate with his friends and tutor, Ali needs to use the Communication Tools sub-menu, which contains student email, forum, chat room and whiteboard options. The Student Tools menu can assist him to publish his personal webpage, search for

information and present learning materials online. Ali is not computer literate. The Support Tools menu can be used to increase his web based skills and contact his friends or instructor. This menu includes Contact, Helpline, Online Training and a Troubleshooting Database. He can use the Contact and Helpline menus to interact with his instructor and technical assistant if he has any problems regarding his learning. He logs off after he has finished exploring the system.

Figure 5.1: Whole User Scenario

Activity Theory can also be used in creating the user scenario in the system. For instance, in the activity system, the scenario is easier to understand and to create. The following figure gives information about the subject and his environment.

Ali is a distance-learning student at the University of Technology in Malaysia. He is working as teacher at secondary school majoring in science and mathematics. He has 10 years' teaching experience at secondary school. He earned a certificate of education from the Teacher College in 1993. He is put in position to respond to the call from the Ministry of Education to upgrade his teaching development in relation to ICT. However, he is busy not only with his school work as a teacher, but is also overwhelmed by his work as a student.

Figure 5.2: User Scenario: Background

In the user scenario above, it shows that we can design and create the scenario based on the activity system. This involves the basic elements of Activity Theory such as the subject, rules, community, division of labour, tools and object. The subject in the scenario is Ali; a distance-learning student. The community is the University of Technology Malaysia, Ali's instructor, friends and the distance learning centre. The activity system can help the researcher to provide guidelines to create the user scenario, particularly in a Malaysian context.

5.1.2 Function Hierarchy

As mentioned earlier, user scenarios can be considered as design tools in the design process. The user scenario represents the context of the learner who works with the system. Therefore, the outcomes of this process will consist of the system specification and

learner's action. The combinations of these elements are called the function hierarchy. Function hierarchy consists of a list of key activities, actions and operations. It represents a description of learner interaction and system functionalities. The issue here is how we generate a list of user needs and requirements from the scenario and transform it to the function hierarchy. Figure 5.3 shows how the scenario can be divided according to the hierarchical structure of the activity.

Ali logs-on to activate his account as a first-time user. While registering he is required to provide relevant information about himself. The system provides guidelines for user registration to avoid errors during registration.

Figure 5.3: User Scenario: Student Registrations

Figure 5.3 contains the user scenario of the system. The first activity involved in this scenario is registering the student, as underlined in the first sentence. Then it can be structured into the action of the activity, including what the subject should do to complete the registration. In this situation, Ali (subject) needs to provide the relevant information to carry out the activity. The system will therefore give guidelines to enable the student to successfully complete the registration activity and fulfil their objective. The sequence of activities can be summarised in the following figure:

Activity	Registering Student
Action	Give relevant information while registering Fill-in the registration form
Operation	Provide guidelines for student Provide the online registration form

Figure 5.4: Hierarchy structure of activity for Student Registrations

This process is also known as mapping the user needs with the technology. For instance, operations in the hierarchy structure of activity represent what the system should provide in order to achieve the goal of the activity. Every activity has its own actions and operations. The second example will demonstrate the process of mapping the user needs with the technology for support.

The Support Tools menu can be used to increase his web based skills and contact his friends or instructor. This menu includes Contact, Helpline, Online Training and a Troubleshooting Database. He can use the Contact and Helpline menus to interact with his instructor and the technical assistant if he has any problems regarding his learning.

Figure 5.5: User Scenario for Gaining Support

Figure 5.5 above demonstrates the user scenario for obtaining support from the course tutor and technical assistant. In this case, the web technologies used to support Ali are contact and the helpline.

Activity	Selecting Support Tools
Action	Choose the helpline
Operation	Offering a platform for the student to communicate for instance the helpline and Contact. Provide a guideline for the student to use the tools

Figure 5.6: Function Hierarchy for Gaining Support

Table 5.6 explains the support mechanism in the function-hierarchy. The full list of Function hierarchies can be seen in Appendix A1. As mentioned earlier, the user scenario has been created based on the Malaysian perspective. Before creating the scenario, attention has been given to the activity system, which involves the subject, community, object and tools. Another sample of a user scenario is shown in Figure 5.7 below:-

To retrieve some information about the weekly topic, Ali has to go to the Course Content menu. From this menu, he can choose the topic to be learned independently every week. The menu includes the topics to be covered each week.

Figure 5.7: User Scenario for Course Content

The scenario above shows that the main activity in the scenario is 'Choosing the course'. From the activity, the action that will be taken by the student is 'Select the course content'. The system will then provide 'Display Syllabus, Content, Glossary and Search' as the operation in the activity. It can be explained in Figure 5.8.

Activity	Choosing the course
Action	Select the course content
Operation	Display Syllabus, Content, Glossary and Search

Figure 5.8: Function Hierarchy for Course Content

For the support tools, the function hierarchy will be written in different ways. For instance, if the students have any problems with the activity of 'Choosing course content', the support will be provided for this activity. A sample of the support mechanism is shown in the Figure 5.9.

Activity	Support [Choosing a Course]
Action	IF [Unable to use glossary, search tools, course content]
Operation	Provide a helpline and contact

Figure 5.9: Function Hierarchy for the Support Mechanism

Figure 5.9 shows the mechanism of the support tools in dealing with students' problems. The word 'IF' means that if the students have any problem regarding the use of glossary, the system will be able to provide the support tools such as helpline and contact.

In the function hierarchy, the main activity consists of four options, namely, Registering New Student, Choosing a Course, Do Weekly Main Task and Do an Evaluation. It will be followed by an action and operation of the system. For instance, to complete the 'Choosing a course activity' the students have to carry out eleven actions and the system will provide thirteen operations.

5.1.3 Mock Design

User needs extracted from the scenario were interpolated into the activity, action and operations and are known as the function hierarchy. The operations are represented by the mapping of the user needs with the technology (Helvert and Fowler, 2003). Thus, in order to get reflective feedback from the actual user, a mock design was created. Mock design consists of the implementation of the list of operations in the function-hierarchy. In this research, mock designs of the system were shown to the participants in the first iteration in the design process. This includes the design of the whole course and the support system. Appendix A2 shows the screen shot of the mock design.

5.2 Outcomes of the Pilot Test and Iterative Process

This section explains the outcomes of the pilot test and iterative process in the design stage.

5.2.1 Pilot Test

A pilot test was conducted before doing the data collection in Malaysia. The purpose of the pilot test was to: a) validate the instrument that is used in the evaluation b) establish the interview and focus groups protocol and c) gain experience before conducting the evaluation in Malaysia. The purpose of the focus group session was to validate the protocol and establish the focus groups protocol. Some questions were asked regarding the system features (interface, instructional strategies and support) and system improvement. The intention for asking this question was to gain feedback and suggestions from the students about the system. Thus, the experience of conducting the pilot study assists me to rationalise the focus group questions during the data collection. In the focus groups sessions, some very valuable feedback and suggestions were received from the subject in relation to the system and support system. Having revised the protocol of the first interview, it was more focused. The interview probes; checklist and objectives attached to every question helped me to gather valuable information from the respondents, especially

their suggestions regarding the prototype. Information related to the student's experience, problems and opinions about online learning were also obtained in this session.

The pilot test session which met the objectives of this session gave me an opportunity to examine the weaknesses in conducting the sessions and then provided a solution, improvement, strategies and guidelines for data collection in Malaysia.

5.2.2 First Iteration

Focus Group Results

The results of the focus group points out the outcomes of user needs and requirements gathered from the group of students. The result is very important to identify the students' needs and capture their requirements during the session. Some questions can be raised in relation to their needs such as 'What do they want to be added into the system?' and 'What is their feedback and suggestions to improve the mock design?' From the analysis of the results for the focus group sessions, the student needs can be categorised into several aspects such as: a) Navigation issues b) communication tools c) design considerations and d) type of support and instructional issues. The detailed results of the focus group sessions can be seen in Appendix B1.

In general the results show that the students prefer to use communication tools to avoid being isolated. For instance, it was suggested that they use SMS (Short Message Service), video conferencing, discussion groups and chatting sessions to communicate among each other. In addition, some of them recommended the advantages of communication tools for assisting them in technical and learning aspects. For instance, video conferencing tools are the most popular tools suggested by the student in all three sessions of the focus groups.

The second element identified in the focus group sessions is the navigational issues. Most of the focus group sessions recommended the use of concept maps for designing the main menu of the course content. However, in the mock design, this feature is not presented. At

this point, this result shows that the users prefer to include the concept maps into the system for their convenience.

For the design consideration, most of the students suggested adding the guideline page in the front page of the system. They also commented on the design of the system since the design was not appropriate for their specification. Regarding the learning issues, most of the students chose to do the online training in order to help them to minimise their technical difficulties.

For the support element, they suggested inserting online references, a printer friendly version, weekly announcements and specialist column and guidance tools, purposely to support them in learning.

Another interesting finding is that the students suggested incorporating the counsellor tools into the system. This was to assist them in dealing with emotional problems such as distress and demotivation when they are away from other students.

Interview Results

In the first iteration, some interviews were conducted with the course tutors who have experience in teaching using an e-learning system (see Appendix B2). From the analysis of the interview results, the user needs can be classified into several aspects of the design such as: a) instructional strategies b) navigation issues c) role of the moderator and d) interface designs. For the interface design, most of the course tutors commented about the screen design of the system. This includes the unbalanced screen design, screen resolution and small icons. This finding gives an indication that the course tutors are more concerned about the interface design of the system than the students.

Another finding from the interview session is that communication tools should be used effectively in order to promote high interaction between the students and course tutors. For example, the role of the moderator should be attached as a coach and guide for the students.

The important finding in the interview was the suggestion as to the best instructional strategies to be adapted into the system. Most of the course tutors recommended that the system should provide: a) an active learning environment b) collaborative learning through the course activity c) a highly interactive and user friendly system d) integrating the system with hypertext and hypermedia elements and e) a rich resources environment.

Another finding regarding support indicates that the course tutors proposed that the system should provide two types of support; learning support and technical support. For the learning support, they suggested adding in the moderator to maintain the chat sessions and discussion groups. In addition, the design of the system should be focused on the appropriate online resources to support the student with rich and quality resources. For the technical support, most of them suggested that a technical person should be included to support the learner with technical difficulties. For the technical aspects, they recommended that the student should be prepared with ICT knowledge before enrolling on the course. For example, this can be done by providing them with the online training course. They also suggested the concept of coaching and mentoring for assisting student learning through the system. Therefore, the role of the course tutor is not only as a knowledge expert but also as a guide for the student to minimise their problems in learning.

From an analysis of the transcripts I found that the students have their own particular needs in relation to the interface design, features, tools design and learning strategies. The main concern is how I categorize and filter all the suggestions and feedback. However, it is impossible to implement all of the needs and requirements of the subjects into the system. Therefore, before starting to design the actual system, some justifications were made for implementing the suggestions made by the students during the interview and focus group sessions. The justifications were made based on several factors such as literature, technology limitations and rational reasoning.

Modification of the Design

The findings from the interview and focus groups provided feedback about usability and user needs, especially in designing an online learning system. However, not all the suggestions and feedback were applied to the system. This is due to technological constraints and feedback overlapping with the existing features. Some modifications from the mock design were made before its implementation. The justification for implementing the users' needs into the system were decided based on several factors, for instance technological limitations and lack of expertise. For example, SMS is difficult to add into the system due to technological constraints. The list of modifications their justification can be seen in Appendices B5 and B6.

Implications for the Next Iteration

The first iteration was conducted in order to obtain the users' needs and requirements from the students and gain reflective feedback, comments and suggestions about the system from the mock designs. Therefore, the mock design was presented to the user since it represented the implementation the operations in the function hierarchy and consisted of the users' requirements. After getting the data from the users in the first iteration, some changes were made to the mock design including the interface, instructional strategies and features of the system. From the mock designs, some modifications were made from the finding from the first iteration. At this stage, the function hierarchy was revised and modified. Finally, on the basis of the modification, the first prototype was released and ready to go for the next iteration. The purpose of the next iteration was to carry out usability testing and system functionality.

5.2.3 Second Iteration

Results of Usability Testing

The results of the second iteration demonstrated that the system worked successfully with two pairs of students. This indicated that the system was reliable and usability testing

showed that every tool was functioning very well without any errors. However, the net meeting did not work properly because of a slow network connection. The findings also include some suggestions for improvements after the first prototype had been tested. The full results of the second iteration can be seen in Appendix B3.

Results of the Interview Sessions

The findings from the interview showed that several design principles should be included and removed from the system (see Appendix B4). Some of the features in the system are useful for learning and need to be retained such as:

- a) a digital library containing hyperlinks related to the course
- b) a moderator to monitor learning during discussion group sessions
- c) video conferencing tools are actually tricky to learn and difficult to understand especially for first time users and they need specific equipment.

The results of the interview indicated that the video conferencing tool is not necessary for an online learning environment because of its slowness. It does not contribute much to learning. The students added that this tool was just for fun without any contribution to learning. According to the student experience in using online learning courses, the video conferencing tool is not really a help for learning. Therefore, it should be removed from the system. The students also pointed out the importance of the helpline and contact menu in promoting sharing of learning, decreasing distress and promoting human touch and emotion in the online learning environment. Generally, the findings are valuable as a guideline in order to design the system. However, not all the suggestions will be implemented into the system.

Before developing the final system, some modifications were made based on the justifications of the second iteration. The list of justifications can be seen in Appendix B7.

5.3 Implications for the Design

Some of the findings in the interview were used to implement the system. However, not all of the feedback was used to develop the system. This was due to overlapped functionality, which was unsuitable for implementing into the system. For example, providing printed materials for online training is unnecessary because the student can print it straight from the Internet. Some suggestions were useful for the system, such as providing a step-by-step guideline for the student to use the system: online training and refresh button.

5.4 The Final System

The online learning system was developed using the Open Source web development programming. The screen shot of the final system can be seen in the CD-ROM. The open source software generally enables the user to view, modify and restructure the source code for specific purposes. In this research, PHPnuke was used as a PHP scripting language for development of the system.

5.4.1 What is PHPnuke?

PHP-Nuke is a web based automated content management system with the PHP as a scripting language and MySQL as a database (Wikipedia, 2006). It is fully managed by a web-based user interface and is known as a content management system (CMS). It is divided into two main sections: user and admin. The administrators have full control of the system and maintain it by using a web-based administration section. However, the users experienced some restrictions in accessing the website and tools based on the set-up created by the administrator. Figure 5.10 shows the overview of Content Management System (CMS). CMS consists of elements such as: a) database b) web server c) web browser and d) administrator module. Phpnuke contains several modules that allow the user to send private messages, use discussion groups, read an article and participate in chat sessions. It can be added easily from the admin module. All the data is stored in the MySQL database. MySQL is 'an open source database management system (RDBMS) that uses Structured

Query Language (SQL), the most popular language for adding, accessing, and processing data in a database' (Shop-script, 2006). It has become the most popular open source database and widely used on more than 20 platforms including Linux, Windows, OS/X, HP-UX, AIX and Netware (MySQL, 2006).

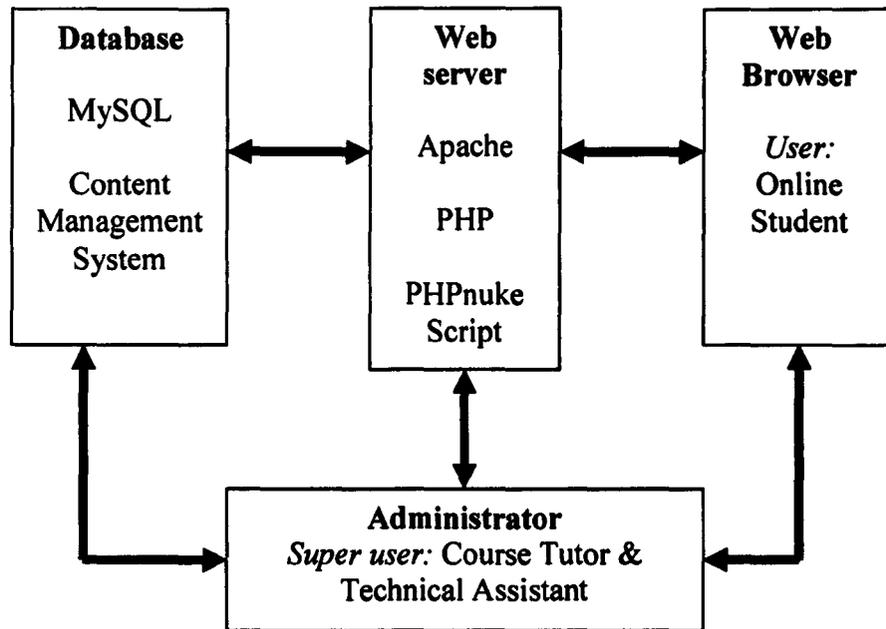


Figure 5.10: The Content Management System

In this study, PHPnuke version 6 was used for the scripting language and MySQL version 4 was used for the database with the Windows platform. In order to use the PHPnuke and MySQL database, an Apache Web server was installed and run on the Windows platform.

5.4.2 Modules in PHPnuke

In order to design the system with the users' needs and requirements, some PHPnuke modules were implemented in the system. The module and its functions are shown in Table 5.1.

Feature	PHPnuke Module	System
Interface design	Forum	Discussion group
Communication tools	SPChat	Chat session
	Forum	Discussion group
	Private message	Contact
Student tools	Shout box	Helpline
	Member list	Student webpages
	Nukeupload	Student learning presentations
Course content	Weblinks	Student learning resources
	Article	Course content
	Encyclopaedia	Student glossary
Evaluation tools	Search	Search
	News	Course activity
	News	Student assignment
Support tools	FAQ's	FAQ's
	News	Online training
Student registrations	Your account	Student registration
Additional tools	Who is online	People online
	Who is where	Tracking the user
	Staff online	Course tutors and technical assistants online

Table 5.1: The Module of the PHPnuke and System

The features of the system, as shown above, were designed based on the results of the first and second iterative evaluation.

5.4.3 Knowledge Domain of the System

This online learning material was designed and developed for use among teachers and education students to explore the learning of digital graphics through online means. The content in this computer-based learning material is based on UTM's teacher education curriculum, namely the "Digital Graphics" course. The course was divided into several topics, as shown in the table below.

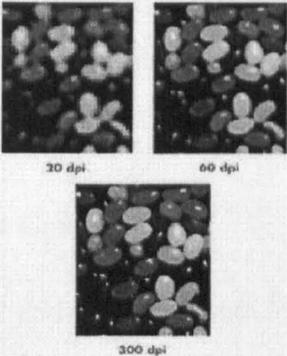
No.	Content	Sub-Topics
1	<i>Introduction to graphics</i>	Introduction to graphics
2	<i>Graphics categories</i>	<ul style="list-style-type: none"> • Raster image • Vector image
3	<i>Graphics quality</i>	<ul style="list-style-type: none"> • Resolution • Image size • Colour depth
4	<i>File format</i>	<ul style="list-style-type: none"> • JPEG • TIFF • PSD • GIF
5	<i>Types of graphics</i>	<ul style="list-style-type: none"> • Cartoons • Photograph • Drawing • Diagrams • Graphs
6	<i>Hardware requirements</i>	<ul style="list-style-type: none"> • Scanner • Digital camera • Printer • CD-R/CD-RW/CD-ROM
7	<i>Working with graphics</i>	Working with graphics

Table 5.2: Course Content

Designing the system involved several common lesson structures. Tutorial (Horton, 2000) is one of the most current models, which was used in designing the system. In this system, the student begins with an introduction to the graphics and then proceeds through a series of pages which contain the basic concepts of the graphics, including graphics categories, graphics quality, file format, type of graphics and hardware requirements. At the end of the sequence, the learner is provided with an example and practice session of working with graphics. This includes the use of the graphics software: Adobe Photoshop module, to deliver the advanced concept of graphics. The system also provides a flexible learning environment with a hypermedia and hypertext interface. A sample of the course content is shown in Figure 5.11.

? Image Size

- Image size refers to the height and width of the image, measured in inches, centimeters, dots, or any other unit of measure.
- Image size is a little tricky to grasp due to the fact that the resolution of an image can vary. For example, it is not of much help to know that an image is 3 by 5 inches if you do not know how many dots per inch make up the image.
- And, an image of 3 by 5 inches at 100 dots per inch contains the same amount of image data as does an image of 6 by 10 inches at 50 dots per inch.
- Alternatively, if the image size is measured in dots or pixels, then you know exactly how much image data exists because a 300 pixel by 500 pixel image contains 15,000 pixels no matter how many pixels you designate per inch.



30 dpi 60 dpi

300 dpi

●  **Online References**

- [Graphic quality for designing webpages](#)

Figure 5.11: A Sample of the Course Content

The system serves some complex and rich activities as a learner-centred learning facility. The learning activities were implemented by the students' tools. After a brief introduction, the students were provided with the tasks required to complete the activities. Some activities were performed by individuals, while others required groups of several students. The web tools provided allowed the students to choose an appropriate means by which to communicate with their peers or instructors.

5.4.4 Features of the System

The online learning system features several packages of Internet technologies such as e-mail, newsgroups and chat in order to allow the student to become active in their learning environment.

The main menu of the system is divided into five categories, namely: Student Tools, Evaluation Tools, Communication Tools, Support Tools and Course Content. Every category contains sub-menus, which allow the student to navigate the course at their own pace of learning.

a) Course Content

'Syllabus' and 'Content' both include the syllabus and course content of the course.

'Glossary' contains the list and descriptions of computer terms that will be encountered during the course. 'Search tools' provides the facilities to search the information based on the keywords typed by students.

b) Student Tools

The 'Student tools' option contains student web pages, student presentations and student learning resources. The student web pages tools allow the student to publish their personal web pages to other members of the course. Student presentation tools enable students to upload their presentation materials, such as power point files and HTML, to the server. This allows them to share their learning materials and shows them to other members of the course. The system also provides student learning resource tools, to help students obtain the learning resources required for the course.

c) Evaluation Tools

The 'Evaluation tools' option consists of course activities, and student assignments.

Course activities include the topic of the task to be completed by the student. For instance, the course presents a problem which students will try to solve, either in groups or as individuals. The students can discuss the problem using the communication tools and submit it to the student tools. They can acquire learning sources from the glossary and student learning resources.

d) Communication Tools

Private Messages

The Private Message is the most common method of interaction asynchronously. It is used for announcements, to afford feedback and to allow learners to communicate with each other and with the instructor. The private message increases two-way communication and give the students a greater sense of privacy.

Discussion Groups

Discussion groups can provide threaded discussions, and the member in the group can retrieve discussions at any time. In discussion groups, students are able to post messages relevant to their tasks. Other group members can then reply to the message.

Chat

Chat enables real-time conversations among a group of people on the Internet (Horton, 2000). The use of chat sessions in the system can provide a high-level engagement on the part of the students in the learning activities. In this study, the use of chat includes real time question and answer, problem-solving sessions, requesting support from the instructor and trouble-shooting sessions.

5.5 Conclusions

Chapter 5 explains the purpose and results of the first and second iterations based on the results of data collection in Malaysia and England. It also describes the modifications needed for the design and the overall structure of system development. The results from both iterations give an impact to the whole process of designing the system. Some justifications were made on account of the findings from the first and second iterations.

Chapter 6

Evaluation

6.0 Introduction

The purpose of this chapter is to describe the whole process of the methodology in relation to its implementation and the presentation of the results. Chapter 6 also explains the overall strategies, including the use of Activity Theory and system hierarchy, that have been adopted in collecting and analysing data. This chapter also rationalises these approaches as a practical way to design and evaluate the system in order to answer the research questions of the study. At this point, the activity structure was used to organise the functions hierarchy into activity, action and operations and this approach was adopted for the data collection in the evaluation. From another aspect, the chapter also explains how the activity system was used to present the case study in relation to the learners' perspective. Therefore, Chapter 6 will be divided into several sections including rationale for the evaluation, data collection and data analysis.

6.1 Rationale for the evaluation

In this study, two general approaches have been adopted in the study. The approaches are a) to use function hierarchy for both design and evaluation and b) to examine the system in action as the object of the evaluation. Therefore, Activity Theory has been used as a practical approach for both design and evaluation. The next section will justify the use of activity structure including activity, actions and operations for collecting data.

6.1.1 Activity Structure for data collection

In order to explain in depth regarding the approach, I would like to recapitulate the methodology of the study. In the design of the system, activity structure was used to organise the function hierarchy into activity, action and operations. As discussed in Chapter 3, activities are related to users' intentions; actions breaks down what the user must do to

achieve the activity; operations describes the functionalities in the software that must be available to the learner to achieve the actions and activities. This approach was used in the design phase because it helps to organise the hierarchy. However, in the evaluation, a similar approach was applied in order to facilitate me in collecting the data for evaluation. In more detail, the evaluation process focuses on the activity, actions and operations which rationalised the data collection methods in the study as follows:

a) Activity

Activity is considered as the overall process of the learner to complete the whole course activity. A method of analysing the student product was implemented to evaluate the students' outcomes from the activity. In the data collection, the student must engage with the activity in order to gain knowledge about the concept of graphics. The outcomes of the activity show how the system contributed to the students' learning and therefore answer the research questions in the evaluation phase.

b) Actions

In the evaluation, actions are known as to what the learner did during the learning process. In particular, this reveals what the user did to achieve the activity in the online environment. In order to examine this aspect in the data collection, two methods were used such as interviews and user tracking data. As mentioned before, interviews were used to gain student experience about how they learn using the system and what strategies they used in understanding the concept of digital graphics. In this particular situation, the interview justifies what the user actually did to gain knowledge about the digital graphics concept. The second method used is user tracking data. The user tracking data is the practical technique used to record the students' actions when using the system. It determines what the user actually did when using the system, for instance, what tools were used for communication and which content pages were retrieved.

c) Operations

The operations are known as what the system did in order to help the user achieve the activity and actions. In the data collection process, the operations were recorded through the system logs in the user tracking. The system logs will show how the operations provide the system functionalities in order to aid the learners to achieve the activity.

The approach of using the activity structure in data collection provides an effective approach in presenting the data in order to answer the research questions. Therefore, the section above describes the relationship between the methods used in the study and the function hierarchy in the data collection. Finally, it justifies the choice of using student product, interview and user tracking as methods for collecting evaluation data.

6.1.2 The Activity System Used to Present the Case Study

a) Case Study

A case study was chosen as a practical approach to organising a range of data about the object, particularly the learners in this research. The data from the evaluation consists of a variety of learners' interactions in the activity system. For instance, the interaction between the learner and the community is the situation in which the learner interacts with the course tutors, other learners and technical assistants. This kind of interaction will show the relationship between their process of learning using the system and the product (in this case their assignment) after the learning session. Therefore, to organise the set of data, case study was used to show how the processes and products are related in practice. This approach gives an effective approach for illuminating the research questions. To elaborate more about the processes and product, I give two examples of how it provides a practical approach in answering the research questions.

Firstly, one of the research questions in the evaluation phase is, how do students make use of the tools in the system? To answer this question, the interaction between the learner and

the tools in the activity system is shown, to see how the learner utilise the tools in the system to gain the knowledge and skills of the concept of digital graphics. This interaction shows their process of learning in relation to how they use the tools.

Secondly, the research question is; what is the contribution of the system to the learning outcomes? In order to respond to this research question, the analysis of the student product was used to examine learners' performance after the learning session. The results of the analysis show the learners outcomes of understanding the concept of digital graphics. Therefore, it shows the relationship between the process of the learning and outcomes (product) of the students.

Obviously, as mentioned above, the case study was used in order to show the relationship between the process of learning and the student outcomes in practice. Therefore, with this approach, the data for each learner can be organised effectively and finally provide a useful approach in answering the set of research questions in the evaluation phase.

b) Outline of the Case Study

The framework of Activity Theory was chosen to analyse the evaluation data. The analysis itself was divided into five episodes for each case study. Each episode answers the relevant research question in Chapter 4.

The Context of the Activity Theory

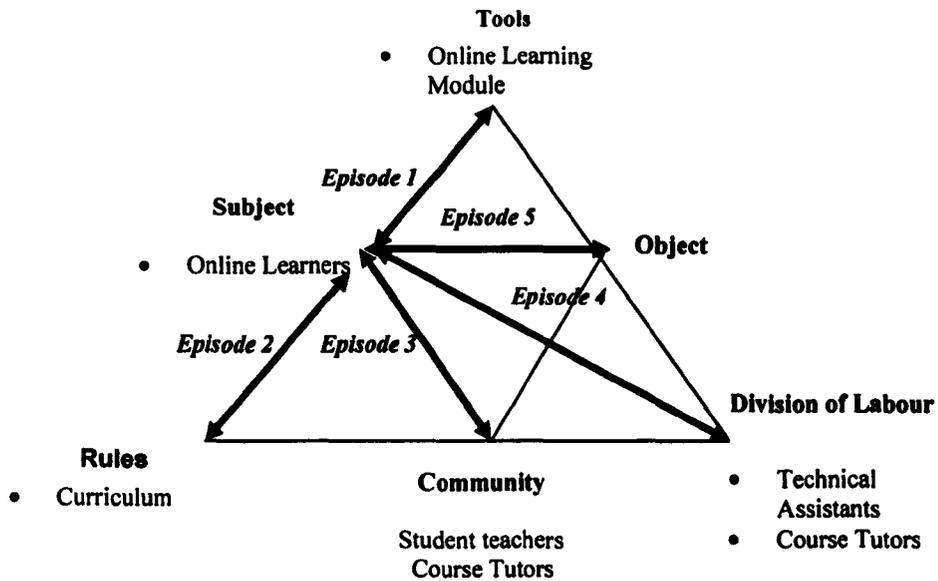


Figure 6.1: Activity System

Before discussing the relationship between the Activity Theory and the subject, let me explain the overall relationship between the subject and its activity system. Figure 6.1, shows the overall activity system in the context of the online learning environment. In order to develop the activity system in depth, the context is divided into a number of episodes, as follows:

Episode	Relationship	Where?	How?	Research Questions (Evaluation Phase)
Episode 1	Interaction between the subject and the tools	Overall pattern of usage of the tools	Analysis of student interaction from monitoring programme	Research questions 3 and 2
Episode 2	Interaction between the subject and the rules	Course materials	Online interviews	Research question 1
Episode 3	Interaction between the subject and the community	Communications tools	Monitoring programme	Research question 4
Episode 4	Interaction between the subject and the division of labour	Support system	Monitoring programme	Research question 5
Episode 5	Outcomes of the activity	Students product	Analysis of student product	Research questions 6 and 7

Table 6.1: Rationale of the Activity Theory Episode

Table 6.1 shows the rationale of the Activity Theory episode for the data analysis evaluation. Each episode has significant links with the subjects in the activity system and therefore answers the research questions.

Episode 1 explains the pattern of use of the tools by the subject during the learning session. At this stage, we can identify how the students make use of the tools in learning digital graphics. These include communication tools, course materials, student tools and course activity.

Episode 2 describes the interaction between the subject and the course materials. Data from the online interview was gathered to determine what they had learned. This data tells us about their learning experiences and strategies, and it supports the interaction between the subject and the course materials.

Episode 3 explains the relationship between the subject and the community. In this situation, synchronous and asynchronous tools were analysed in order to identify the significant interaction between the subject, the course tutors and the other students.

The relationship between the subject and the division of labour was explained in Episode 4. In this episode the analysis is focused on support and is related to course tutors and technical assistants as well as the division of labour.

Finally, Episode 5 focuses on the analysis of student outcomes. This analysis is very important to determine the success of the whole activity. The student assignments are analysed, based on several criteria, as noted in the task specifications.

6.2 Data Collection

6.2.1 Sample

User-tracking of the system was administered to the distance-learning students from the School of Professional Development and Continuing Education (SPACE), the University of Technology, Malaysia. Eight subjects participated in the study. Most were student teachers with at least five years teaching experience. The rationale for selecting the participants was related to the real subject who was involved in the activity system. Table 6.2 illustrates the demographic background of the respondents.

Sample Total	Age	Gender	Profession	Teaching Experience
8	30-41	Male (5) and Female (3)	Full time teacher / Part time student	> 5 years

Table 6.2: The Background of the Sample

The reason for choosing the sample is the research background associated with the online learning environment. Therefore, it is important to select the subject with regard to their

experience of online learning, especially in the Malaysian perspective. The subjects were chosen based on their context according to the activity system as discussed in Chapter 3. In this study, the scope of the sample is Malaysian higher learning students who enrolled in distance learning courses that were conducted by one of the higher institutions in Malaysia.

6.2.2 Background

The actual learning session was set up at the beginning of the semester. Before conducting the online learning session, a demonstration of the online learning module was given to the course tutors. Prior to this session, the students were asked to register online. In the first week, the preliminary session was conducted to ensure that the students were familiar with the system before the actual learning session started. They were requested to explore the online module for about a week. At this stage, I noted several errors and faults for the last time, before the actual session started. After the preliminary session, the students were asked to participate in the activity given in the module. The session was divided into three phases.

Phase 1: Learning Session

The learning session started at the beginning of the semester. The students were required to enrol in the digital graphics course, which formed part of the multimedia course. A digital graphics course was one of the topics to be taught in the Multimedia Technology course, which required every student to enrol as a requirement for the Bachelor of Education. This course is normally taught in the first half of the semester and is followed by the Digital Video topics. However, in this research, only the digital graphics topics were implemented during the online learning session.

In the learning session stage, the students were asked to discover the system at their own pace. The aim of this stage was to ensure that they explored the course materials, glossary and learning resources provided by the system. The rationale of this session was to observe

their interaction with the course materials and tools and to study the relationship between the subject, rules and tools in the activity system in the first stage of evaluation.

Phase 2: Online activity

The aim of this phase was to encourage the students to use the communication tools, especially the synchronous and asynchronous ones. They were able to contact each other through private messages, discussion groups and chat sessions. As the importance of this stage was the interaction, we can examine how they made use of the system and what the relationship between the subject, the community and the division of labour in the activity system was.

The discussion groups were divided into four categories, such as Course Activity, Learning Problems and Technical Problems organised by course tutors and technical assistance. Each discussion group was open to all the students and they were encouraged to participate in contributing and discussing ideas. To ensure that the students engaged in the discussion groups, course activity was created and the students were obliged to send their contributions. The focus of the course activity was to encourage them to use the tools and interact with their friends and course tutors.

In the chat session, four channels were created, including Learning Problems, Technical Problems and Course Activity. As discussed previously, and based on the interview data and user needs, the chat session was designed as a platform for the students to discuss their learning and technical problems synchronously with other people. Therefore, the system provided various channels for the student to use in the chat session. The helpline was one of the platforms for them to send their learning problems and technical difficulties.

Phase 3: Student assignments

At the end of the learning session and online activity, the students were required to submit their assignments to the server. The details of the assignment were published on the front

page of the online module. In the final week of the learning session, the students were reminded of the assignment. This message appeared on the front page of the module. One session was conducted to discuss the assignment and the skills needed to complete the graphics assignment. The rationale for evaluating the students' assignment was to examine the outcomes of the activity system. It was possible to do this by analysing the student product. The rationale of these activities is shown in Table 6.3.

Online Activity	Duration (estimated)	Rationale	Relationship with Activity Theory
Learning sessions			
	2 weeks	<ul style="list-style-type: none"> To ensure that the student is familiar with the course materials and tools provided in the system 	Interaction between the subject, tools and curriculum
Course activity 1			
	2 weeks	<ul style="list-style-type: none"> To encourage the student to use communication tools i.e. synchronous and asynchronous tools 	Interaction between the subject, community and tools
Course activity 2			
	2 weeks	<ul style="list-style-type: none"> To encourage the student to use communication tools i.e. synchronous and asynchronous tools 	Interaction between the subject, community and tools
Course activity 3			
	2 weeks	<ul style="list-style-type: none"> To prepare the student for the course assignment 	Interaction between the subject, community and tools
Ongoing activity			
	All weeks	<ul style="list-style-type: none"> To provide support To encourage the student to actively engage with the system To examine the interaction with the support tools and system To allow the student to give and ask for support 	Interaction between the subject, division of labour and community (student support)
Student assignments			
	2 weeks	<ul style="list-style-type: none"> To allow the student to finish the course assignment 	Outcomes of the activity (student product)

Table 6.3: The Rationale of the Online Activity

Table 6.3 shows the rationale of the online activity and its relationship with Activity Theory. The activity was designed with reference to the Activity Theory framework, as

discussed in the previous chapter. The results of the activities were transformed into outcomes. Thus, the analysis of the graphics assignment helped the researcher to understand the outcomes from the activity.

Length of evaluation

The evaluation took about two months and it was conducted in parallel with other evaluation methods, such as the monitoring programme and the interview. During the learning session, I acted as a moderator and technical assistant for monitoring the students.

6.2.3 Student Preparation

Before participating in the learning sessions, each student had taken the prerequisite subject, such as Instructional Design, which emphasised the design of educational courseware in previous semesters. In addition, this course exposed the student to some principles and important elements in designing the educational courseware including building the storyboard and applying educational theory to the system design. This experience will integrate the use of technologies in the learning environment and stimulate their creativity. Creativity is one of the elements that will be evaluated during the end of the learning session. Computer literacy is one of the prerequisite subjects undertaken by the students in the previous semester. Taking this into consideration, the students have understood how a computer works and how to employ basic applications of the computer software such as Internet browser and word processing.

They have a basic knowledge about the Internet and some applications since they have enrolled on the Computer Literacy course during the first year of the study. However, using the system is different and therefore, the orientation sessions were conducted in order to familiarise the student with the online learning system.

Orientation Sessions

Before an actual learning session was held, the student was given some orientation time, about 2 weeks. The purpose of the orientation weeks were to:

- a) Make the student familiar with the system, its features and the interactive facilities it provides. The system includes some complex facilities including private messaging, forums, concept maps and chat sessions and requires a basic skill with using the Internet.
- b) Give some exposure to the student about the system before the actual learning session.

Procedure

Before the sessions started, the course tutor was contacted to discuss their role during the orientation week. The collaboration between the course tutors was made before the learning sessions and they were acting as course coordinators in the learning sessions. During the orientation week the tutors sent a guidance email asking students to log-in to the website. Then, they were given guidelines about how to use the website including:

- a) How to register as a first time user
- b) How to log-on to the system
- c) How to use the facilities in the system

In order to assist the student in using the system, several guidelines were provided for the first time user including Frequently Asked Questions (FAQ's), course objectives and online training.

Some procedures were given to the students in order to guide them in using the system such as:

- a) Create a first time user page to guide a student whilst using the system.

In this page, the first time users were given some direction about the student's registration guidelines. On the same page, they were also provided with a technical assistant and course tutor email for helping them if there were any problems during the registration sessions.

b) Create FAQ's as guidelines if they have any problems.

The front page also provides the FAQ page which offers the first time user information about questions and answers regarding the student's registration and system facilities. In addition, the system also provides a course objective and the course activity at the left side of the front page. The rationale is to facilitate the student with some guidelines about what to do each week and what goals should be achieved during that week.

c) Make the student aware of the email and private messaging systems that they have to use if they have any queries regarding the system.

The moderator also prepared the existing facilities to support the first time user. For example, the email and private messages were provided in order to respond to any difficulties that the student had during the orientation weeks. This is to ensure that they have mastered the skill of using the facilities. At the same time, a technical assistant will be acting as a moderator in order to deal with any questions that arise.

d) Ask the student to use any facilities in the system.

In the orientation weeks, the students were asked to explore the facilities especially synchronous and asynchronous interaction. The exploration techniques can stimulate the student to use these tools in their learning.

Online Activity

At the beginning of the course, most of the students were asked to participate in the course activity and use the facilities that are provided by the system. At this stage, students were

required to use all the facilities such as private messaging, discussion groups, concept maps, web links and chat sessions in order to increase their skills in using the system.

Learning Approach

The approach to learning is an exploratory learning in a rich resources environment and is integrated through the use of scaffoldings. Students were asked to explore the content and participate in weekly course activities. They were involved with the activities which required them to use the facilities in order to enhance their learning. In addition, the course tutor and technical assistant acted as facilitators to support their learning and technical problems. At the same time, scaffoldings were given to the students such as hyperlinks and course content and concept maps and web links. Web links give some references for them to learn about associated sub-topics.

6.2.4 How the Data was Collected ?

a) Observation

The monitoring programme is one method to discover student action using the system (McAteer, 1998). It helps me to track their activity and their action. To ensure that the student is really showing a true understanding of the effectiveness of the system, I examine their activity and actions. From this, I can see the correlation between their perception and their action.

From this evaluation, several data were obtained, including:

- a) those about student activity and actions using the system,
- b) student learning activities,
- c) how the students learn using the system.

These data are important for examining how they learn and what they learn from the system.

Procedure

In order to analyse the students' action, the IP Tracking programme was installed in the system, which automatically recorded the individual's navigation path. The students' identification was tracked by their Username. Every one of their interactions was recorded by the system itself once the students logged-on to the system. All the data were stored in the database and could be retrieved remotely from the admin module. The data were analysed using the spreadsheet programme.

Instrument

The data were recorded synchronously with the IP Tracking program from the PHPnuke module. A set of data from this program was analysed using the MS Excel. It was sorted into categories according to the purpose of the research. This helped the researcher to obtain information about how the students learned and made use of the system during their learning sessions.

b) Analysis of the Student Product

Multimedia is a 'hands-on' subject. It is one part of the method employed to evaluate the students' assignments. By using it, we can measure whether they have achieved their learning objectives or not. This method specifically uses the student product to obtain data about his/her achievement using the system. Based on these results, it is possible to examine the effectiveness of the system and determine what the students learning outcomes are. The results of the analysis of the student product are correlated with the monitoring program and the interview.

Procedure

The students were given the course activity to be completed. In order to measure the effectiveness of the learning outcomes, the assignments were analysed according to several

criteria. For example, they were given their course assignment and had to submit it online and then the entire file was analysed. An analysis of the student product provides evidence of the learning outcomes of the system. From this evaluation, some data were obtained concerning the effectiveness of the learning when using the system, the student learning outcomes and the relationship between the learning and the system.

Student Assignments

The analysis of the students' outcomes was based on several criteria, for instance, at the end of the course, the student had to be able to:

a) understand the concept of graphics, including different types of graphics, colour resolution, colour depth and image size, and b) acquire the skill of using the graphics editing software. In addition, the judgement of the quality of the student product had to include the ability: a) to understand the concept of graphics, and b) to use the graphics software in their assignment with the specifications given in their tasks.

Therefore, in order to examine their learning achievement, the student had to successfully complete the task given in the assignment. The task included the Graphics Assignment below:

Course Activity: Graphics Assignment

Create ONE poster using Adobe Photoshop with 640 x 480 resolution. Your poster must meet the specifications below:

- a) Your original work must be combined with scanned images, illustrations or text and related to the area of multimedia and education
 - b) The standard compression formats of GIF and JPEG must be used for your poster
 - c) You must UPLOAD your file using the Student Presentation menu.
-

Figure 6.2: Graphics Assignment

The files must meet the criteria for the assignment. For example, if they submitted the graphics file, it must be in 640x 480 pixels and GIF or JPG format. The file also contains a combination of scanned image and other pictures.

The Relationship between this Evaluation and the Function Hierarchy

This method gives me data about student activity using the support system. It shows me what action the students take if they are having problems in the online learning environment. Therefore, it can be determined whether the support system is really useful and gives full assistance for online students.

The evaluation can examine the quality of the student's activity and action in the system hierarchy. From the evaluation, we can learn his/her perception of the support system and the data will show whether the system hierarchy is well designed to support their learning environment.

c) Online Interviews

The purpose of the student interview is to ascertain their views about the learning experience using the system, including strategies, outcomes and approaches. The instrument protocol used in the interview sessions consists of a series of open-ended questions, including some about the student's experience when making use of the system for learning digital graphics.

Procedure

The interview sessions were conducted remotely both in England and Malaysia. The difference in time between Malaysia and England is about eight hours. Therefore, to manage this disparity, each respondent was emailed with reference to their availability and their schedule a week before the interview began. After their agreement, one email was sent concerning the tools preparation and the time plan for the interview. Both computers were installed with Yahoo Messenger. This is one of the communication tools that allow people to communicate synchronously at a distance. However, the communication is limited to chat sessions only. Before the session started, the researcher was given some brief information about the research, including its objectives and contribution. All the

interview sessions were automatically recorded into the archive provided by Yahoo Messenger.

Instrument

The instrument that was used in the interview session consisted of an interview protocol. It included a set of questions about learning experiences and outcomes. These questions are also related to the students learning strategies and the approach to learning used during the learning session. Due to geographical constraints, the Yahoo Messenger tools were used to obtain the interview data. During the interview sessions, the tools were installed for on the computer, for the interviewer and the interviewee. This approach was effective and convenient for gathering data because distance-learning students do not have much time and are bound by a tight schedule

6.3 Data Analysis

An activity contains various artefacts such as tools, division of labour, rules and community. Therefore, the links between the artefacts of an activity are not direct but mediated. For instance, the tool in the activity system mediates between the subject and object. It means that in order to achieve the goal of the activity, the tool must be utilised to transform the object into outcomes. In the study, tools are known as asynchronous and synchronous. They are provided in the system to be used by the subject to achieve the learning objective. The intention of case study analysis is to identify and determine the interaction of the subject with the artefacts surrounding them. Therefore, the Activity Theory framework was used to analyse the data. The rationale of using this framework was that it gives a practical approach to analysing the relationships between the subject and the artefacts in the activity system, and eventually answers the research questions. The analysis itself was divided into five episodes for each case study. Each episode represented the interaction and relationship between the subject and the artefacts such as tools, division of labour, rules and community.

Artefacts	Research Questions (Evaluation Phase)
Interaction between the subject and the tools	Research questions 2 and 3
Interaction between the subject and the curriculum	Research question 1
Interaction between the subject and the community	Research question 4
Interaction between the subject and the division of labour	Research question 5
Outcomes of the activity	Research questions 6 and 7

Table 6.4: The Relationship Between the Subject and the Artefacts

In order to answer the relevant research question, Table 6.4 demonstrates the links between the structures for analysis in the case studies. The outcomes of the analysis will provide the facts about how the subject learns, what they learn and the contribution of the system and support to their learning.

6.3.1 The Method for Coding

As mentioned earlier, three methodologies were implemented for evaluation of the system including user tracking, online interview and analysis of student product. For analysing of the user tracking methods, I have used a coding technique to categorise the student's interaction and content analysis. Some of the relevant codes were identified for analysing the interaction of asynchronous and synchronous tools such as discussion groups, chat sessions, the helpline and private messages. Every code represents the activity that the student did during the learning sessions as shown in Table 6.5.

No.	Coding	Definition	Activity
1	CA	Discussion group	Subject reads and posts the learning in the discussion groups
2	CS	Chat session	Subject participates in chat sessions
3	HL	Helpline	Subject reads and posts technical and learning problems in the helpline
4	PM	Private messages	Subject receives, reads and replies to messages from other users

Table 6.5: Coding for the Tools

Table 6.6 demonstrates the definition of the code for analysis purposes. After the coding was defined, it was applied to the user tracking data as follows:

No.	Date	Activity	Actions
9	17/01/2005 09:36	Selecting the helpline HL1	HL: anybody who knows about to created effect in Photoshop. Can you please contact me via Private Message?
9	17/01/2005 09:39	Logout	
10	18/01/2005 15:56	Selecting discussion group DG2	Course activity 1 I think the relationship of graphic and animation are animation made from the movement of graphics. That the only I know about it.
	18/01/2005 15:58		View forum index
	18/01/2005 15:59		Read forum topics
	18/01/2005 16:00		Read forum topics
	18/01/2005 16:01		View forum index
	18/01/2005 16:02		Read forum topics
	18/01/2005 16:04		Read forum topics
	18/01/2005 16:05		Read forum topics
10	18/01/2005 16:08		View forum index
10	18/01/2005 16:10		Read forum topics
11	19/01/2005 17:05	Selecting the discussion group DG3	I cannot find the sub menu to rotate the image. What menu we should use to rotate the image? Anybody please direct me how to do it.

Table 6.6: A Sample of User-Tracking Data

In the user-tracking data, it is difficult to determine the interaction between the subject and the community since the data will come out with the date and the learner's actions.

However, to overcome this problem, the coding methods provide a systematic approach to analysing the interactions and the content in relation to what page the student has been exploring, what message they send to other users and when they read the message. This data is important to clarify the actual interaction of the subject during the learning sessions. Therefore, Table 6.6 demonstrates the use of the coding technique to assist me in analysing the complexity of students' interactions. This is useful to capture and analyse the user interaction every single second. The outcomes of the interaction were therefore categorised in relation to their form of usage. For instance, after the coding of the interaction has been made, it will transform into a list, and the type of interaction is shown in Table 6.7.

No.	Date	Activity	Actions
1	10/01/2005 18:54	Selecting chat	View chat rooms
2	10/01/2005 18:55	CS1	Participate in chat Chat Room: learning problem Conversation: about graphics resolution
3	10/01/2005 18:56		Participate in chat
4	25/01/2005 17:31	Selecting chat	View chat rooms
5	25/01/2005 17:32	CS2	Participate in chat Chat Rooms: technical problems Conversation: about scripting error
6	25/01/2005 17:32		Participate in chat
7	18/01/2005 18:04	Selecting chat	View chat rooms
8	18/01/2005 18:05	CS3	Participate in chat Chat rooms: learning problems Conversation: about graphics software
9	18/01/2005 18:07		Participate in chat
10	15/01/2005 18:56	Selecting chat	View chat rooms
11	15/01/2005 18:56	CS4	Participate in chat Chat Rooms: learning problems Conversation: about graphics format
12	15/01/2005 18:56		Participate in chat
13	03/02/2005 17:58	Selecting chat	View chat rooms
14	03/02/2005 17:58	CS5	Participate in chat Chat rooms: technical problems Conversation: about private message

15	03/02/2005 17:58		Participate in chat
16	24/02/2005 18:10	Selecting chat	View chat rooms
17	24/02/2005 18:10	CS6	Participate in chat Chat rooms: learning problems Conversation: about image enlargement
18	24/02/2005 18:11		Participate in chat

Table 6.7: A Sample of Chat Session Activity

Table 6.7 illustrates the results of the chat session activity undertaken by the subject. From the table above, it tells us how many times the subject participates in the chat session and what topic was discussed during the learning sessions.

As mentioned in the previous paragraph, the rationale for using the coding method is that it provides a systematic and practical approach to identify and categorise the data from the user tracking module since the user tracking data comes with the date and actions taken by the user. Therefore, this technique is useful to assist me in identifying and analysing the interactions between the subject and their artefacts in the activity system.

Analysis of Student Product

One of the methods used to examine the learning outcomes for the student is analysing their learning product. However, several criteria must be assigned to discover the success of the product in relation to learning. Therefore, to scrutinize this, I created the outline of the specification and criteria for evaluating the student outcomes from the learning activities. Table 6.8 shows the criteria for evaluating the student's assignment/product.

Specifications	Criteria
1. Original work	Original ideas
	Creativity
2. Combined with image, illustration and text	Image, illustrations and text
	Image and illustrations only
	Image and text only
	Text and illustrations only
	Text only
	Image only
	Illustrations only
3. Related to multimedia and education area	Multimedia and education
	Multimedia only or education only
	Other areas
4. Standard format GIF or JPEG	GIF or JPEG
	Other formats
5. Resolution must be 640 x 480	640x480 pixels
	Other formats

Table 6.8: The Criteria for Evaluating a Student's Assignment

Table 6.8 illustrates the specifications and the criteria for evaluating the student's assignment after the learning session. The student must meet the criteria for evaluation in order to identify their accomplishment of the learning of digital graphics. For example, one of the specifications of the assignment is that the poster must be combined with an image, illustration and text. However, if this specification is not presented in their poster, it will be considered that the student has not gained the knowledge to apply the skills and therefore this will affect the result of their learning outcomes.

6.4 Conclusions

Chapter 6 explains the whole process of the evaluation of the system including the methods, procedure of the evaluation and how the data was analysed. This chapter also describes the coding method for analysing the communication tools during the learning

session. The next chapter will discuss the results of the evaluation and four case studies will be presented.

Chapter 7

Case Studies

7.0 Introduction

Chapter 7 explains some case studies of students learning using the system. It describes the case studies of four different learners. The case studies consist of an explanation about the interaction between the subject and the tools, the rules, division of labour and community. It also explains about the system contribution to learning and the support contribution to learning. At the end of the case studies, the outcomes of the study and the conclusions will be discussed. The purpose for presenting the case studies is to examine how students learn through the system and use the support tools to achieve their learning outcomes. Moreover, the results of the case study may reflect the entire design of the system. It explains how the students use the system, what impact it has on their learning and their relationship to the activity system. In this case study, several findings have been used to illustrate the learning processes and its relationship with the activity system. This includes the interaction with the system, the use of the system, the use of synchronous and asynchronous tools and the interaction within the community. Several methods have been used in order to gather the data, including data logging, interviews and the transcription of synchronous and asynchronous sessions.

The framework for the Activity Theory was chosen to analyse the evaluation data. The analysis itself was divided into five sections for each case study. The rationale for choosing the learners in the case studies is because their approaches to learning and interaction in the activity system are different during the learning session. Each learner has their own learning strategies and pattern of interacting with the artefact (tools, community, division of labour and rules) in the activity system. Beside that, another reason for choosing the learners is to examine the pattern of interaction in relation to the learning strategies, usage of tools and their experience of learning, since they have different approaches to learning using the system. In order to categorise the students for my convenience in the research, I have labelled the students with a phrase such as enthusiastic, reluctant and passive.

However, the label does not reflect any objective judgement on the students and it is only for research purposes.

Definition of Terms

According to the Oxford Dictionary (1995:988), reluctant is 'unwilling therefore slow to act', enthusiasm is referred to as 'a strong feeling of excitement; great eagerness' (Oxford Dictionary, 1995:385) and passive means 'asserting oneself; not active' (Oxford Dictionary, 1995:847).

From the definition, we can state that a reluctant student is the kind of person who does not want to contribute his/her knowledge to the activities. In this research, the reluctant student is unwilling to help another student, but uses the tools to obtain assistance for her/himself. However, the enthusiastic student is the opposite of the reluctant student. The enthusiastic student can be defined as active, highly committed to their work and a contributor to the learning. A passive learner is referred to as inactive, a selfish learner and someone who prefers to work alone in his/her learning process. The definitions above have been made from the analysis and results of the case studies.

7.1 CASE STUDY 1

Ali: The Enthusiastic Learner

Ali was a part-time distance learning undergraduate student from the University of Technology in Malaysia and enrolled as a Bachelor of Education. He was also a full time teacher and currently teaching at a secondary school in Malaysia. Ali was 35 years old and an adult learner. He had moderate IT skills and had some experiences using the Internet and computer applications. This is the first time he had used the online learning system for his course.

An enthusiastic person can be defined as an active, highly committed student and a contributor to learning. Ali was classified as an enthusiastic learner since he had the tendency to give assistance to the other students and share his knowledge about the concept of digital graphics. This category is appropriate to Ali as he had the ability to use the tools for helping other students and he liked to interact with the other students in sharing his knowledge. In general, Ali could be categorised as an excellent and hardworking student and he was always committed to the course. As mentioned before, this label does not reflect any objective judgement on the students. It is only used for classification of the users.

7.1.1 Interaction with Tools

This section explains Ali's use of the tools (online learning module) in his learning session (see Appendix C1). The main focus of this section considers how he used them to achieve his learning objectives. Table 7.1 shows how he made use of the various parts of the system during the time he worked with it.

Session	CM	DG	CS	PM	HL	Learning Support	Technical Support
1	√						
2		√	√			1	
3		√			√	1	
4					√		
5	√						
6			√			1	
7			√			1	
8	√	√			√		
9	√						
10		√	√	√		3	3
11	√						
12	√	√		√	√		1
13	√	√	√				
14		√				1	
15		√	√				2
16		√		√		3	
17					√		1
18	√						
19	√			√	√		
20		√			√		
21					√		1
22				√			1
23				√			1
24		√	√		√	2	1
25	√				√		
26		√			√		1
27					√		1
28	√						
29	√						
30	√						

CM – Course Material; DG- Discussion Groups; CS – Chat Sessions; PM – Private Messages; HL- Helpline

Table 7.1: Ali's Use of the Tools

Session 10 was the busiest day for Ali during his learning sessions. In this session, he sent a message and replied to the topic of the discussion groups about seven times. This was about technical problems, such as unstable chat session problems, and occurred at 16:49. He followed this by sending a message about a scripting error at 16:55. At 18:33, he sent another about learning problems related to ready-made graphics in a course assignment. At 18:37, Ali sent a query about the graphics software, Adobe Photoshop. He also sent feedback the same day, at 18:41, about the best animation software on the market. At 19:02, he posted a message about animation and graphics principles. The same day, he also

participated in the chat session about scripting errors through the chat problem room. The final activity in Session 10 involved sending a private message to the course (tutor/participants?) about buying a digital camera.

This session showed that Ali started to make valuable use of the tools in order to resolve problems regarding his learning and technical difficulties. The function of the tools in these activities was to help him achieve his learning objectives by discussing his problems with other people. On the other hand, the tools, especially those for communication, helped him not only to interact with other people, but also provided him with opportunities to help others deal with their problems.

Session 10 also showed that Ali made use of the system in various ways, such as by:

- gathering information about the course content
- giving feedback
- gaining support for learning problems and technical difficulties.

He showed his skill with the tools and made effective use of them to improve his learning. In Activity Theory, the concept of tools is one of mediating between subject and object.

Prior to the above, there was a steady build up as he familiarised himself with the system. First Ali read the course content in the main menu. Next, he used the chat session to enquire about graphic resolutions. Ali spent time obtaining help about the course content, specifically on how to browse the course content in Session 3. On the same day, he sent his opinion to the discussion groups about graphics and animations. Then, in Session 5, he tried to understand the course content by reading about graphics quality and other topics. He was involved in a chat conference for a second time in Session 6, providing feedback about how to change the graphics format.

This behaviour shows that Ali made very useful interactions by providing meaningful feedback for the other students. After several sessions, he started to supply feedback about the graphics format for the first time in Session 6. He made effective use of the tools by developing his learning and by sharing his knowledge with the other students.

Ali used the chat mechanism for feedback to Naz about good graphics software in Session 7. The data from Session 8 shows that he spent time retrieving material from the discussion group; then followed this by sending his comments about the scripting error. The session ended with Ali reading the helpline and course content. In Session 9, he began his learning session by again reading the course content and followed this by participating in discussion groups about image enlargement. He received support from the helpline regarding the scripting error. He also gave his reaction to Shah regarding the scripting error, which indicated that Shah had the same problem as him. In this session we can see that Ali liked to share problems and information with other people. The use of the tools also helped him increase his understanding of the topic by sharing ideas and information with others.

Sessions 8 and 9 show how Ali made use of the system to gain technical support. This data shows that he used the system not only to gather information about digital graphics but also to gain technical support. As well as helping with learning problems, tools can also be applied to minimise technical problems.

The next day, in Session 11, Ali only browsed and read the course content. This may have been because, on the previous day, he had engaged in a lot of activities.

In Session 12, Ali spent his time reading messages from the other students and followed this by sending his advice to Naz on how to save the graphic file from the Internet. Next, he gave his response to Dilla about the low-end animation software. After reading the other postings, Ali provided Dilla with feedback about 2D animations and the uses of graphics on the web. The last posting by Ali was about low-end animation and went to Dilla.

Session 12 showed that Ali had gained a lot of knowledge from the system. Furthermore, this session showed that Ali sent three different responses about learning. In this session, he resolved the difficulty regarding the course content and the learning problem by helping other students.

Ali did not do many activities in Session 13; he simply explored the course content in the morning and ended by reading the other students' postings in the evening. In Session 14, he sent four postings to the discussion groups. These included a query about graphics software, Adobe Photoshop, some feedback about greyscale in graphics, a query about the best web development software and finished by looking at an online video and audio tutorial.

His learning activity became more productive in this session, with feedback about greyscale in graphics. Instead of asking questions in this session, Ali gave some useful feedback about a learning process, particularly about changing colours in graphics.

In Session 15, Ali sent a message about problems relating to the net meeting and, on the same day, he also took part in some chat sessions discussing Private Messages. In Session 16, he posted a message to the discussion group about the use of graphics in designing websites and how to create animation on the web. He also sent one about graphic tutorials in Malay and asked a question about how to change colours in graphics. The last posting to the discussion group was about digital cameras and he enquired about the latest models on the market. At the end of the session, Ali sent a private note to the course tutor about buying a new printer.

At this point, Ali started sharing what he has obtained from the other website. As a result, he sent the graphics tutorial in Malay as guidance for his friends to carry out the assignment. This proves that he was making his knowledge more valuable by sharing the links with his friends. From another perspective, the posting also proves that he is an exploratory learner, as he mentioned in the interview sessions.

The activity in Session 17 shows that Ali was receiving support regarding the unstable chat sessions. However, in Session 18, he simply explored the course content and not many activities were recorded in the data tracking. He read the private messages and helpline, and ended by consulting the course content in Session 19. In Session 20, he just read and sent a message to the discussion group querying a piece of information. The activity in Session 22

shows him sending a private message to a technical assistant about the difficulty of video conferencing. He spent his time sending a private message to the course tutor in Session 23; this was about slow network connections.

Sessions 17, 18, 19, 22 and 23 showed that Ali spent his time obtaining technical support from the other students. At this point, he sent some queries about a technical problem but not about a learning one. This may be because he had no difficulty with his learning any more.

Ali sent two questions to the discussion groups in Session 24. The first was about how to scan a photo from the scanner and the second related to the GIF format and GIF animation. Both questions were about the course assignments. Ali merely explored the course content and read the helpline in Session 25. In Session 27, he simply sent a help message to the helpline about network connections. In Sessions 28, 29 and 30, Ali spent his time exploring the course content both in the morning and evening.

The final posting to the discussion group was about the course assignment and about exploring the course content. In this session, Ali gave his attention to the course assignment regarding acquiring the skills for using the scanner. This skill is part of his applying what he has learnt in the system, to the learning skills. The skills of scanning the photo emphasise several topics of the course content, such as graphic format, graphics hardware, and resolution and image size. Therefore, after mastering the course content, Ali tried to apply what he had learnt by using the scanned photo in his assignment.

From the point of view of Activity Theory, the use of tools explains how the subject interacts with the system to achieve his learning objective. Thus, this interaction shows that their use helps Ali to learn digital graphics in an online learning environment. The relationship between him and his use of tools can be evaluated by investigating the interaction. In this situation, the system tools can be identified by their interaction process.

7.1.2 Interaction with the Curriculum

This section explains the interaction between Ali and the curriculum through the interview data. Ali (subject) has to manage his learning activity by focusing on the curriculum or course content in order to achieve the goal of the activity.

The example below is about the interaction between Ali and the curriculum.

19/01/2005 05:06	Selecting course content	<u>View concept maps</u>
19/01/2005 05:07		Read course content Topic: <u>hardware requirement</u>
19/01/2005 05:08		Read course content Topic: <u>hardware requirement</u>
19/01/2005 05:08		Read course content Topic: <u>resolutions</u>
19/01/2005 05:09		Read course content Topic: <u>graphics quality</u>
19/01/2005 05:09		Read course content Topic: <u>colour depth</u>
19/01/2005 05:12		Read course content Topic: <u>vector 1</u>
19/01/2005 05:13		Read course content Topic: <u>bitmap images</u>

Table 7.2: Ali's Interaction with the Course Material

The table above shows how Ali spent his time exploring the course content at the beginning of the course. It shows that at this stage, he tries to make use of the system by exploring what he has to learn before switching to another link. In this situation, he is interacting with the rules known as the Course Materials. In addition, these are an important element because without them the activity system cannot function.

Learning

Table 7.3 below shows Ali's learning experiences when using the system.

Query	Regarding student's learning experiences using the system.
Answer	I like this approach. It is not a sequential kind of approach. For example, if we would like to know about the graphics we can click on the appropriate topic and we can go straight away to the topic. It is not a sequential approach.

Table 7.3: Ali's Learning Experiences

The table above shows that Ali likes to explore the course content from a non-sequential standpoint. This also illustrates the fact that he is a self-exploring student and non-sequential learner. It also indicates that he prefers to navigate the content in a non-sequential kind of way.

The significance of this point is that the learning approach of the system encouraged him to learn. The concept of exploration and exploratory learning gives him free access to the content and is supported by the use of concept maps which help him to manage his learning and gives him free control of the content. The example below shows what Ali has learnt from the system.

Query	Regarding what the student has learnt from the system.
Answer 1	I learnt about graphics and their elements. More than that. For example, we know how to use and manage the e-learning system.
Answer 2	Actually, before using this system, I knew nothing about graphics. Now, after one and a half months exploring them, I discovered a lot of information about graphics such as resolution, colour depth, the quality of graphics, type of graphics and the format. Instead of using this knowledge to complete the assignment, I also use it when buying a digital camera. For example, resolution and graphics are the important thing when buying a digital camera. And look, now I can easily give some advice to my friends about graphics especially about digital cameras.

Table 7.4: Ali's Learning: 1

The transcriptions above clearly show how Ali actually interacts with course materials in order to achieve the learning objectives of this course. In the activity system, the rules can lead to the performance of the activity. For instance, in his interaction with the curriculum

in the activity system, he discovered a lot of information about graphics. Thus, his interaction with the curriculum contributes to his learning about graphics.

The table below is another example of Ali's opinions about what he has learnt.

Query	Regarding what the student has learnt from the system.
Answer	The resolution is related to the monitor. So the information about graphics resolution provides me with knowledge about the sharpness of the resolution. It is very useful when developing WebPages and printing photos. Now, I know how to set-up my monitor with suitable resolutions and build my website with the best view in certain resolutions.

Table 7.5: Ali's Learning: 2

The table above notes with what Ali has learnt about graphics resolution. He found that it was useful for building WebPages, setting up the monitor resolution and printing the photos. Therefore, his interaction with the rules shows that he learnt how to apply his knowledge about graphics resolution to different situations.

The example below is another comment about his learning.

Query	Regarding what the student has learnt from the system.
Answer	This system also provides the space for the students to share their knowledge and information in synchronous or asynchronous communications. And I think this is a very great experience for me to increase my knowledge by sharing with other students, which is something I never do in the traditional classroom.

Table 7.6: Ali's Learning: 3

From the table above we can see that what Ali has mentioned about the learning strategies he had used. One of his learning approaches is sharing knowledge with the other students. Therefore, he develops his understanding by becoming actively involved in the activity and sharing his expertise with the other students. His interaction with the curriculum shows that he devises his own strategies for learning and one of them is knowledge sharing. Another remarkable example is shown in the table below.

Query	Regarding what the student has learnt from the system.
Answer	I get the new information from the old information... I mean that I explore so as to learn something and get the information from the website.

	It is like the constructivist approach. For example, I get the new information from the information itself.
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Table 7.7: Ali's Learning: 4

The table above illustrates how the course content of the system reflects his learning process. He mentions the constructivist approach and exploratory learning in getting information from existing information. It seems that Ali likes this kind of approach to help him achieve his learning objectives. To support the above statement, the example below illustrates his learning approach.

Query	Regarding the learning approach
Answer	The student can explore and search the information. It is more like exploratory learning which is good for the online learner. For me, I'm an exploratory learner. I like to explore and understand the content, search the information and learn from it.

Table 7.8: Ali's Learning Approach

The table shows Ali alluding to his learning technique which is to use an exploratory approach. According to the data above, we can understand that he strongly interacts with the course materials, especially when exploring the content and participating in the activity. Therefore, this explanation shows how he learns effectively by using the system.

7.1.3 Interaction with the Community

This section is about Ali's interaction with his community in the activity system. This community refers to the students and course tutors who engage in the activity. This section also explains the example of the synchronous and asynchronous tools, which have been used by Ali in order to communicate with the community. In this case, the synchronous tool refers to newsgroups and the asynchronous tool refers to the chat tool. It explains how Ali makes use of the synchronous and asynchronous tools and what approach he uses in order to gain knowledge about graphics.

The example below is a sample of the sequence of activities carried out by Ali when browsing the discussion groups.

30	25/01/2005 16:40	Selecting the discussion group	View forum index
31	25/01/2005 16:40		Read forum topics Topic: course activity 2
32	25/01/2005 16:40		Read selected topics Topic: course activity 2
33	25/01/2005 16:40		View Forum index
34	25/01/2005 16:40		Read Selected Topics Topic: course activity 2
35	25/01/2005 16:44		Read Selected Topics Topic: course activity 2
36	25/01/2005 16:44		Read selected topics Topic: course activity 2
37	25/01/2005 16:44		View forum index
38	25/01/2005 16:45		View forum index
39	25/01/2005 16:45		Read forum topics
40	25/01/2005 16:45		Read selected topics
41	25/01/2005 16:45		Read selected topics
42	25/01/2005 16:45		Read selected topics

Table 7.9: Ali's Interaction with the Discussion Group

The table above shows that Ali explored the messages in the discussion groups in less than 5 minutes, from 16:40 to 16:45, before sending his first message. The data logging system shows that he made a lot of contact, using the discussion group as one of the platforms to talk about his technical and learning problems. The postings to the discussion group amount to 26. The first activity in his first login on 25/01/05 was to read the posted messages in the discussion group. For example, he read a few topics about course activity, starting at 16:40.

It shows that in the first stage Ali likes to explore the discussion related to the session topics. It indicates that Ali likes to read the content of the discussion group first, before sending a message to it. This allows him to get an idea of what is happening in the discussion group. In addition, he is a discovery student and likes to explore new things during his learning sessions.

Asynchronous Tools

The table below is an example of the use of a discussion group.

44	25/01/2005 16:49	CA32, ILS3	Post topics Topic: query about unstable chat sessions. Transcriptions: Ali: chat session is not stable. Anybody have the same problem? Technical Assistant: Ali. You need to click on EXIT after using the chat session otherwise it will be hung. Log-on again and click on the EXIT button.
45	25/01/2005 16:49		Read forum topics - means Ali is browsing the main menu of the discussion group before clicking on the topic that he interested in.
46	25/01/2005 16:50		Read selected topics - means Ali is reading the topic he chooses in the discussion group
47	25/01/2005 16:50		Read selected topics
48	25/01/2005 16:50		Read selected topics

Table 7.10: Ali's Discussion Group Activity: 1

The discussion above is about unstable chat sessions. The table shows that Ali discussed and shared the problem about unstable chat sessions at 16:49. After sending the message, he examined the other messages. The posting was about a technical problem and he tried to use the discussion-group tools to share his problem with his online friends.

Despite this, the posting shows the interaction between Ali and the technical assistant as one of the community in the activity system. At the same time, he received support from the technical assistant by communicating with him about his problems. In the online learning environment, interaction is a vital element in ensuring that the student always feels as if he is in the traditional classroom. Therefore, the use of the asynchronous tool is one way for Ali to obtain help with his technical difficulties.

The next five postings are about learning. In these, we can see how Ali learns the topic of animation, graphics and graphic principles. The table below is an example of the discussion group related to his learning.

	25/01/2005 05:18	CA12	Reply to the selected topics.
			<p>Topic: giving feedback about animation.</p> <p>Transcriptions:</p> <p>Shah: animation is very difficult to create. For example, it is not easy to create a 2D cartoon and Malaysia is one of the worst countries for the production of animation.</p> <p>Ali: yes, I agree with you. We do not have the technology to produce quality cartoons like Walt Disney.</p>

Table 7.11: Ali's Discussion Group Activity: 2

The session above shows how Ali received feedback from Shah about the relationship between animation and graphics. He agreed with Shah about a 2D cartoon with his own perception about producing poor quality 2D cartoons in Malaysia. This is due to a lack of technology and skills in the feedback from Shah. In this interaction, the discussion is about the relationship between graphics and animation, since we know that animation is in part a combination of graphics. Therefore, the feedback from Shah shows that Ali has the right idea in his learning about the production of 2D animation and its relationship to graphics. The example below is a posting about ready-made graphics.

54	25/01/2005 18:24		Read the selected topic
56	25/01/2005 18:33	CA41	<p>Post discussion</p> <p>Topic: query about course assignment; ready-made graphics.</p> <p>Transcriptions:</p> <p>Ali: who has any idea about obtaining the ready-made graphics for the assignment?</p>

Table 7.12: Ali's Discussion Group Activity: 3

The table above is a query about the course assignment in relation to ready-made graphics. This section shows that Ali is trying to interact with the other members of the community in the system, such as the course tutor, the technical assistant and his friends. The role of the asynchronous tools is that of mediating between Ali as a subject in the activity system and the community, and, as a result of the interaction, he received meaningful feedback to resolve his learning problem. The table below is an example of feedback from Ali to the other students.

25/01/2005 18:37	CA42, ILS4	Reply to the selected topics <u>Topic:</u> a query about graphics software, Adobe Photoshop. <u>Transcriptions :</u> Naz: anybody familiar with Adobe Photoshop? Ali: yes...it is very user-friendly software...easy to use and easy to understand. You can download the tutorial from this website: http://www.adobe.com/products/tips/photoshop.html . Happy Browsing! Naz: Thanks Ali
25/01/2005 18:37		Read forum topic
25/01/2005 18:38		View forum index

Table 7.13: Ali's Discussion Group Activity: 4

The session shows that Ali has started to share his knowledge with somebody else in the community. The query from Naz is about the graphics software. Ali responds with a suggestion about the links to a related website. The posting shows that his role has now been changed to that of a helper giving support to his friends. This is because he is an exploratory person, who has discovered a lot of things to learn on the website. At the same time, he has acquired knowledge about new matters which he then shares with other members of the community. Table 7.14 is an example of the feedback about the best animation on the market.

25/01/2005 18:41	CA13	<p>Reply to the selected topics</p> <p><u>Topic:</u> feedback about the best animation software on the market.</p> <p><u>Transcriptions:</u></p> <p>Naz: what is the best animation software on the market right now?</p> <p>Ali: Naz...I think the best ever animation on the web is Macromedia Flash. I wish I could learn it one day but now I am too busy with the assignment. No time to learn.</p> <p>Naz: yes...It would be good if we could learn the animation. Especially on the web and then we could publish it all over the world.</p>
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Table 7.14: Ali's Discussion Group Activity: 5

The conversation above identifies the best animation software on the market. It shows Ali giving his response about the latest animation software on the market.

From the learning perspective, the excerpt shows how Ali becomes acquainted with the latest animation software on the market. It confirms that he has a lot of knowledge about animation, especially the software. One of the reasons for this might be that he is a person with an enquiring mind, as he mentioned in the interview. He likes to explore new things on the website. He discovers a lot of information about animation there and learns something new from the course content.

From the standpoint of Activity Theory, this excerpt also shows Ali's role in helping his friends with their learning difficulties about animation. This interaction is one of the pieces of evidence that explains how he used the discussion group in order to communicate with his community in the activity system. The table below is the last posting about animation and graphic principles in this session.

25/01/2005 19:02	CA14	Posting new topics <u>Topic:</u> opinion about animation and graphics principles. <u>Transcriptions:</u> Ali: I think that to learn about animation, we have to know about graphic principles, such as graphics and animation. Shah: yes, absolutely, I agree with you Ali.
25/01/2005 19:03		View posted topics

Table 7.15: Ali's Discussion Group Activity: 6

The above table shows Ali's opinion about graphic principles. He mentions that graphics are one aspect of animation and these have a very close mutual relationship. He makes a good posting creating an agreement with his friends. This kind of agreement is one of the successful interactions of the activity system. As part of the community, Shah tries to cultivate a positive relationship with Ali.

Synchronous Tools

Ali also used a chat session as a tool to communicate with his friends and course tutors. However, he used this facility less as a medium for discussing his problem. This is shown by data-logging records which indicate that he used the tools only 6 times. For example, on 25/01/05, he took part in the following chat session:

4	25/01/2005 17:31	Selecting chat	View chat rooms
5	25/01/2005 17:32	CS2, IUS3	Participate in chat Chat rooms: technical problems. Conversation: about scripting error Transcriptions: Ali: hi Dilla, Naz Dilla: hi Ali Naz: hi Ali Ali: anyone here come across the scripting error when exploring the website? Naz: me Dilla: me too.
6	25/01/2005 17:32		Participate in chat

Table 7.16: Ali's Chat Session

The chat session started at 17:32 when Ali raised the scripting error issue to share with the other students. The table above shows that this problem was also discussed with other students. From the user tracking data, Ali is shown to have used the chat sessions about 4 times.

The table shows the conversation about the scripting error. The issue is about a technical problem in the system. From the viewpoint of Activity Theory, this interaction takes place among three different students. The question is about the scripting error. This interaction is very different from the discussion groups as it categorises the synchronous tools. In the activity system, the synchronous tool is one of the ways of interacting in the communities. It shows how Ali used the chat tools to communicate with Naz and Dilla by raising the scripting error issue. This activity presents evidence about the notion of the social context, specifically in an activity system community.

The use of a private message is also important to gain an understanding of the course in Ali's learning sessions. The table below provides an example of a private message to the course tutor.

5	25/01/2005 19:05	PM1,ILS6,ILS3	Post private message
			Message: about buying a digital camera
			Sent to: course tutor
			Transcriptions: Sent Messages: if I buy a digital camera, what resolution is the best to produce better photos?

Table 7.17: Ali's Private Message

The table above illustrates the way Ali used a private message in order to obtain help to buy a digital camera. At 19:05, he posted a private message to the course tutor about buying a digital camera. The message shows the way he interacts with his community to come by information about graphics. It also demonstrates how he learns about graphics resolution. As we know, the course content provides information about graphics resolution, but in a different situation, Ali prefers to learn about this matter by asking the course tutors. It means that instead of accessing the information provided on the website, the students also have their own style of learning.

7.1.4 Interaction with the Support System

This section describes the interaction between Ali and the management team in dealing with this problem in learning. Specifically, the group responsible for dealing with Ali includes an administrator and web designer. In this instance, I acted with the web designer, technical assistant and course tutor in dealing with the questions and problems regarding his learning and technical difficulties. Such teams can be called support teams. These teams also use communication tools, such as chat sessions, the helpline (specific), private message and discussion groups, as tools to support Ali and manage his problems. The help is divided into two types; learning support and technical support.

The user tracking data shows that Ali used both types of support in handling his problems. Data-logging records also show that he used all the support tools (private message and the helpline) and communication tools, including discussion groups and chat sessions, in his

learning sessions. For example, the support mechanism with the use of the helpline can be viewed in the table below.

11/01/2005 17:10	Selecting the helpline	View the helpline
11/01/2005 17:10		Read message on the helpline
11/01/2005 17:14	HL1	Send message on the helpline <u>Issues:</u> course content <u>Transcriptions:</u> Ali: how to browse the course content?

Table 7.18: Ali's Helpline Session: 1

It shows that the use of the helpline is dedicated to a part of the division of labour in the activity system, such as the technical assistant and course tutors. This is one example of how Ali, as a subject, interacts with the administrator and technical assistant, as a mechanism to solve a problem in his learning session. The second example is about the interaction between Ali and the support teams with regard to his problem. This is about losing the password, as shown in the table below:

27/01/2005 18:01	Selecting the helpline	View the helpline
27/01/2005 18:01		Read message in the helpline
27/01/2005 18:06	HL2	Send message in the helpline <u>Issues:</u> password <u>Transcriptions:</u> Ali: I have lost my password. What should I do?

Table 7.19: Ali's Helpline Session: 2

In addition, the support also involves the use of discussion groups and private messages, for example, the posting on 25/01/05 to the discussion group regarding a technical problem about a scripting error. The example is as follows:

49	25/01/2005 16:55	CA33, IUS3	Post topics. <u>Topic:</u> query about scripting error. <u>Transcriptions:</u> Ali: Scripting error, help me. Technical Assistant: Ali, Please check your browser. Maybe it's not compatible with the PHP.
51	25/01/2005 17:17		Read forum topics
	25/01/2005 17:17		Read selected topics

Table 7.20: Ali's Support from the Discussion Group

The table above shows a message relating to a scripting error at 16:55. This was followed by the reading of other messages at 17:17. It illustrates that Ali also used the discussion groups as a medium to obtain help from the 'division of labour' in the activity system. In this case, he received feedback from the technical assistant about a non-compatible browser that causes scripting errors when exploring the system. The user tracking data show that most of the messages in the chat session were about his technical and learning problems. The example below was recorded on 18/01.

18/01/2005 18:04	Selecting chat	View chat rooms
18/01/2005 18:05		Participate in chat <u>Chat Rooms:</u> learning problems. <u>Conversation:</u> about graphics software. <u>Transcriptions:</u> Naz: anybody know about what software is good for graphics? Ali: yes...I am using Adobe Photoshop 5.5. It very easy and simple. Naz: where can I get a copy?

Table 7.21: Ali's Chat Session about the Support Mechanism

This session was about graphics software. The query was raised by Naz. Ali suggested that Adobe Photoshop is a good software for graphics. Besides using platforms like the helpline, discussion groups and chat sessions, Ali also used tools like private messages in order to

obtain help from the course tutor. The example below is taken from the section above and concerns the use of a private message, but in a different situation.

5	25/01/2005 19:05	PM1,ILS6,ILS3	Post private message Message: about buying digital camera Sent to: course tutor Transcriptions: Sent messages: if I buy a digital camera, what resolution is the best to provide better photos?
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Table 7.22: Ali's Private Message to the Support Mechanism

In the interaction with the community, Ali's interaction with the course tutor is as an example of community interaction in the activity system; however, in this section the interaction is one of the processes used to obtain help regarding buying a digital camera. In this interaction, the course tutor is part of the management team involved in dealing with learning problems. This kind of interaction is more to do with the division of labour. It is totally different from the context of interaction with the community, where the course tutor acts as part of the community in the activity system.

7.1.5 Analysis of the Student Product

Ali has produced a high quality assignment and fulfilled all other criteria in the assignment. A sample of Ali's assignment is shown in Figure 7.1.



Figure 7.1: A Sample of Ali's Student Assignment

The assignment sample shows that Ali is highly skilled in using the software to complete his assignment. He also has high creativity skills with his correct combination of colour, effect and image. The criteria for the evaluation are shown in Table 7.23 below.

Specifications	Criteria	Ali
1. Original work	Original ideas	√
	Creativity	√
2. Combined with image, illustration and text.	Image, illustrations and text	√
	Image and illustrations only	
	Image and text only	
	Text and illustrations only	
	Text only	
	Image only	
	Illustrations only	
3. Related to multimedia and education area	Multimedia and education	√
	Multimedia only or education only	
	Other areas	
4. Standard format GIF or JPEG	GIF or JPEG	√
	Other formats	
5. Resolution must be 640 x 480	640x480 pixels	√
	Other formats	

Table 7.23: An Evaluation of Ali's Student Product

The findings in Table 7.23 show that the assignment has met the criteria. These include graphics resolution, graphics format and the use of various types of graphics in his assignment.

7.1.6 System and Support Contribution to Learning Outcomes

Analysis of the student product showed a strong correlation between the system and the learning outcomes. This suggests that the system and support system did contribute to the student's learning. However, each subject has its own learning strategies and experiences, as reported in the user tracking and the online interview.

Table 7.24 shows the contribution of the system and support tools to Ali's learning process.

How the System Contributes to Learning Outcomes	Support Tools Contribute to Learning Outcomes	
<ul style="list-style-type: none"> • High interaction with the curriculum • Discover new aspects of the software 	<ul style="list-style-type: none"> • Private message 	<ul style="list-style-type: none"> • Gaining feedback about the technical problem • Not using the tools for the learning problem
<ul style="list-style-type: none"> • Make use of the hyperlink and hypertext to gain knowledge about the course materials 	<ul style="list-style-type: none"> • Discussion group 	<ul style="list-style-type: none"> • Giving feedback • Sharing the information with the student regarding the course assignment
<ul style="list-style-type: none"> • Seeking information from the Internet 	<ul style="list-style-type: none"> • Helpline 	<ul style="list-style-type: none"> • Gaining feedback about the technical problem • Not using the tools for the learning problem
<ul style="list-style-type: none"> • Sharing knowledge makes him feel comfortable with the environment 	<ul style="list-style-type: none"> • Chat sessions 	<ul style="list-style-type: none"> • Discussing the learning problem of DPI • Giving feedback to other students about graphics resolution and image size

Table 7.24: The relationship between the System, Support Tools and Learning Outcomes for Ali.

The table illustrates how the system and support system influence learning. The Data showed that the system provided different learning experiences for Ali and the other students. For example, based on the analysis of his interaction with the community and the division of labour, we can see that Ali is an enthusiastic person. In comparing the system to the support system, we can state that the system contributes more to his learning. This is because Ali is an inquisitive person and used the course materials and the hyperlinks to acquire knowledge about graphics. In addition, he used his expertise with the support tools to help other students in the learning session. The following section explains Ali's interaction pattern when using the system. It demonstrates the how the system contributes to Ali's learning as shown in Table 7.24.

Ali's Pattern of Usage

The following section describes Ali's pattern of interaction via the asynchronous and synchronous tools, during his learning session. Findings show that Ali's pattern of interaction in using the tools were mostly about providing feedback and sharing knowledge

by responding to other student messages. His interaction pattern can be categorised into several characteristics such as:

- a) Sharing information
- b) Providing feedback
- c) Seeking information including querying about learning
- d) Exploring the course content and resources
- e) Responding to other peoples' message
- f) Gaining help regarding technical problems.

The analysis of the interactions given below shows that Ali has created a meaningful learning environment by providing a support to his friends and seeking information from the course tutor.

Asynchronous Tools

Ali prefers to use asynchronous tools due to the flexibility of the tools in sending messages asynchronously to the other course members. Table 7.25 shows Ali's pattern of interaction using the asynchronous tools.

Tools	Transcriptions	Type of questions	Sent to
Discussion group	Ali: anybody here facing scripting error when browsing the website?	Query about a technical problem.	Everyone
	Ali: chat session is not stable. Anybody have the same problem? Technical Assistant: Ali... You need to click on EXIT after using the chat session otherwise it will be hung. Log-on again and click on EXIT button.	Query about a technical problem.	Everyone
	Ali: scripting error...scripting error help me. Technical Assistant: Ali...Please check you browser. May it not compatible with PHP.	Query about a technical problem.	Everyone

	<p>Naz: I have problem with save the graphic file from the Internet...Anybody have any experience?</p> <p>Ali: Naz...Move your cursor (mouse) to the picture you want to save in. Then right click on the mouse and choose save picture as...then choose you directory and click OK.</p>	Providing feedback	Everyone
	<p>Shah: how to make the image black and white?</p> <p>Ali: It so easy Shah...go to Image...then choose Mode and choose Grey Scale...then click OK...</p>	Providing feedback	Everyone
	<p>Ali: I am having problem with net meeting. Anybody here can help me to use the net meeting?</p> <p>Technical Assistant: we have terminated the net meeting session at the moment due to slow connection of the system. Please contact me if you have any problem</p>	Query about a technical problem	Everyone
	<p>Ali: can anyone explain to us about the latest version of digital camera?</p>	Query about a technical problem	Everyone
	<p>Ali: who have any idea to get the ready made graphics for the assignment?</p>	Query about a technical problem	Everyone
	<p>Naz: anybody familiar with Adobe Photoshop?</p> <p>Ali: yes... It very user-friendly software...easy to use and easy to understand. You can download the tutorial from this website: http://www.adobe.com/products/tips/photoshop.html. Happy Browsing!</p> <p>Naz: thanks Ali</p>	Providing feedback	Everyone
	<p>Ali: I just discovered the new website suitable for those who looking for the online tutorial with the Video and Audio. The website is http://lynda.com/freepass/cs2/. You need to registered first before using the website.</p>	Providing feedback	Everyone

	<p>Dilla: anybody knows about the graphics tutorial in Malay? Ali: why don't you go to http://www.sifoo.com? Very good website in Malay. Dilla: thanks Ali</p>	Providing feedback	Everyone
	<p>Ali: I would query about the how to change colour for the image. Let say from normal colour to Blue or Green. Course tutor: please use Photoshop in order to do this. Go to Image...Adjust ...and choose Colour Balance...then adjust your image and choose the right colour...green or blue...good luck</p>	Query about learning	Everyone
	<p>Shah: anybody have experience scanning the photos? Ali: Shah...you need to have a scanner and photo. You can do this at the department lab. Or borrow the scanner from your friend and then install the software and read the instruction. Make sure that you choose the right resolution to maintain the quality of your image.</p>	Providing feedback	Everyone
Private messages	If I buy a digital camera, what resolution is the best to provide better photos?	Query about learning	Course tutor
	Could you suggest me the best printer brand in market at the moment?	Query about learning	Course tutor
	Can you please put the information about Video conferencing? What equipment and software should we have for video conferencing?	Query about learning	Technical assistant
	The connection is too slow. I've tried to make connection with my friends but it not successful. I think the connection is too slow.	Query about learning	Course tutor

Table 7.25: Ali's Interactions using Asynchronous Tools

Table 7.25 demonstrates Ali's pattern of interaction using discussion groups and private messaging. He tends to give feedback in the discussion group. Ali's pattern of interactions indicates that he did more posting and replying in order to give his feedback to other course members. He had less interaction in requesting help but gave more assistance to his friends. Finally, his support to course members benefited them in learning. For instance, most of his

friends were getting feedback from him about learning in the discussion groups. The discussion groups was most heavily used by Ali to discuss the course assignment, exchange his views, ask for assistance and share the technical problems that they had had. The types of questions that have been asked in private messaging were not in the course curriculum. However, they were related to the graphics aspect. For instance, one of the questions was about the best digital camera and printer on the market. Table 7.26 illustrates in detail Ali's interactions using asynchronous tools.

Tools	Interaction with	Type of Interaction	Number of Interactions
Discussion group	Technical assistant	• Making a query about technical problem	3
	Naz	• Providing Feedback	2
	Shah	• Providing Feedback	2
	Dilla	• Sharing information	1
Private messages	Course tutor	• Making a query about learning	3
	Technical assistant	• Making a query about technical problems	1

Table 7.26: Ali's Interactions with the Community using Asynchronous Tools

Table 7.26 shows the number of interaction between Ali and the community using asynchronous tools. Ali has a high amount of interaction with Shah but at the same time he also tends to communicate with technical assistants and course tutors for gaining help about learning and technical problems. Ali was tending to be an enthusiastic student since the interaction recorded more emphasis on providing feedback and sharing information among the students.

He tended to give feedback in the discussion group. The type of interaction was more focused on providing feedback about digital graphics to Dilla, Shah, Shikin and Naz. Most of the queries were answered by Ali.

Ali liked to use the discussion group more than the other asynchronous tools due to the flexible usage of the tool which can be used at anytime and any way. As a result, about seven interactions have been recorded using this tool.

The findings also indicated that the postings from other students and course instructors were providing an advantage to the students for their learning. Some of the postings actually contained responses and feedback regarding the learning problem in the session. For instance, in the discussion group, Ali provided four interactions regarding providing feedback and one interaction in relation to sharing information with another student.

From these types of questions we can show that asynchronous tools are a valuable way for Ali to share information, discuss problems and give feedback to other course members.

Synchronous Tools

Ali also prefers to use synchronous tools to share his view and provide feedback to other friends. Table 7.27 shows the interactions between Ali and other friends via chat sessions and the helpline.

Tools	Transcriptions	Type of question	Sent to
Chat sessions	Ali: hi there! Shikin: hi! Ali: are you busy at the moment? Shikin: no. May I help you? Ali: thanks...I would like to know about resolution in graphics. I am confusing with the dpi. Shikin: yes...no problem...dpi is dot per inch. This is actually the unit of resolution. Ali: how does it works? Shikin: if you have big dpi, your graphic will be more quality, but the low no. of dpi indicate that the picture is less quality. Ali: oh that fine. Thanks for your help.	Query about learning (Ali is asking)	Shikin

	<p>Ali: hi Dilla, Naz Dilla: hi Ali Naz: hi Ali Ali: anyone here have facing the scripting error during exploring the website? Naz: me Dilla: me too.</p>	<p>Query about a technical problem</p>	<p>Dilla</p>
	<p>Naz: anybody knows about what software is good for graphics? Ali: yes...I am using Adobe Photoshop 5.5. It very easy and simple. Naz: where can I get the copy?</p>	<p>Query about learning (Ali is answering)</p>	<p>Naz</p>
	<p>Amin: I have problem here. Help me...help me... Ali: yes ...what can I do for you? Amin: how to change the graphic format from BMP to JPEG? Ali: oh it easy...go to Adobe Photoshop...click on the Open the BMP file... Amin: OK...Next. Ali: then...Choose File and Save a Copy and then choose JPEG format and click on Save. Your JPEG format will be ended with extension .jpg.</p>	<p>Query about learning (Ali is answering)</p>	<p>Amin</p>
	<p>Dilla: who can teach me using the private message? Ali: Dilla...Private message is like an email. Technical Assistant has showed me how to use it. Dilla: an email? Ali: yes absolutely, now go to Contact Menu and click on private message. Dilla: yup. Ali: then...to send a message you have to know your friends nickname. Dilla: OK Ali: click on New post and choose the username, the title and type the message in the message box. Finally, send submit button. Dilla: that's fine. Thanks</p>	<p>Query about a technical problem (Ali is answering)</p>	<p>Dilla</p>

	<p>Shah: I have problem using Adobe Photoshop?</p> <p>Ali: yes...Shah...What up?</p> <p>Shah: how to enlarge your graphics file?</p> <p>Ali: go to Image menu and choose Image size.</p> <p>Shah: OK.</p> <p>Ali: choose the size for instance in this assignment we required to make 640 x 480 and then click on OK.</p> <p>Shah: where should I put 640 and 480?</p> <p>Ali: put 640 for width and 480 for height.</p> <p>Shah: thanks Ali.</p>	Query about learning	Shah
Helpline	How to browse the course content? Replied by technical assistant	System	Everyone
	I have lost my password. What should I do?	Password	Everyone
	My chat session is always disconnected. Why? Anybody had this experience.	Chat session	Everyone
	I have registered as a new student but I haven't received any confirmation in my email. Could your please help me?	Registration	Everyone
	Anybody here have scripting error when exploring the system? How to solve it?	Scripting error	Everyone
	Shah: Ali...I also have the scripting error ... could you help me? Ali: Shah...Maybe we can ask technical assistant and I think our browse is not the original one...	Scripting error	Everyone
	Anybody knows how to use Private Message?	Private message	Everyone
	The connection is too slow. Technical Assistant, please help me...	Connection	Everyone

Table 7.27: Ali's Interaction using Synchronous Tools

From the table above, it shows that the pattern of interactions is more focused on discussing the learning problem and technical problem using the asynchronous tools. This indicates that Ali was concerned about the technical error and always sends the technical issue to the

helpline. The detail of Ali's interaction using synchronous tools is shown in Table 7.28 below.

Tools	Interaction with	Type of Interaction	Number of Interactions
Chat sessions	Shikin	<ul style="list-style-type: none"> • Making a query about learning 	1
	Dilla	<ul style="list-style-type: none"> • Making a query about technical problems 	2
	Amin	<ul style="list-style-type: none"> • Providing feedback 	1
	Shah	<ul style="list-style-type: none"> • Providing feedback 	1
Helpline	Everyone	<ul style="list-style-type: none"> • Making a query about technical problems • Responding to other student messages 	8

Table 7.28: Ali's Interactions with the Community using Synchronous Tools

Table 7.28 shows the number of interactions between Ali and the community using synchronous tools. From the analysis of the interaction, it reveals that Ali is aware of what happens to the system during the learning session. For instance, types of questions posted into the helpline were a connection problem, scripting errors, passwords and other technical aspects. Chat sessions were used to discuss both learning and technical problems. Ali interacts with most of the course members including Shah, Naz, Amin, Dilla and Shikin to share his experiences and views about the course. About 8 interactions have been recorded in the helpline in relation to technical problems and the rest are related to providing feedback and queries about learning.

The findings demonstrate that the support system contributes to learning by providing a platform to the students to allow social interactions amongst each other. Learning that has occurred from the social interactions gives Ali the chance to share knowledge, explore the information, respond to the enquiries and seek help in an online environment. In addition, it contributes to learning by providing students with a rich resource environment, flexible times of communication and easy use of navigational tools as shown in Tables 4.3 and 4.4.

7.1.7 Conclusions

How does Ali learn?

The overall pattern of usage shows that Ali is an exploratory learner, actively seeking information about the course content and someone who likes to discover new knowledge. He also likes to share his knowledge with his friends. The interaction also reveals that he makes effective use of the system in his learning sessions by responding to other people's messages, receiving feedback and sharing his knowledge of the communication tools. This approach means that Ali is a self-exploring person and does not depend on anybody else in his learning. Based on the user tracking data, he made effective use of the system tools and he is the student who has made the highest number of interactions with every tool. For instance, in interactions with tools the data shows that he made eight postings to the helpline, six private messages, a dozen postings to discussion groups and took part in chat sessions on seven occasions. However, he made less use of private messages in his learning. This is due to the fact that he preferred to search for information by himself and not depend on others.

How does the System Contribute to Learning?

The system contributes to learning by offering various approaches to learning strategies. One of them is the non-sequential approach, which is presented in the course content. The findings also reveal that the exploratory learning technique also provides advantages to Ali in his learning. For instance, he claims that he is an exploratory learner who likes to seek information from the Internet. The data reveals that he is a non-sequential learner. He states that he does not like to learn by the sequential approach. For example, in the interview session, he mentions this approach in exploring the course content. The main contribution to learning that the system provides is space for the students to share their knowledge and information through synchronous or asynchronous communications. Ali claims that the sharing knowledge concept can increase his learning proficiency. In addition, he also states that the design of the system allows the student to gain knowledge

by exploring the information. He also mentions that this technique is like the constructivist approach.

How have the Support Tools Contributed to Learning?

The support tools have contributed to learning by offering a platform for the student to communicate and explore. As mentioned above, Ali made effective use of most of the tools. He used the helpline in order to gain information about technical problems and private messages to obtain feedback about learning problems. For instance, he acquires knowledge about printers when he sends the message about the latest version of the printer on the market to the course tutor. The findings also show that his was the highest amount of interaction using the discussion groups. He builds up his knowledge by sharing his ideas, views and suggestions with the community.

The use of chat sessions as a support tool also contributes to his learning. This is one of the platforms used by Ali to share his knowledge with other students. For instance, in interactions with the community, the findings show how he helps Shah with image enlargement in Photoshop. By sharing his ideas, he makes his knowledge more useful and valuable.

7.2 CASE STUDY 2

Shah: The Reluctant Learner

Shah is a part time student at the University of Technology of Malaysia. At the same time, he works as a full-time secondary school teacher in Malaysia with 10 years teaching experience. He is about 30 years of age. He graduated from the Teacher Training College and gained his Teaching Certificate in 1995. Due to the aim of the Malaysian Ministry of Education for teachers to have a Bachelor's degree by the year 2010, Shah has taken this opportunity to upgrade his qualification by enrolling in distance learning courses. As a part-time student, he has commitments and responsibilities to work and study. He possesses moderate IT skills with higher abilities in Computer Literacy.

Shah has been categorised as a reluctant learner because the findings show that he has made less contribution in sharing knowledge with the other students. A reluctant student is unwilling to help another student, but uses the tools to obtain assistance for her/himself. They use the facilities in the system for their self-interest especially to gain knowledge about the content. Due to the analysis of the pattern of interactions during the learning sessions, Shah can be classified as a selfish person and concentrates on his own interests in every interaction. Again, this classification is only for research purposes and is nothing to do with the person himself.

7.2.1 Interactions with Tools

This section explains Shah's pattern of usage during his learning session (see Appendix C2). It is important to examine how Shah learns using the system. The example below is about Shah's overall pattern of usage.

Session	CM	D G	CS	PM	HL	Learning Support	Technical Support
1	√						
2	√						
3	√						
4				√		1	
5	√	√					
6		√					
7	√	√		√		1	
8	√	√	√		√	2	
9	√	√			√	1	
10		√					
11		√		√		2	
12		√					
13	√	√					
14	√	√				1	
15	√		√			1	
16	√	√					
17		√		√		2	
18		√					
19	√	√		√		1	
20	√			√			1
21		√				2	

22			√			1	
23		√		√		1	
24	√						
25	√						

CM – Course Material; DG- Discussion Groups; CS – Chat Sessions; PM – Private Message;
HL- Helpline

Table 7.29: Shah's Use of the Tools

From the table above, it can be seen that Shah likes to read the other students' messages. He also used a private message to the course tutor to ask about his learning problems and technical difficulties.

In Sessions 1, 2 and 3, Shah explored several features provided by the system, such as a glossary, FAQ's, online training, etc. This shows that at the beginning of the learning process, he wanted to become familiar with the system by exploring every single menu. During the first stage, Shah's pattern of interaction is similar to that of the other students. He also seeks to explore and discover the course content in order to build up his understanding of graphics. This is shown in Sessions 1, 2, 3 and 4. In a similar session, the data recorded that Ali went to Online Training, specifically a Net meeting, to learn about the Internet. Unfortunately, the Net meeting had been facing a problem due to a slow connection.

In Session 5, Shah started to read the other students' postings in the discussion group and to explore the topic in the course activity. This indicates that he began to focus his attention on the content of the discussion group. As a result, he sent a message to the course tutor to obtain information about the activities for the group.

In Session 6, Shah started to engage in the discussion group by sending a few postings. In a similar session, he sent a message to the technical assistant regarding a scripting error problem.

After getting used to the asynchronous tools, he began to make social contacts with the other students and received help about his learning problems in Sessions 10, 11, 12 and 13. As a result of this, he always visited the other student's web pages from Session 1 to

Session 17. This was one way in which he got to know the other students. In the same sessions, Shah sent a few postings to his friends to obtain feedback from them on the course assignment. This suggests that he was successful in persuading the other students to help him with his learning.

The data tracking results show that Shah interacted most when exploring the course material and reading the other students' postings rather than providing feedback, comment and suggestions in the discussion group. He did not like to give his opinion and share his knowledge with other students. Consequently, the data tracking shows that he sent only eight messages to the discussion group. This also shows that Shah preferred to use Private Messages to discuss his learning problems and obtain help from the course tutor. This can be seen in Sessions 19, 21 and 24 where Shah just sent emails to the course tutor and his friends.

Sessions 1, 2, 3 and 4 show that Shah visited and explored the weblink in order to acquire information. For example, in these sessions, he visited the weblink about 9 times and this is one of the course content support materials. Shah also sent a few postings to the helpline to obtain help with technical difficulties.

Shah only used the chat session 3 times, as recorded in Sessions 3, 13 and 14. The reason that he joined the session was to discuss scripting and net meeting. This shows that he did not use the chat sessions to share his experience with other students but used private messages in order to share his learning experience and problems with the course tutor.

The data tracking results show that Shah was a reluctant learner. Although, he had a good result in his assignment, he used the asynchronous and synchronous tools the least. He acted as an observer during his learning sessions without sharing any knowledge with the other students. However, he recorded the greatest number of interactions in sending messages to the course tutor and was the student most using private messages as an asynchronous tool.

7.2.2 Interaction with the Curriculum

The Use of Course Content

The example below is about Shah's use of the course content in his learning sessions.

	Shah	Activity	Actions
1	27/12/2004 14:08	Selecting course materials	View concept maps
1	27/12/2004 14:10		Read course content (graphics quality)
1	27/12/2004 14:13		Read course content (introduction to graphics)
1	27/12/2004 14:13		View concept maps
1	27/12/2004 14:14		Read course content (hardware requirements)
1	27/12/2004 14:58	Selecting course materials	View concept maps
1	27/12/2004 14:58		Read course content (graphics quality)
1	27/12/2004 15:01		Read course content (image size)
1	27/12/2004 15:01		View concept maps
1	27/12/2004 15:01		Read course content (file formats)
1	27/12/2004 15:02		Read course content (working with graphics)
1	27/12/2004 15:02		Read course content (graphics quality)
2	28/12/2004 18:04	Selecting course materials	View concept maps
2	28/12/2004 18:14		Read course content (working with graphics)
2	28/12/2004 18:14		Read course content (introduction to graphics)

Table 7.30 Shah's Interaction with the Course Material

The table above shows Shah's pattern of interactions in exploring the course content. As mentioned above, this shows how the students interact with the curriculum. This interaction can be defined as their learning pattern. In this case, Shah develops his understanding of graphics by reading the content using a non-sequential approach. This means that he did not follow the topic sequence.

Learning

The example below shows Shah's learning experiences during a learning session.

Query	What are your learning experiences?
Answer	I had a very good time using the system. I really enjoyed learning using this system. This system draws me closer to my friends and the course tutors. For example, by using the tools, I can communicate and interact with other people at any time and anywhere. It has increased my social contact with other people, especially my friends.

Table 7.31: Shah's Learning Experiences

This excerpt shows that Shah really enjoyed using the system. He emphasizes that social contact with other people was a meaningful form of interaction in learning. He mentions the flexibility of a learning process that can be managed at any time and in any way. The uniqueness of Activity Theory is that it highlights the relationship between every factor surrounding the subject. Therefore, in this case, Shah claims that interaction with people provides him with a meaningful moment during the learning sessions. The second example is the interview data about learning.

Query	Regarding learning approaches
Answer	It is like a discovery learning with a combination of hypertext and hypermedia and supported with some resources from the internet.

Table 7.32: Shah's Learning Approaches: 1

The data above shows that the learning strategy implemented in the system is discovery learning with the use of hypertext and hypermedia. As mentioned in Ali's interaction, this explanation reveals that the interaction between the subject and the rules will create a variety of patterns of interaction. In this case, the patterns are considered to be their learning strategies. Thus, Shah states that this approach was suitable for him to use in his learning sessions. The example below describes the learning environment.

Query	Regarding learning approaches
Answer	Another thing I would like to highlight is that by using the system I have full control over my learning environment, including gaining access to the learning material at any time, contacting people at any time and sharing ideas. We can share ideas and information with the other students and the course tutor.

Table 7.33: Shah's learning approaches: 2

The data above shows Shah's explanation regarding his learning environment. He mentions that the system provides him with full control of his learning environment with flexibility in accessing the content and interacting with other people. Activity Theory emphasises the important element of the user's context in designing the system. Thus, it indicates that the online learning module provides Shah with a conducive learning environment with a learner control aspect, and flexibility of learning. The data below illustrates the learner control aspect in learning.

Query	Regarding learning experiences
Answer	The navigation of the system is very good and I can follow the content sequence very easily. Besides, the communication tools allow us to communicate with each other. I like to use private messages to contact my friends to discuss the assignment and the content.

7.34: Shah's Learning Experiences

The data shows how learner control helps Shah in his learning environment. It also reveals that learner control not only focuses on the navigation system but also draws attention to the tools that give flexibility to people when interacting with each other. This is an indication of how the user context is important in providing a successful design for learning. Therefore, by providing the learner with a conducive learning environment, the learning outcome can be successfully achieved. The example below is about the learning process.

Query	What have you learnt from the system?
Answer	I think the most important thing I have learnt is the use of software for our assignment. Yes, I am talking about Adobe Photoshop. Just imagine, before this I knew nothing about this software, but after enrolling on this course, I acquired the skills for using it. It is not too advanced but just right for me to carry out the assignment. This approach is useful for encouraging the student to discover new things rather than just giving them the course materials to read. This system also provides me with meaningful learning activities to stimulate me to think about the topic.

7.35 Shah's Learning

The table above describes the effectiveness of the learning strategies that are implemented in the system. The finding shows how the learning strategies were appropriate for Shah to acquire knowledge about graphic software. It shows that Shah really likes this kind of approach where the student is encouraged to learn by discovering the content and course materials. It also reveals that he has acquired the skills for using the software by exploring its potential. The data supports the idea that interaction with the rule provides different kinds of learning strategies. Thus, this interaction is evidence of Shah's experience of meaningful activities in his learning about graphics. As a result, he feels comfortable with the strategies. The example below is about the use of private messages in his learning.

Query	What have you learnt from the system?
Answer	I love to use private messages to share my problems with my friends and course tutors. For me it is easy to use and gives me greater privacy.

Table 7.36: Shah's use of Private Messages

The difference between Shah and the other students is that he likes to use private messages to share his problems with his friends and course tutors. He claims that the privacy aspect comes with using this tool. From the user tracking data, the use of a private message contributes to helping Shah understand the content and the software. This data shows the relationship between the rules and the tools. It also emphasises the significant role of the tools in supporting the rules (content) in providing better learning outcomes. Therefore, this claim demonstrates the mediating process of the rules, the tools and the subject in the activity system.

7.2.3 Interaction with the Community

This section explains the interaction between Shah and the communication tools, specifically the asynchronous and synchronous tools. In general, Shah sent 8 postings to the discussion group, 3 engagements to the chat sessions and 14 postings of private messages.

Asynchronous Tools

Shah was involved about 8 times in the discussion group. The table below gives an example of a first posting to the discussion group.

Date / Time	Activity	Actions
07/02/2005 9:34	Selecting the discussion group	Post topic
		<p>Topic: query about the assignments.</p> <p>Transcriptions:</p> <p>Shah: I would like to query some questions regarding our assignment:</p> <p>a) how creating the effects in Photoshop?</p> <p>b) how creating the image in Photoshop?</p>
		View posted topics

Table 7.37: Shah's Discussion Group Activity: 1

The table shows Shah's query about the assignment. It is about using the Adobe Photoshop to create a poster for the graphics assignment. The interaction demonstrates that Shah has started to gain support from the community. This query was posted to everyone in the community. It indicates that Shah prefers to use the communication tools to develop his understanding of the skills for using Photoshop and it contributes to his knowledge and learning. To illustrate the significance of the above interaction, the example below shows Shah's query about Photoshop.

Date / Time	Activity	Actions
19/01/2005 17:05	Selecting the discussion group	Post topics
		<u>Topic:</u> query about Photoshop. <u>Transcriptions:</u> Shah: I am facing a problem about the image rotation. Does anybody here know how to rotate the image in Photoshop?
		View posted topics

Table 7.38: Shah's Discussion Group Activity: 2

The table shows the query regarding image rotation. In this interaction, Shah is obtaining help for the course assignments. As one of the community in the activity system, he uses this opportunity to get support for his learning difficulties. By seeking help from the community, he receives quick information, especially about doing the assignment. From the Activity Theory perspective, the role of the community is not only that of an online student but also an assistant in dealing with other's individual problems. From the learning perspective, both interactions show that Shah is not an explorative learner. He likes to obtain information in an easy way merely by making an enquiry about it to the community. The first example below is a message about a technical problem.

Date / Time	Activity	Actions
22/02/2005 15:45	Selecting private message	Post topics
		<u>Topic:</u> problem with log-in <u>Sent to:</u> technical assistant <u>Transcriptions:</u> Shah: I had a problem in login to the system. Can you please help me?
		View posted topics

Table 7.39: Shah's Private Message: 1

The table above shows the problem that Shah had during his learning session. He used a private message to send his problem to the technical assistant. The use of the private message is an alternative approach for Shah to overcome his problems with technical difficulties and support his learning process. Sending the message to the community demonstrates the importance of the relationship between the individuals in the community. Thus, the community plays an important role in providing ideas and in helping Shah to

solve his problems during the learning process. Below is the second example of an interaction using a private message.

Date / Time	Activity	Actions
01/03/2005 01:07	Selecting private message	Post topics
		<u>Topic:</u> query about Photoshop. <u>Sent to:</u> course tutors <u>Transcriptions:</u> Shah: I don't know how to combine two graphics in Photoshop. Could you please explain to me?
		View posted topics

Table 7.40: Shah's Private Message: 2

The table above shows a similar approach used by Shah to obtain support for his learning. At this time, he also used the private message to get help but in a different situation. He sent a question to the course tutors about his problem in using Photoshop. Yet again, as mentioned in the excerpt above, Shah was trying to make use of the community for his learning purposes. He openly uses the private message facility for querying the problem about the skills required for using Photoshop. The third example of a private message below is about learning support.

Date / Time	Activity	Actions
19/01/2005 17:12	Selecting private message	Post topics
		<u>Topic:</u> query about the content. <u>Sent to:</u> course tutors <u>Transcriptions:</u> Shah: I am confusing about the relationship between dpi and resolutions. What is the effect on the image size if I choose a big resolution in our assignment?
		View posted topics

Table 7.41: Shah's Private Message: 3

The table above illustrates a query about course material sent by Shah to the course tutors. This example shows that he was facing a problem with resolution and its relationship with

size. This is a similar excerpt to that about gaining learning support. However, it differs from the two previous examples in the context of the support. In this example it is about course content, not technical help and the skills for using Photoshop, as mentioned in the two examples above. On the other hand, the similarity between those excerpts is the use of the community in a meaningful role in the learning process. As a result, Shah obtained information about the course by interacting with the community in the activity system rather than reading the course materials in the module.

Synchronous Tools

The first example below illustrates the use of asynchronous tools.

Date / Time	Activity	Actions
24/02/2005 18:07	Selecting chat	Log-on into chat sessions.
		Shah: I have a problem using Adobe Photoshop? Ali: yes...Shah...What up? Shah: how do you enlarge your graphics file? Ali: go to the Image menu and choose Image size. Shah: OK. Ali: choose the size, for instance, in this assignment we are required to use 640 x 480 and then click on OK Shah: where should I put 640 and 480? Ali: put 640 for width and 480 for height. Shah: Thanks Ali

Table 7.42 : Shah's Chat Session

The table above reveals how Shah sought assistance from the community. As with other tools, Shah prefers to contact his community to solve the problem. In Activity Theory the collaboration element, which is mediated through the use of tools, is one of the methods for individuals to interact with their community. Therefore, Shah engages in meaningful interaction by collaborating with the community to obtain technical support from the system. It shows that chat sessions with Ali can provide him with information about image

size. The second example below is about securing technical support using the helpline.

Date / Time	Activity	Actions
15/01/2005 18:45	Selecting the helpline	Post message
		<p><u>Topic:</u> query about the Net meeting.</p> <p><u>Transcriptions:</u></p> <p>Shah: I have a problem using net meeting, The connection is too slow. Help me please.</p>

Table 7.43: Shah's Helpline Session

The table above highlights the use of the helpline in seeking support for net meeting problems. The helpline is one of the platforms where students can share their problems with each other. This form of interaction reveals how Shah utilises the helpline by communicating with his friends to get help. Therefore, the function of the activity is specifically to gain support from the community. This situation contributes to an effective online learning environment by sharing problems and experience with others.

7.2.4 Interaction with the Support System

This section explains the interaction between Shah and the administration team in dealing with problems. The group is responsible for dealing with problems regarding learning and technical support. The section will define the use of the support tools for obtaining help from the administration team and the division of labour. Every single interaction offers an example to explain the connection between the subjects and the division of labour. This section also provides an example of the division of labour and its relationship with the activity.

Discussion Group

The example below relates to the learning support provided by the system.

	23/02/2005 13:39	Post message	Reply to the selected topics.
			<p>Topic: querying about scanning.</p> <p>Transcriptions :</p> <p>Shah: anybody have experience about scanning photos?</p> <p>Ali: Shah...you need to have a scanner and photo. You can do this at the department lab. Or borrow the scanner from your friend and then install the software and read the instruction. Make sure that you choose the right resolution to maintain the quality of your image.</p>

Table 7.44: Shah's Discussion Group about the Support Mechanism

The table above shows the message concerning photo scanning in the course content with a reply from Ali. The data show how asynchronous tools mediate between the division of labour and the subject in the activity system. The use of discussion groups is one way in which Shah obtains support through the division of labour.

This excerpt is unlike the interaction of the subject with the community because of their different roles in the activity system. For instance, the role of Ali in this interaction is that of an administrator. However, in the other situation, he forms part of the community that shares the activity in order to achieve the objective in the activity system. Although, we have similar data from the asynchronous and synchronous tools, the perspective is completely different in the Activity Theory.

Helpline

The second example explains the use of the helpline as a support tool.

	17/01/2005 09:36	Post message	Reply to selected topics.
			<p>Transcriptions:</p> <p>Anybody who knows about to create effects in Photoshop. Can you please contact me via Private Message?</p>

Table 7.45: Shah's use of the Helpline as a Support Mechanism

The table above shows how Shah used the helpline to get help for his learning difficulties. The message was sent to the technical assistant. Just as with the excerpt above, the use of the helpline shows how Shah obtains support regarding his learning difficulties. It also reveals how the helpline tool contributes to his learning. The message was answered by the course tutor. He explains the systematic approach to creating effects in Photoshop. The third example is about the use of chat tools for technical support as follows.

15/02/2005 14:24	Selecting chat	View chat rooms
	CS2, IUS3	Participate in chat <u>Chat Rooms:</u> learning problems. <u>Conversation:</u> about Photoshop <u>Transcriptions:</u> Shikin: hi there Shah: are you familiar with Photoshop? Shikin: not...but I have tried Paint Shop Pro before? Shah: I have a question about Photoshop. Shikin: what is it? Shah: do you know how to use the Magic Wand tool? Shikin: I am sorry, I am not familiar with the tools. I always use the rectangle tool to do my graphic editing.

Table 7.46: Shah's Chat Sessions about the support mechanism

The table above demonstrates the use of chat tools to obtain support for technical difficulties. The problem raised by Shah is about Photoshop. However, the conversation ends with no satisfactory answer.

In this case, the type of tool plays an important part in the interaction with the division of labour in the activity system. For instance, the data-tracking record shows that Shah did not use the Chat session often to obtain support. According to the table above, this is possibly because he did not receive appropriate feedback regarding his problem and maybe because he dislikes sharing his problems with the other students and prefers to manage his learning by discussing it in private with the course tutors. Thus, he uses the private message to discuss his learning and technical problems with the course tutors.

Private Messages

The data-tracking record shows that Shah performed most interactions using private messages. These interactions focused on acquiring support for his learning problems and technical difficulties. Therefore, this section will expand upon two examples of each problem: learning and technical. The first example of a private message is about learning problems, as shown in the table below.

Date	Activity	Actions
08/01/05 14:50	Selecting a private message	I am confusing with the raster image and vector image. Can we say that the vector image generates from the drawing using the computer software?

Table 7.47: Shah's Private Message about the Support Mechanism: 1

This illustrates the learning problem that Shah sent to the course tutors. The interaction reveals that Shah was attempting to make an important contact with the course tutor in order to minimise his learning problem about graphics. As a division of labour in the activity system, the role of the support team is transformed from that of being part of the community to that of an expert in dealing with the problem. However, the transformation is not only relevant to the support team but it can also be applied to the students as well. For instance, if the student gives a response to the problem with regard to learning, we can say that his role is changed to that of the division of labour in the activity system. Therefore, this modification means that the task of every individual will always change, depending on the structure of the activity in the system. To support the excerpt above, the example below is about a learning problem.

Date	Activity	Actions
23/02/05 13:51	Selecting a private message	I have a question regarding Photoshop. How to create the effects in Photoshop? I know there are a few examples in the tutorial but my question is purposely about the Glow effect. Can you tell me how to do it?

Table 7.48: Shah's Private Message about the support mechanism: 2

The table shows the feedback from one of the students for the learning problem sent by Shah. This problem is related to the scripting error. As mentioned in the paragraph above, the support team is supposed to represent the division of labour in the activity system. However, this example shows that the role of the division of labour can be changed according to the individual task in the activity system. The second example of the private message is about a technical problem as shown in the table below.

Date	Activity	Actions
22/02/05 15:45	Selecting a private message	I had problem in login to the system. Can you please help me?

Table 7.49: Shah's Private Message about the support mechanism: 3

The data above demonstrate the technical problem sent by Shah to the course tutor. The problem relates to the scripting error. The great number of times that Shah enquires about technical problems to the technical assistant provides him with opportunities to develop his own knowledge in dealing with them. For instance, the feedback from the technical assistant helps Shah to minimise technical difficulties in the future. Therefore, we can see how important the role of the division of labour is in helping the subject deal with the problem.

7.2.5 Analysis of the Student Product

To assess the student outcomes from the assignment, a marking scheme was administered to each student with the collaboration of the course tutors. The assignments were evaluated according to a number of requirements that the students needed to fulfil. For example, the resolution of the poster had to be 640 x 480 pixels. This indicates that the student understands the concept of resolution in digital graphics.

The analysis of the student assignments show that Shah did well in the assignment. Table 7.50 shows the criteria of the evaluation. The sample of the assignment shown below meets the requirements of the criteria. The result of the assignment is shown in Table 7.50.



Figure 7.2: A Sample of Shah's Student Assignment

This finding proves that Shah acquired a knowledge of graphics during the learning session. For instance, he used the standard format of graphics and the right resolution. However, in terms of creativity, he was less original because he did not use any other graphic effect in the assignment.

Specifications	Criteria	Shah
1. Original work	Original ideas	√
	Creativity	√
2. Combined with image, illustration and text.	Image, illustrations and text	
	Image and illustrations only	
	Image and text only	√
	Text and illustrations only	
	Text only	
	Image only	
3. Related to multimedia and education area	Illustrations only	
	Multimedia and education	√
	Multimedia only or education only	
	Other areas	
4. Standard format GIF or JPEG	GIF or JPEG	√
	Other formats	

5. Resolution must be 640 x 480	640x480 pixels	√
	Other formats	

Table 7.50: The Evaluation of Shah's Student Product

7.2.6 System and Support Contributions to Learning Outcomes

In order to examine the contribution of the system and support to the learning outcome, an analysis was made to determine the relationship. Table 7.51 shows the system and support's contribution to learning.

System Contributions to the Learning Outcomes	Support Tools Contribution to the Learning Outcomes	
<ul style="list-style-type: none"> • Makes use of the community to gain help for the course assignment. • High interaction with course content • Discovers learning approaches while the combination of hypertext and hypermedia encourage him to learn. • Use of the learning resources from the Internet • System provides rich information related to the course. • User-friendly navigation tools. • System provides meaningful learning activities to encourage the student to be active in the learning environment. • Provides the flexibility aspect of learning 	<ul style="list-style-type: none"> • Private message 	Uses the tools to query: <ul style="list-style-type: none"> • The use of scanner • Creating of effects in Photoshop • Graphics editing
	<ul style="list-style-type: none"> • Discussion group 	<ul style="list-style-type: none"> • Query about black and white image • Query about scanning photos • Image rotation methods.
	<ul style="list-style-type: none"> • Chat session 	<ul style="list-style-type: none"> • Discussion with Shah about resolution and how to change image size in Photoshop.
	<ul style="list-style-type: none"> • Helpline 	<ul style="list-style-type: none"> • Query about creating effects in Photoshop.

Table 7.51: The relationship between the System, Support Tools and Learning Outcomes for Shah

The table demonstrates that support tools were extensively used to communicate and gather information about the course assignment. With the support tools, Shah made his contact

and actively questioned the other students about the content. This shows that he is a reluctant learner and always depends on other persons to learn. However, he was also impressed with his handling of the navigation and flexibility of the system, which had a positive impact on his learning. The following section reflects on Shah's pattern of interaction and how it contributes to his learning.

Shah's Pattern of Usage

The analysis of Shah's interaction shows that he prefers to use asynchronous tools to gain help from the course tutor. He uses the asynchronous tools in several ways such as:

- a) to communicate and contact the course tutor to ask about his learning
- b) to give an opinion about course activity
- c) ask other friends to gain support for learning problems.

However, no sharing information or knowledge was recorded in the interaction using both tools.

Asynchronous Tools

Asynchronous tools are one of the communication tools that bring flexibility for the student in order to communicate with their friends and course tutor. Table 7.52 demonstrates the type of tools, transcriptions and type of questions asked by Shah during the learning session.

Tools	Transcriptions	Type of questions	Sent To
Discussion group	<p>Shah: animation is very difficult to create. For example, it not easy to create 2D cartoon and even Malaysia is one of the worst countries to produce their own animation.</p> <p>Ali: yes, I agree with you. We do not have such technology to produce the quality cartoon like Walt Disney.</p>	Giving an opinion	Everyone

	<p>Ali: I think to learn about animation, we have to know about graphics principles such as graphic and animation.</p> <p>Shah: yes, absolutely, I agree with you Ali, but to learn about graphics needs a lot of time.</p>	Giving an opinion	Everyone
	<p>Shah: I have experience in developing website. The best website is the best graphics. I mean if you can produce a quality graphics your website will be amazing.</p> <p>Ali: yes absolutely Shah, the design of website is depend on the use of graphics. For me less creative graphics on the website</p>	Giving an opinion	Everyone
	<p>Shah: how to make the image black an white?</p> <p>Ali: it so easy Shah...go to Image...the choose Mode and choose Grey Scale...the click OK...</p>	Query about learning	Everyone
	<p>Shah: anybody have experience scanning the photos?</p> <p>Ali: Shah...you need to have a scanner and photo. You can do this at the department lab. Or borrow the scanner from your friend and then install the software and read the instruction. Make sure that you choose the right resolution to maintain the quality of your image.</p>	Query about learning	Everyone
	<p><i>Course Activity 1</i></p> <p>I think the relationship of graphic and animation are animation made from the movement of graphics. That the only I know about it</p>	Opinion	Everyone
	<p>I am facing problem about the image rotation. Anybody here knows how to rotate the image in Photoshop?</p>	Query about learning	Everyone

	<p><i>Course Activity 2</i></p> <p>The uses of graphics on the internet are making the web page more beautiful with the combination of button, icon, photos, illustration and picture. It will bring the website with variety of design and all of the design is depend on the use of graphics.</p>	Giving an opinion	Everyone
	<p>I would like to query about Photoshop:</p> <p>a) How creating effect in Photoshop?</p> <p>b) How resizing the image in Photoshop?</p>	Query about learning	Everyone
Private messages	<p>I am confusing with the raster image and vector image. Can we say that vector image generates from the drawing using the computer software?</p>	Query about learning	Course tutor
	<p>Have you heard about Corel Draw and Paint Shop Pro? What is the different with Photoshop?</p>	Query about learning	Course tutor
	<p>I am confusing about the relationship between dpi and resolutions. What is the effect on the image size if I choose a big resolution for my poster?</p>	Query about learning	Course tutor
	<p>My question is about scanner. I need to scan photo for our assignment. What is the best format you suggest me to use?</p>	Query about learning	Course tutor
	<p>I went to the chat session but nobody was there. When exactly our session?</p>	Query about a technical problem	Technical assistant
	<p>I had problem in login to the system. Can you please help me?</p>	Query about a technical problem	Technical assistant
	<p>I have a question regarding Photoshop. How to create the effect in Photoshop? I know there are a few examples in the tutorial but my question purposely about the Glow effect. Can you tell me how to do it?</p>	Query about learning	Course tutor

	I don't know how to combine two graphics in Photoshop. Could you explain to me?	Query about learning	Course tutor
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Table 7.52: Shah's Interaction using Asynchronous Tools

Table 7.52 shows that Shah prefers to use asynchronous tools in order to communicate with the course tutor, technical assistant and course members. However, only Ali seems to reply to the messages. As a result high amounts of interaction were recorded using the discussion groups and private messages. Shah's interaction with the community using asynchronous tools is shown in detail in Table 7.53.

Tools	Interaction with	Type of Interaction	Number of Interactions
Discussion group	Ali	<ul style="list-style-type: none"> • Giving an opinion (4) • Making a query about technical problems (1) 	5
	Everyone	<ul style="list-style-type: none"> • Giving an opinion (3) • Making a query about technical problems (1) 	4
Private message	Course tutor	<ul style="list-style-type: none"> • Making a query about learning 	6
	Technical assistant	<ul style="list-style-type: none"> • Making a query about technical problems 	2

Table 7.53: Shah's Interaction with the Community using Asynchronous Tools

Table 7.53 illustrates the number of interaction between Shah and the community in the online learning environment. However, the interactions were more focused on obtaining feedback and gaining help from the course tutors and other course members. The findings show that Shah has a high number of interactions with Ali, as recorded. Shah has contact with Ali six times using the discussion group and chat sessions. He made contact six times with both course tutors and technical assistants in private messages. Most of the interactions emphasised a learning problem and technical difficulties. However, the pattern of interaction, such as providing feedback, was less recorded and it proves that Shah did not engage in giving responses to the messages posted by other students. For peer support, Shah has less interaction with other course members but high interaction privately with course tutors. He sends messages to everyone but only a few of the course members

replied. He also has less feedback in responding to other people posting. He recorded a high interaction in seeking knowledge from the course tutor by making some enquiries about the course content. The transcription reveals that the tools provide a meaningful learning interaction between Shah and his friends and with course tutors.

Synchronous Tools

Shah only logged into the chat session about three times to gain help about course content and using the helpline to discuss technical problems. Table 7.54 illustrates the transcription of the chat session and helpline.

Tools	Transcriptions	Type of questions	Sent To
Chat Sessions	Shah: hi Amin Amin: hi Shah Dilla: hi Shah Shah: have you started do the assignment? Amin: not yet, It not easy. Shah: yeah, I know. Dilla: what about you? Have you started? Shah: not yet...I am now exploring the software. It's not hard to learn. Amin: me to. Shah: I need to know how to use special effect in the Photoshop? Have you tried it? I know we can use it to make icon and button. Amin: really. Shah: yes. Dilla: that's good. Amin: I don't know about it may be you can ask course tutor about this. Dilla: me too. It's better to ask the course tutor. Shah: no problem...thanks	Query about learning	Amin and Dilla
	Shikin: hi there Shah: are you familiar with Photoshop? Shikin: not...but I have tried Paint Shop Pro before? Shah: I got question about	Query about learning	Shikin

	<p>Photoshop. Shikin: what is it? Shah: do you know how to use Magic Wand tool? Shikin: I am sorry, I am not familiar with the tools. I always use rectangle tool to do my graphic editing.</p>		
	<p>Shah: I have problem using Adobe Photoshop? Ali: Yes...Shah...What up? Shah: How to enlarge your graphics file? Ali: go to Image menu and choose Image size. Shah: OK... Ali: choose the size for instance in this assignment we required to make 640 x 480 and then click on OK Shah: where should I put 640 and 480? Ali: put 640 for width and 480 for height. Shah: thanks Ali</p>	Query about learning	Ali
Helpline	<p>I have problem to use net meeting due to the connection is too slow. Help me please.</p>	Query about a technical problem.	Everyone
	<p>Anybody who knows about to created effect in Photoshop. Can you please contact me via Private Message?</p>	Query about learning	Everyone

Table 7.54: Shah's Interactions using Synchronous Tools

The pattern of interaction above describes how Shah makes use of the chat session and helpline in order to communicate with other students in the community for his learning purposes. This interaction also demonstrates how the chat session gave a platform to Shah to share his views and problems with other friends. Table 7.55 shows Shah's interactions with the community using synchronous tools.

Tools	Interaction with	Type of Interaction	Number of Interactions
Chat Sessions	Amin	<ul style="list-style-type: none"> • Responding to other peoples' messages 	1
	Syikin	<ul style="list-style-type: none"> • Making a query about learning 	2
	Ali	<ul style="list-style-type: none"> • Making a query about learning 	1
	Dilla	<ul style="list-style-type: none"> • Responding to other peoples' messages 	1
Helpline	Everyone	<ul style="list-style-type: none"> • Making a query about learning (1) • Making a query about technical problems (1) 	2

Table 7.55: Shah's Interaction with the Community using Synchronous Tools

The interaction as shown in Table 7.55 above also demonstrates how the chat session gave a platform to Shah to share his views and problems with other friends. It also provides some advantages to communicating openly with other course members. However, in this situation, Shah tends to be the receiver rather than a knowledge contributor compared to Ali. As a result, 5 interactions were recorded regarding queries about learning and technical problems in the chat sessions.

This support did contribute to learning by preparing the tools to interact and discuss the learning and technical problems. The result proves that the type of questions that have been asked placed more emphasis on gaining help about learning problems. However, only the helpline was used to discuss technical problems. He could be regarded as reluctant and a selfish person in the learning environment. This is due to the fact that the types of interactions were more about gaining help about learning and technical assistance.

7.2.7 Conclusions

How does Shah Learn?

Shah develops his knowledge about digital graphics by interacting with the course online learning community and exploring the course materials. He makes use of the community in

order to obtain some beneficial feedback from it. This kind of valuable feedback provides him with information about the content and course assignment. He behaves as an observer during the learning session without sharing any information with the other students. He makes heavy use of the asynchronous and synchronous tools in order to gain valuable feedback about his progress. The findings from the interaction with the support system show that he recorded a higher interaction with the course tutors using private messages. The analysis of his pattern of learning, shows that he is a non-sequential learner as he explores the course materials without following a sequence of actions. However, he spends a lot of time exploring the course materials.

How Does the System Contribute to Learning?

In Shah's case study, the system contributes to the progress of his learning by giving him opportunities to communicate and interact with the community in the online learning environment. In addition, it provides the tools for him to get close to the other students and with this advantage he makes effective use of them to learn. As a result we can see that he interacts a good deal, using the communication tools to learn. He develops his knowledge by using several approaches, such as reading the course materials, questioning the administrator about his problems, interacting with the community and utilising the tools to make his learning meaningful.

According to the findings in the interview data, the design of the system also contributes to his learning. The introduction of the discovery learning approach combined with hypertext and hypermedia, encourages him to learn. The learning resources from the Internet also make the system useful and rich with information related to the course. The system is also designed with user-friendly navigation tools, using concept maps such as the table of contents. The findings also show that the learning strategies implemented in the system provide meaningful learning activities to encourage the students to be active in their learning environment. The flexibility aspect of the learning, as mentioned in the interaction with tools section, also contributes to Shah's learning process. With full control of his learning environment, he can pursue his learning at any time and anywhere.

How do the Support Tools Contribute to Learning?

The design of the support tools, such as private messages, the helpline, chat sessions and FAQ's in the system, also contribute to the mastering of digital graphics. The major contribution of the support tools is the employment of the private message and the discussion group. The findings show that Shah has increased his interaction using these tools. Most of these activities concerned tips about using Photoshop in the course assignment. However, Shah did not use FAQ's and the online training course in order to increase his skills in using the Internet facilities.

7.3 CASE STUDY 3

Fabila: The Passive Learner

Fabila is an adult learner aged 41. She has 14 years' teaching experience at a secondary school in Northern Johore, South Malaysia. She is enrolled in the Bachelor of Education course at the Faculty of Education of the University of Technology in Malaysia. Like other students, she also has a Diploma in Education from the Teacher Training College. She has a low IT level, especially with regard to the Internet and Web Applications.

Fabila is a passive learner since she has no interest in learning online. A passive learner is referred to as inactive and prefers to work alone in his/her learning process. The findings from the interviews show that she did not like to read the content on the computer screen but printed it for reading. User tracking identifies that she has very much less involvement with the communication tools. Thus, this classification is appropriate after taking into account her interaction with the artefacts of the Activity System.

7.3.1 Interactions with Tools

This section explains Fabila's overall pattern of usage during her learning sessions (see Appendix C3). The table below is an example of Fabila's pattern of usage when exploring the system.

Session	CM	DG	CS	PM	HL	Learning Support	Technical Support
1	√						
2	√	√					
3	√	√				1	
4		√			√		1
5		√				2	
6	√				√		
7	√	√		√		2	
8			√				
9	√	√		√		2	
10	√						
11	√	√		√		2	
12	√	√		√		2	
13	√						
14	√						
15	√						
16	√						
17	√	√				1	
18	√						

CM – Course Material; DG- Discussion Groups; CS – Chat Sessions; PM – Private Message; HL- Helpline

Table 7.56: Fabila's Use of the Tools

The table above displays Fabila's pattern of usage in her learning sessions using the system. It indicates that her meaningful interaction with online students is very low.

The data also shows that she has her own approach to learning. She is the type of person who does not like to learn through the computer. She develops her knowledge of the courses by reading from the hardcopy. However, she has also made a few postings to the discussion groups, chat sessions, the private message facility and the helpline in order to obtain some feedback regarding the course content. She did not like to pick up new information using the computer. Because of this, she has few meaningful interactions with the course content and the community. However, this does not mean that she does not acquire knowledge about the course. Although, she has limited interaction with the course materials and the community, she uses various learning strategies to help her understanding of the course. The interview data shows that she gathers information from the printed copies of the course materials rather than reading from the screen.

In the first session exploring the system, Fabila printed the learning materials using the printer-friendly icons. She did the same in Session 2 and explored and observed what was happening in the discussion group. In Session 3, she started to send postings to the discussion group and asked about useful reading references for the topics.

She began to use the helpline for the first time in Session 4. The message was about a scripting error that she made when browsing the system. She sent a query about the Photoshop book in Malay to the discussion group in Session 5. In Session 6, she just browsed the course materials and sent a message to the helpline about Photoshop.

In Session 7, Fabila started her course by sending a message to the discussion group about the course activity. Next, she posted a message to the course tutors for advice about the assignment. The posting was about the graphics software, graphics resources and everything about the assignment. At the end of Session 7, she browsed the course content. In Session 8, she participated in chat sessions discussing the assignment with her friend.

She sent a posting about the assignment again in Session 9. It was about the function of Adobe Photoshop in designing a poster. Next, she explored the course content and ended the session by sending a private message. The message was sent to the course tutors and was again about the course assignment.

In Sessions 11 and 12, Fabila used the same tools to send a problem regarding her learning difficulties. In Session 11, she sent a query about graphics hardware to the discussion group. Next, she sent the same query to the course tutor about graphics hardware, especially about the digital camera. In Session 12, she posted a message to the discussion group about photo editing in Photoshop. And again, she sent a private message to the course tutor with the same query.

In Sessions 13, 14 and 15, Fabila simply spent her time browsing the course content. In Session 17, she posted her last message to the discussion group. The message was about

image enlargement in Adobe Photoshop. Finally, in the last session, she merely looked through the course content.

The data above shows that Fabila has her own pattern of learning. She is the type of person who does not like to learn through the computer. She develops her knowledge about the courses by reading from the hardcopy. However, she also made a few postings to the discussion group, chat sessions, private messages and helpline in order to obtain some feedback regarding the course content. She did not like to discover new material using the computer. Because of this, she has a low rate of meaningful interactions with the course content and the community. The way she learns is totally different to that of the other three case studies.

7.3.2 Interaction with the Curriculum

This section explains the data from the interview and the use of the course content. It also describes the learning strategies and the experience of using the system.

The use of the course content

The example below concerns Fabila's interactive method of exploring the course content.

No.	Date	Activity	Actions
1	03/01/2005 14:22	Selecting the course materials	View concept maps
1	03/01/2005 14:45		Read course content (working with graphics)
1	03/01/2005 14:45		Read course content (introduction to graphics)
1	03/01/2005 14:46		Read course content (hardware requirement)
1	03/01/2005 14:47		Read course content (printer)
1	03/01/2005 14:47		View concept Maps
1	03/01/2005 14:48		Read course content (scanner)
2	07/01/2005 18:14	Selecting the course materials	View concept Maps
2	07/01/2005 18:16		Read course content (graphics quality)
2	07/01/2005 18:17		Read course content (resolution)

2	07/01/2005 18:17	View concept maps
2	07/01/2005 18:19	Read course content (image size)
2	07/01/2005 18:19	View concept maps
2	07/01/2005 18:20	Read course content (hardware requirement)
2	07/01/2005 18:24	Read course content (digital camera)
2	07/01/2005 18:26	View concept maps
2	07/01/2005 18:26	Read course content (types of graphics)

Table 7.57: Fabila's Interaction with the course material

From the table above, we know that Fabila started her learning session by reading the topic regarding working with graphics. She then went to the graphics introduction and followed this by checking the hardware requirement. This excerpt means that she is like the other students in the case studies who explore the content using the non-sequential approach. This happened because of her use of concept maps as a main menu in the course content. The use of concept maps allows the student to see an entire representation of the learning content. This allows the students to adopt their own pace of learning. As a result, we can see that most students choose a non- sequential approach in exploring the course content.

Learning experiences

The example below is about Fabila's learning experience during her learning sessions.

Query	Can you please tell me your learning experiences while using the system?
Answer	I can ask the course tutor about the course at any time and anywhere. The strength of this system is that it provides me with facilities to communicate with others i.e. the private message and discussion board. The system also offers us opportunities to get close and know each other through the chatting facilities.

Table 7.58: Fabila's Learning Experiences: 1

The table above demonstrates the flexibility of the system as a communication tool. During the learning session, Fabila experienced flexible interactions between herself and the course tutors. It means that the use of communication tools brings her closer to the other students. This kind of interaction reveals that she likes to communicate with others in the activity

system. By providing communication facilities, we can fulfil the needs and requirements of the user and give flexibility to their learning environment.

The following example refers to her learning strategies.

Query	Can you please tell me about your learning experiences while using the system?
Answer	I don't like to read the content on the computer screen. Alternatively, I printed the course content and read it on paper. Fortunately, this system provides me with a printer-friendly button with which I can print the content straightaway from the internet.

Table 7.59: Fabila's Learning Experiences: 2

The table above provides evidence of how Fabila learns using the system. It seems that she does not like to learn from the computer screen. To avoid it, she prints her learning material from the module. From an Activity Theory perspective, this means that she rarely interacts with the rules of the activity. However, it does not mean that she can not cope with her learning. In addition, she uses a different style of learning to develop her understanding of the content. The example below is about her learning approaches.

Query	What have you learnt from the system?
Answer	The course materials are enough to learn the basics of digital graphics, especially for us, the teacher. The content is appropriate to our capability, as you know we do not have much time to learn.

Table 7.60: Fabila's Learning

From the above finding, it is clear that the content design is suitable for Fabila to learn about digital graphics. Back to the user context, in this case, it confirms that the design met the requirements for student needs and context, especially for Fabila. The example below shown Fabila's learning approach.

Query	Regarding learning approaches.
Answer	For me the content is sufficient for learning the concepts of digital graphics. However, I like to learn from the hardcopy. I feel a little bit bored if I read the course materials on the computer screen. Consequently, I printed the entire course content straight from the Internet to the hardcopy.

Table 7.61: Fabila's Learning Approach: 1

The data above clearly shows Fabila's method of learning using the system. She mentions that disruption occurs when learning through the computer screen. As a result, she printed the content and related links from the online module. Again, as mentioned in the example above, this results in a very low level of interaction compared with the other students in the learning sessions. The second example below is about learning strategies.

Query	Regarding learning approaches
Answer	<p>What I wanted to highlight here is this system has both approach to learning. For instance, the theory of graphics was provided in the course content but at the same time the hyperlinks about Photoshop were also given for the student to learn.</p> <p>For me it is a brilliant way to encourage the students to explore and implement what they have learnt in theory and apply it using the graphics software for the assignment.</p> <p>This is really good because we are not just given an electronic book but are also being forced to explore and discover the tutorial about Photoshop in order to complete the assignment. This approach means the students are encouraged to actively seek information and apply it in the assignment with the use of the software. To be honest, I like this approach.</p>

Table 7.62: Fabila's Learning Approach: 2

The table above demonstrates the learning strategies that were implemented in the module. Fabila mentions the way the activities were presented, such as active learning, discovery and exploratory learning. It seems that the approach to learning gives her opportunities to explore and actively search for information and finally apply it in the course assignment. The rules mediate the interaction between the subjects in the activity system. Therefore in this research, they can be defined as learning strategies. As a result, the subject has his/her own learning strategies to achieve the objectives of their activity system. The third example below is about learning.

Query	What have you learnt from the system?
Answer	The links for every topic inspire me to explore the content. I would say that the course comes with a rich resource environment, which can encourage the student to learn about digital graphics.

Table 7.63: Fabila's Learning Approach: 3

The table above explains the advantages of hypertext as a link to a rich resource environment. The use of the hypertext concept in the design provides advantages to Fabila in her learning. This notion leads her to increase her knowledge of digital graphics. Once again, this design meets her user needs in the context of learning.

7.3.3 Interaction with the Community

This section describes the interaction between Fabila and the community in the activity system. It explains the two different tools in the system, namely, asynchronous and synchronous tools.

Asynchronous Tools

In order to get in touch with the community, the system provides a variety of tools. These include a discussion group and private messages. The following few examples illustrate Fabila's use of the discussion group and private messages to help her learn. The data tracking record shows that she has concluded nine meaningful interactions with the discussion group. All of this was about learning in relation to the course assignment and course content. The example below is about the use of the discussion group in the learning sessions.

Date / Time	Activity	Actions
16/01/2005 14:39	Selecting the discussion groups	Post topics
		<p><u>Topic:</u> query about the content.</p> <p><u>Transcriptions:</u> hello! Anybody know about the references about Photoshop except in this course. Please share with us here.</p>

	View posted topics
--	--------------------

Table 7.64: Fabila's Discussion Group Activity: 1

The table above illustrates the use of the discussion group for seeking information about the course references from friends. From the above data, we know that Fabila was trying to increase her knowledge by collecting additional information about the course. This was one way in which she was able to use the advantage of the community for the benefit of her learning. As mentioned in the interaction with tools section, Fabila did not like to read the course material on the screen. So this was a way for her to obtain information about the course to support her learning. The significance of this interaction is that each person has his/her own way of making useful contacts with their community. Therefore, she employed this approach to develop her knowledge of digital graphics.

The following example is about the use of discussion groups for dealing with learning difficulties.

Date / Time	Activity	Actions
05/02/2005 15:32	Selecting the discussion group	Post message
		Transcriptions: Anybody here know how and where to use blur function for the image. I would like to apply it on my poster.

Table 7.65: Fabila's Discussion Group Activity: 2

The data above represent a help message in relation to a course assignment. The message is a query about how to create a blur image in Photoshop. Yet again, with the same approach, she receives immediate feedback from the community and this gives her the chance to build up her understanding of the concept of graphics. From another perspective, the interaction is not simply to obtain learning support but also to help her maintain her relationship with the community. Contact is important for individuals to keep in touch with each other in order to preserve their relationship in the activity system. Therefore, it is important to relate this aspect to their learning outcomes.

The example in the table below concerns the use of private messages.

Date / Time	Activity	Actions
16/02/2005 14:00	Selecting the private message	Post message
		Topic: query about the course assignment. Sent to: course tutors Transcriptions: I got the photo from the internet and it to big for me to add into the poster. Can you please explain to me how to use the editing tools?
		View posted topics

Table 7.66: Fabila's Private Message Activity

The data above show that the message was sent to the course tutor corresponding to the course assignment. This message was a query about the Adobe Photoshop software. It contains a set of questions about the image size and resolution relating to how to apply these criteria to the assignment. As in the excerpt above, Fabila was trying this time to obtain immediate information by asking the course tutor about it. Although all the links and information about the query are provided in the course content, she used the same approach to get immediate feedback from the community regarding the course content.

Synchronous tools

The following example is about the use of the chat session.

Date / Time	Activity	Actions
04/02/2005 14:51	Selecting chat tools	Participate in chat sessions
		Transcriptions: Fabila: Have you used blur effect in Photoshop? Amin: Yes. It is very easy to use. Fabila: How? Amin: OK ...it's simple...you go to the effect menu... Fabila: Then... Amin: Just click on the blur... remember there are too many types of blur. Choose the right one. Fabila: What should I choose? Amin: Just use normal blur. Make sure to open your graphics file first. Amin: Yes...sure...thanks...I will try it now.

Table 7.67: Fabila's Chat Sessions

Only three interactions have been recorded in the user tracking file for the chat session. One of these is mentioned in the table above. It discussed the problem of the net meeting and the slow network connection. It seems that Fabila used the contact with the community as a platform to discuss her technical difficulties. The data also show that she only used the chat session to discuss her technical problem. This may be because she wanted to receive immediate feedback from the community. Contacting the community is one way for Fabila to relieve her stress when facing a problem in her learning session.

Another platform where Fabila can share her technical difficulties is the helpline. The example below demonstrates use of the helpline to obtain support about technical and learning problems.

Date / Time	Activity	Actions
28/01/2005 13:50	Select the helpline	Post message
		Transcriptions: I got problem when using this system. Errors occur when I go to frontpage.

Table 7.68: Fabila's Helpline Sessions

The above table shows a help message regarding a scripting error. Instead of participating in the chat session, this is another method whereby Fabila obtains immediate support from the community. The role of community becomes an important element in reducing the pressure when the online student faces problems with any issue during their learning session. This can minimise disruption during the learning session.

7.3.4 Interaction with the Support System

This section illustrates the role of the division of labour, which indicates the administrative and support team that deal with students' problems. The following text exemplifies the use of the private message for learning support.

Date / Time	Activity	Actions
16/02/2005 14:00	Selecting the private message	Post message
		Topic: query about the course assignment. Sent to: course tutors Transcriptions: I got the photo from the internet and it too big for me to add to the poster. Can you please explain to me how to use the editing tools?
		View posted topics

Table 7.69: Fabila's Private Message about the Support Mechanism

The data shows the message sent to the course tutor on the topic of the course assignment. Fabila posted the query about the problem of using Photoshop and it has been replied to by the course tutor. The problem was about the use of editing tools in Photoshop. In Activity Theory, the division of labour means the distribution of tasks and benefits among the participants in the activity system. Therefore, in this case, the support team, which is referred to as the division of labour, plays a valuable part in giving assistance as well as benefiting from the learning process. As noted in the extract above, Fabila, as a subject, makes use of the support team to help her solve her learning problem. Then, she reinforces

her learning concept about the content by receiving feedback from the course tutor. The following is another excerpt about learning support using the discussion group.

Date / Time	Activity	Actions
16/02/2005 14:11	Selecting the discussion group	Post topics
		Topic: query about the content. Transcriptions: I saved a picture from the Internet and it too big for me to add to the poster. Anybody know how to use the editing tools?
		View posted topics

Table 7.70: Fabila's Discussion Group about the Support Mechanism

The posting above concerns a query about the course assignment and the course content. The message was answered by other students in the group. Again, as mentioned in the previous section, the role of the division of labour can be changed according to the community task. On this occasion, the support team came from the community, specifically the online students taking part in the course. The contribution to learning of the above interaction was the feedback received from the other students who helped Fabila to learn how to use the editing tools. The third example is about a scripting error.

Date / Time	Activity	Actions
28/01/2005 13:50	Selecting the helpline	Post message
		Transcriptions: I have a problem when using this system. Errors occur when I go to frontpage.

Table 7.71 Fabila's Helpline about the Support Mechanism

This example shows how she makes use of the helpline to obtain assistance with a scripting error. As a student in an online learning environment, Fabila is forever facing problems in all sorts of situations. Besides using the synchronous tools to win support for learning, she also uses the asynchronous tool to obtain help with her technical difficulties. The advantage of being offered support means that the student is not coping with the problem alone. In

such a case, the role of the division of labour is taken by an expert who answers all the questions relating to technical and learning issues addressed by the students. The fourth example is similar to the above extract in that it concerns gaining support for learning difficulties.

Date / Time	Activity	Actions
04/02/2005 14:51	Selecting chat tools	Participate in chat sessions
		Transcriptions: Fabila: Have you used the blur effect in Photoshop? Amin: Yes. It is very easy to use. Fabila: How? Amin: OK...it's simple...you go to the effect menu... Fabila: Then... Amin: Just click on the blur... remember there are many types of blur. Choose the right one. Fabila: What should I choose? Amin: Just use the normal blur. Make sure to open your graphics file first. Amin: Yes...sure...thanks...I will try it now.

Table 7.72: Fabila's Chat Session about the Support Mechanism

The data shows that the chat session is another method for Fabila to obtain help from the support team about the net meeting and the scripting error. Even so, the extract uses similar data to the interaction with the community section. However, the circumstances of the interaction are totally different. Again, as mentioned in previous case studies, this interaction is with one of the community or course tutors in the activity system. However, the role of the course tutor is changed, not as a community but as a division of labour who is responsible for resolving the students' problems.

7.3.5 Analysis of the Student Product

A sample of one of Fabila's student assignments is shown in Figure 7.3.



Figure 7.3: A Sample of Fabila's Student Assignment

Figure 7.3 illustrates Fabila's learning outcomes after the learning session. Although, it meets the criteria of the assignments, as shown in Table 7.73, the creativity element is still at a low level.

Specifications	Criteria	Fabila
1. Original work	Original ideas	√
	Creativity	
2. Combined with image, illustration and text.	Image, illustrations and text	√
	Image and illustrations only	
	Image and text only	
	Text and illustrations only	
	Text only	
	Image only	
3. Related to multimedia and education area	Multimedia and education	√
	Multimedia only or education only	
	Other areas	
4. Standard format GIF or JPEG	GIF or JPEG	√
	Other formats	
5. Resolution must be 640 x	640 x 480 pixels	√

480	Other formats
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Table 7.73: The Evaluation of Fabila’s Student Product

The analysis in Table 7.73 above shows that Fabila has successfully applied what she has learned from the system. She understood the concept of graphics, format and resolution and also acquired several skills from the software. As a result, the assignment was successfully created and fulfilled the specifications.

7.3.6 System and Support Contribution to Learning Outcomes

The following table shows Fabila’s system and support tools contribution.

System Contributes to Learning Outcomes	Support Tools Contributes to Learning Outcomes	
<ul style="list-style-type: none"> • Makes use of the community to gain help for the course assignment but very low meaningful interaction. • Learning by hardcopy. • Printed the material from the course content and other references linked to the topics. 	<ul style="list-style-type: none"> • Private message 	Query about: <ul style="list-style-type: none"> • the graphics resources for the assignment • best pixel for the digital camera • use of the editing tools • Creating text
	<ul style="list-style-type: none"> • Discussion group 	<ul style="list-style-type: none"> • blur function • editing tools • image enlargement in Photoshop
	<ul style="list-style-type: none"> • Chat sessions 	<ul style="list-style-type: none"> • Discussing blur image
	<ul style="list-style-type: none"> • Helpline 	<ul style="list-style-type: none"> • Queries about creating text in graphics.

Table 7.74: The Relationship Between the System, Support Tools and Learning Outcomes for Fabila

A study of Fabila’s interactions reveals her actual learning pattern. However, this was different to the other case studies. The system plays a minimal role in her learning as she likes to learn by using the hardcopy. She prefers to use the support tools to ask the community about the course assignment. In order to demonstrate the how the system contributes to learning, the following section elaborates on how Fabila makes use of the

system for her learning. This will explain the relationship between how the system contributes to learning.

Fabila's Pattern of Usage

Feedback in the online environment such as suggestion and encouragement give some benefit to other students in learning sessions. The types of questions asked also describe what type of problems the student had in the learning sessions. However, Fabila did not use these facilities to obtain assistance for her learning. The result shows that Fabila has less interaction compared to the other students. It means that the asynchronous and synchronous tools are contributing less to her learning. However, it did contribute in some aspects of learning. For instance, based on the type of questions asked, Fabila needed to gain help about her learning and technical difficulties.

Asynchronous Tools

Fabila used the asynchronous tools purposely for gaining support from the course tutor. She makes use of discussion groups and private messaging in order to make enquiries about learning and course activity. Table 7.75 shows the pattern of interaction via discussion groups and private messages.

Tools	Transcriptions	Type of questions	Sent to
Discussion group	Hello! Anybody knows about the references about Photoshop except in this course. Please share with us here.	Query about learning	Everyone
	I am searching the book regarding to digital graphics and Photoshop in Malay. Please send private message if you know about this.	Query about learning	Everyone
	I am a little bit confusing about the course activity. Why related with animation. This is two different topics. Anyway, anybody who knows the answer please send me private message.	Query about course activity	Everyone

	Anybody here knows how and where to use blur function for the image. I would like to apply it on my poster.	Query about learning	Everyone
	What is the best pixel of the digital camera for quality data?	Query about learning.	Everyone
	I have saved a picture from the Internet and it to big for me to add into the poster. Anybody knows how to use the editing tools?	Query about learning.	Everyone
	I would like to enlarge the image in Photoshop. Somebody please teach me how to use it.	Query about learning.	Everyone
Private messages	I am not sure about the theme of my poster. I am planning to create a theme about Internet and Education. Is that OK? Can I use other graphics software for the assignment?	Query about learning.	Course tutor
	Can you advice to me where can I get the graphics resources for the assignment?	Query about learning	Course tutor
	Hi there! Can you tell me the best pixel of the digital camera for quality data? What I mean is the finest pixel for the good photos.	Query about learning	Course tutor
	I got the photo from the internet and it to big for me to add into the poster. Can you please explain to me how to use the editing tools?	Query about learning	Course tutor

Table 7.75: Fabila's Interaction using Asynchronous Tools

The interaction pattern, as shown in Table 7.75 above, shows that Fabila has mostly used the discussion group for obtaining help from other course members. At this stage, results indicate that she likes to share her problems with the community. It might help her to gain some understanding about digital graphics. Although she has few interactions using the asynchronous tools, the type of questions asked were emphasising her concern about learning. Private messages prove that she was successful in using it to contact the course tutor in dealing with her learning difficulties. Table 7.76 shows Fabila's interaction in detail.

Tools	Interaction with	Type of Interaction	Number of Interactions
Discussion groups	Course tutor	<ul style="list-style-type: none"> Making a query about learning 	7
Private message	Course tutor	<ul style="list-style-type: none"> Making a query about learning 	4

Table 7.76: Fabila's Interaction with the community using asynchronous tools .

Table 7.76 demonstrates the number of interaction between Fabila and other community members such as course members, course tutors and technical assistants using asynchronous tools. A low amount of contact has been recorded between Fabila and other course members. However, she communicates about 11 times with course tutors in order to gain help regarding learning and seeking information for the course content.

Synchronous Tools

The analysis of interactions using synchronous tools shows that Fabila was using these tools the least in her learning. Table 7.77 shows her interactions using chat tools and the helpline.

Tools	Transcriptions	Type of questions	Sent to
Chat sessions	<p>Have you used blur effect in Photoshop? Yes. It is very easy to use. How? OK ...it simple...you go to the effect menu... Then... Just click on the blur... remember there are too many type of blur. Choose the right one. What should I choose? Just use normal blur. Make sure open your graphics file first. Yes...sure...thanks....I will try it now...</p>	Query about learning.	Amin

Helpline	I got problem when using this system. Errors occur when I go to frontpage. Anybody please help me.	Query about a technical problem.	Everyone
	Please help me. I am having difficulties in creating text in my graphics. I see the tools and try it but the text not appeared. What should I do?	Query about learning.	Everyone

Table 7.77: Fabila's Interactions using Synchronous Tools

As shown in the table above, Fabila preferred not to use the synchronous tool for learning. She used the asynchronous tool with minimum interaction but specifically for gaining help about course content. She also recorded only one interaction using the chat session and this indicates that she was not interested in using the synchronous tools. Fabila had less peer contact but recorded a high interactivity with the course content. She also had less contribution in sending the messages to other members and no feedback was recorded in the learning session. Table 7.78 shows Fabila's interactions using chat sessions and the helpline.

Tools	Interaction with	Type of Interaction	Number of Interactions
Chat sessions	Dilla	<ul style="list-style-type: none"> Making a query about learning 	2
Helpline	Everyone	<ul style="list-style-type: none"> Making a query about learning (1) Making a query about technical problems (1) 	2

Table 7.78 : Fabila's Interactions with the Community using Synchronous Tools

Table 7.78 above shows Fabila's interactions with the community using synchronous tools. Only one interaction is recorded in a chat session and two messages were sent to the course tutors. However, a high amount of interaction was recorded between Fabila and the course content. The course content gave Fabila flexibility in obtaining material, due to minimum interaction recorded during the learning session. Fabila also used the printer friendly

version to download the notes since she did not like to learn through the computer screen.

7.3.7 Conclusions

How Does Fabila Learn?

She developed her understanding of graphics by reading the printed material provided in the module. The pattern of interaction with the course materials was non-sequential and limited. According to the interactions with the tools section, she made a few contacts through private messages, the discussion group, chat sessions and the helpline by sending questions about the content. At this point, she obtained information by sending a question to the community. She also learned a few topics by receiving feedback and responses from the community. However, she used the tools less for her learning.

How Does the System Contribute to Learning?

The system contributed to learning by providing an appropriate content for learning digital graphics which matched her ability. The strategies that are implemented in the system encourage the student to actively seek information. The use of the links as references provides the student with a rich resource environment. Fabila mentioned these effective aspects of learning during the interview.

The excerpt from the interaction with the community and support system also shows how the system contributed to her learning. Interaction with the community through the use of asynchronous and synchronous tools proved that she acquired information about graphics by receiving feedback and responses from the community, thanks to the division of labour. For instance, the excerpt in Section 3 shows that the use of communication tools was an efficient way of seeking information about the course references.

How do the Support Tools Contribute to Learning?

The literature suggests that problems with the online learning environment can diminish the motivation to learn. Therefore, by providing the student with a platform to share their difficulties, we can prepare them for an effective learning environment. The support tools contributed to Fabila's learning by minimising the problems related to a number of technical issues. The support tools provide a platform for the students to express their problems and share ideas in a learning environment. For instance, in the interaction with the support system section, she used the helpline to obtain help about a scripting error. This can actually help her avoid some interruptions to her learning.

7.4 CASE STUDY 4

Naz: The Reluctant Learner

Naz was an undergraduate student from the University of Technology of Malaysia. He enrolled in the Faculty of Education as a part time B.Ed. student. He was about 35 years old and worked as a teacher at a secondary school in Johor Bahru, located in the South of Malaysia. He has a Diploma in Education from one of the teaching colleges. As a teacher and part-time student, Naz had a commitment to teaching in a school and study at university. His IT level was moderate but he had considerable skill in basic computer applications. Like Shah, Naz was also categorised as a reluctant learner. He used the system for his own interests without contributing knowledge to other students. He also used the system just to gather knowledge from the community to develop his understanding about the content. Thus, with this characteristic, I classified him as reluctant learner.

7.4.1 Interaction with Tools

This section explains Naz's use of the tools during the learning session (see Appendix C4). The table below shows his pattern of interaction with the tools.

Session	CM	DG	CS	PM	HL	Learning Support	Technical Support
1	√						
2	√						
3	√						
4	√						
5	√						
6	√						
7	√						
8	√						
9	√						
10	√						
11	√						
12		√	√	√		2	
13	√	√				1	
14	√	√	√	√		2	
15		√			√	1	1
16	√	√		√		2	
17							
18		√					
19		√	√	√		2	1
20	√			√		2	
21	√			√	√	1	1
22	√						
23	√						
24	√						
25				√		1	
26	√						
27	√						
28	√						
29				√		1	
30					√		
31		√		√		1	
32	√	√					
33		√	√	√			1
34	√	√	√	√	√	2	

CM – Course Material; DG- Discussion Groups; CS – Chat Sessions; PM – Private Message; HL- Helpline

Table 7.79: Naz's Use of the Tools

In Sessions 1 to 12, Naz merely explored the course materials without performing any other activities. From Session 12 on, he started posting messages to the discussion group, participating in chat sessions and sending messages to the course tutors. In Session 13, he sent a message to the discussion group about graphic format. In the next session, he used

most of the tools, for instance, sending a communication about gradient tools, sending a private note to the course tutors about layers in Photoshop and participating in chat sessions. In Session 15, Naz started the session by sending a message about animation and another about Photoshop. He ends by contacting the helpline about a net meeting. In Session 16, Naz got in touch with the discussion group about graphics from the Internet. He did the same thing in Sessions 18, 19 and 20. All the messages were related to the course assignment, scripting errors and Photoshop. In Sessions 19, 20, 21, 25, 29, 31, 33 and 34, he dispatched private messages to the course tutor. Most of the questions were about the course assignment. Here we can see that Naz used the private message tools to develop his learning competence in graphics and software. However, most of the messages were related to the use of the Photoshop and the course assignment. Naz only used the helpline twice in Sessions 15 and 30. Both postings were about the net meeting and scripting errors. Finally, Naz took part in the chat session in Sessions 12, 14, 19, 33 and 34. Most of the conversations were about the course assignment and Photoshop.

From the user tracking data, we can see that Naz had a slightly different pattern of interaction to the other case studies. It shows that he mainly used the course materials as a reference for his learning activity. In every single log-in, he explored the course content and spent most of his time reading the course content to develop his understanding of digital graphics. He also used support tools, such as private messages to gain support for his learning and technique. The categories of questions related to software, the application of the graphics concept in creating a poster, and hardware requirements. He used two helpline sessions to obtain feedback about a scripting error, a chatting error, the net meeting and a slow network connection. He relayed a few links about tutorials for the assignment to the student resources page. In spite of using the system to learn graphics, Naz also shared information with his friends by sending some links about the Adobe Photoshop tutorial to the web links. Naz's activity patterns lay great emphasis on sending messages to his friends and course tutors.

7.4.2 Interaction with the Curriculum

This section describes Naz's interaction with the curriculum. It explains the use of course content and of learning by using data from the interview.

The Use of the Course Content

The examples below show Naz's use of the course content in his learning sessions.

	Naz	Activity	Actions
1	28/12/2004 10:42	Selecting course materials	Read course objective
1	28/12/2004 10:42		View concept maps
2	29/12/2004 17:32	Selecting course materials	View concept maps
2	29/12/2004 17:33		Read course content (types of graphics)
3	02/01/2005 14:08	Selecting course materials	View course content.
3	02/01/2005 14:10		Read course content (graphics quality)
3	02/01/2005 14:13		Read course content (graphics categories)
3	02/01/2005 14:13		View concept Maps
3	02/01/2005 14:14		Read course content (working with graphics)

Table 7.80: Naz's Interactions with the Course Material

The table above shows Naz's sequence of learning by exploring the course content of the system. It shows that he liked to read the content using non-sequential methods. He started exploring the system by reading the course objectives and followed this by viewing the concept maps. The significance of this excerpt is that the system design provides a variety of interaction patterns for the students. This reflects the role of the rules in the activity system. The pattern of interaction can be defined as a rule in the activity system.

Therefore, the interactive process with the curriculum provides a variety of learning patterns. In that case, based on the data, we can say that Naz was a non-sequential learner.

Learning Experiences

The example below shows Naz's learning experiences.

Query	Can you please tell me your learning experiences while using the system?
Answer	The course content is well designed with a very helpful concept map. The concept map allow me to navigate the course content very easily and if I am lost, I can go back to the map. The navigation menu is brilliantly designed and very user-friendly. The concept map also helps me to understand the overall picture of the content.

Table 7.81: Naz's Learning Experiences: 1

The above table shows the advantage of using concept maps in designing the online module. Based on Naz's experience, the concept map provided him with a very user-friendly navigation system for the course. He built up his understanding from it. The rules refer to the regulations, norms and conventions in the activity system. Therefore, the navigation concept as well as that of the learning strategies will be the rule for the online learning environment in this research. A comprehensive idea of the content contributed to his course learning. Below is the second example of Naz's learning experiences during his learning sessions.

Query	Can you please tell me your learning experiences while using the system?
Answer 1	I very much liked to use the private message and helpline.
Answer 2	A most valuable experience using this system was that I could freely contact the person I wanted to and discuss anything about the content. This gave me the impression of being in an actual classroom and the technical assistant really assisted me with my technical difficulties as well as my learning problems, such as how to use the tool in adobe Photoshop and the basic concept of graphics.

Table 7.82: Naz's Learning Experiences: 2

This table shows the benefits of Naz's full interactions during the learning sessions. It suggests that Naz liked to use the communication tools to discuss his problems with the community. The rules regulate the interaction in the activity system, however, the interaction has its limitations. This limitation actually derives from the rules. This means that the communication tools have their limitations, such as time constraints and non-verbal

delays in receiving replies and in text only messages. Thus Naz had his own pattern of learning, such as making use of private messages to develop his understanding of concepts. Although these procedures have their limitations, Naz was comfortable using them as his learning tools.

Learning

The example below is about learning.

Query	What have you learnt from the system?
Answer	I learnt the concept and principles of graphics. The most important thing is that now I know how to create my own graphics project. I also acquired some skill in editing photos from the digital camera and scanner. For me, this is a very useful experience because before this, I did not have any grasp of these skills.

Table 7.83: Naz's learning: 1

The table above shows what Naz achieved in his learning sessions. He managed to learn the skill of editing photos and creating a graphics project. He also talks about the valuable experience he had in the learning session. This excerpt demonstrates Naz's interaction with the rules of the curriculum. The notion of interaction left Naz with a meaningful experience of his learning development. The second example is about the advantages of online learning.

Query	What have you learnt from the system?
Answer	We can ask anything about technical problems and obtain information from the resources without hesitation. This is something I really admire. This is because we are reluctant to ask for something in a face-to-face situation but in online learning, this does not happen.

Table 7.84 : Naz's learning: 2

The table above shows the benefits of an online module in obtaining resources and help. It relates to the student's culture, especially those from Malaysia. Most Malaysian students are reluctant to share their opinions in the traditional classroom. However, with the advent of communication tools, the culture has changed, and by providing this platform, it supports them and offers a comfort zone in their learning environment. It makes their

learning more enjoyable and meaningful. The third example is about the use of web links in the learning process.

Query	What have you learnt from the system?
Answer	The links also help me to understand the basic concepts of each topic. For instance, those of the File Format topic provide in-depth information about what type of graphics to use and who has developed them. Also the student learning resource links contain a lot of information about graphics.

Table 7.85: Naz's Learning: 3

The use of web links has a positive impact on Naz's learning. He mentioned that they provided him with in-depth information about the content of the student learning resources. This is one of the strategies to encourage the student to actively seek information. Again, this procedure refers to the function of the rules in the activity system. Therefore, by providing the student with a well-designed content, it contributes to positive outcomes in their learning sessions. The example below is about Naz's perceptions of learning when using the system.

Query	Regarding learning approach
Answer	The aspect of learning that I enjoyed is the fact that the student is encouraged to use the tools. I think this approach is useful to make the student active and committed to his learning. For instance, if the course activity is about the use of communication tools, it means that the students have to use these facilities. In addition, they are, at the same time, acquiring skills to use the tools to achieve their learning outcomes.

Table 7.86: Naz's Learning Approach: 1

The findings confirm the statement about the learning strategies implemented in the system. Naz mentioned that he enjoyed the use of the tools in learning. Again, this excerpt demonstrates the significant use of the rules in applying learning strategies in the module. It proves that the rule makes an effective contribution to their learning proficiency. The example below is about learning skills.

Query	Regarding learning approach
Answer	Besides learning about the course content and about graphics, I also learnt about the skills relating to the internet, such as chatting, posting to discussion groups and using the helpline. I acquired this skill by exploring the system and by browsing the online training tools.

Table 7.87: Naz's Learning Approach: 2

The table shows Naz describing how he developed the skill to use the facilities throughout the system. He mentions the online training tools when learning the skills to take advantage of the system. Besides learning about the content, the student also acquires the skill of using the facilities. These skills also play an important role in learning to use the system. Therefore, mastering them can contribute to a comfortable learning environment for the student.

Query	Regarding learning approach
Answer 1	Another point is that the student does not necessarily have to follow the sequence of instructions but can choose his/her own pace of learning. They can go wherever they want and it is more like a self-directed approach.

Table 7.88 : Naz's Learning Approach: 3

This excerpt is similar to the previous section where Naz talks about self-directed approaches in his learning. As discussed previously, this shows that the rules or the learning strategies have a variety of patterns. Thus, Naz prefers the self-directed pattern of learning in using the system for his learning.

7.4.3 Interaction with the Community

This section explains the relationship between the subject and the community and demonstrates Naz's use of communication tools to interact with the community. The section describes the use of both synchronous and asynchronous tools.

Synchronous tools

The example below demonstrates Naz's use of chat sessions.

	Date	Activity	Actions
	15/03/05 18:24	Selecting chat session	Log-on into chat sessions
			Naz: Have you started doing your poster? Amin: Not Yet. Naz: I am having a problem searching for a suitable image. Amin: First thing is you should have your own concept. Then relate it to the theme. Naz: Yes, I agree with you Amin: What are you planning to do Naz? Naz: Maybe my poster is about ICT in the classroom. That's my theme. That sounds good

Table 7.89: Naz's Chat Sessions

The table above details a discussion in the chat session about the course assignment. This session was between Naz and the other members of the community in the system. It shows that the chat session is a tool that allows every individual in the system to interact in the same time. This furnishes advantages to the community, allowing them to get closer to each other by discussing every issue, especially the learning process. In this particular case, the function of the community can be described as sharing ideas and issues about particular issues. As demonstrated in the data above, the community contributes to learning by offering suggestions and feedback about the course assignment. The example below is about Naz's use of helpline tools.

l	Date	Activity	Actions
	24/01/05 17:05	Selecting the helpline	The Net meeting is not functioning. Does everybody realise this?

Table 7.90: Naz's Helpline Sessions

The table above contains a message regarding the net meeting. In Activity Theory, the activity may be supported by the community and facilitate the goal of the activity. With the use of asynchronous tools, the online learning community may offer support to Naz so as to aid his learning by sending feedback to the helpline. This interaction contributed to an effective learning environment for Naz and may provide better outcomes at the end of the course.

Asynchronous Tools

The example below highlights a learning problem that Naz sent to the discussion group.

	Date	Activity	Actions
	21/01/05 12:26	Selecting discussion group	What is the difference between JPG and BMP? Why don't we use BMP format in our assignment?

Table 7.91: Naz's Discussion Group Sessions: 1

The data shows that the above query was about the course content related to the graphic format. At this stage, Naz was improving his learning by sending a question to the whole community on the course. The message was about the different graphics formats. He made use of the community to obtain information about the graphics format in the module and this is one of the learning strategies that has been applied in the learning sessions. A similar approach had been implemented to obtain help for a technical problem, as shown in the example below.

	Date	Activity	Actions
	29/01/06 15:07	Selecting discussion group	I am facing a problem with the system when I am browsing. Every time I log-on to the front page, the scripting produces an error message. I do not know why. Anybody here had a same problem?

Table 7.92: Naz's Discussion Group Sessions: 2

The data shows the problem of a scripting error. This is a problem that most of the students in this research have faced. The advantage of the discussion group's sessions is that the student is able to send a message to the whole of community in the online learning environment. Although the student does not receive immediate feedback, this tool is effective in obtaining a response about several issues. For example, the discussion about the scripting error made the people in the community aware of what was happening in the system. From the Activity Theory perspective, the significance of this excerpt is that we can observe how the individuals in the community share the same experience of a problem and must decide what action should be taken and who is responsible for dealing with it. This excerpt shows significant links between them. The example below is about the use of private messages to obtain learning support.

	Date	Activity	Actions
	30/01/05 08:51	Selecting private message	Post private message Sent to: course tutors Could you please explain to me: a) How to combine the layer graphics with other graphics files? b) How to put text in graphics?

Table 7.93: Naz's Private Message Sessions

The data show that the queries about Photoshop relate to editing the image. This enquiry is about the difficulties that Naz had when doing the course assignments. He used the private message facility to send his question to the course tutor in order to solve his learning difficulties. In Activity Theory, when people hope to achieve a certain goal, the context of community is described as that of a mediator. In this case, the course tutor acted as a mediator in assisting Naz to attain the objectives of his activity. Therefore, this kind of mediation provided Naz with advantages for developing his knowledge of the course. It actually contributed considerable assistance to his learning process.

7.4.4 Interaction with the Support System

This section illustrates the use of support tools by Naz to minimise his problems when using the system. The division of labour in the research concerns the role of status-holders who have full control of the system and are in charge of the management of online learning courses. In this particular case, the division of labour refers to the administrators of online learning, such as the course tutor and the technical assistant. Students are not categorised as division of labour because they have no power or control in the management team.

However, in certain circumstances, they can act in that capacity. For instance, if they give feedback and support towards solving problems, it can be claimed that a particular student is part of the division of labour.

The example below shows Naz's query about Adobe Photoshop.

	Date	Activity	Actions
	24/01/05 17:00	Selecting discussion group	<p>Naz: Anybody familiar with Adobe Photoshop?</p> <p>Ali: Yes...It very user-friendly software...easy to use and easy to understand. You can download the tutorial from this website: http://www.adobe.com/products/tips/photoshop.html. Happy Browsing!</p> <p>Naz: Thanks Ali</p>

Table 7.94: Naz's Discussion Group Support Mechanism

The table above is about the message concerning Photoshop. With regard to the statement in the first paragraph above, in this particular case, Ali had become a division of labour within the system. This is because he acted as a course tutor in dealing with Naz's learning problems. Although he is not the part of the management team, he used his knowledge to help a fellow student. From the learning perspective, Naz is in no way an explorative learner. He merely receives resources from other people when developing his understanding of Photoshop. The data below shows two examples of the helpline use in relation to support for technical difficulties.

	Date	Activity	Actions
	24/01/05 17:05	Selecting the helpline	The Netmeeting is not functioning. Anybody else aware of this?
	05/02/05 10:55	Selecting the helpline	I have a problem with a scripting error. Who is facing the same problem?

Table 7.95: Naz's Helpline Support Mechanism

The data show that the problem is about the net meeting or the scripting error. The role of the division of labour is important in helping student minimise his learning and technical problems. The helpline is one of the tools that can provide interaction between the student and the management team and it is slightly different to the other communication tools. The helpline is a facility for students to discuss their problems with the community in an online learning environment. However, due to the sharing problem concept of the helpline, the community plays the key role rather than the division of labour. Therefore, the kind of interaction found on the helpline is more open and flexible. Everyone can read the message and send a short note to the board. This reduces the role of the division of labour in managing students' problems.

Chat sessions

The advantage of the chat tool is that it allows immediate feedback to the participants. Another example of support tools is chat tools, as shown in the following table.

	Date	Activity	Actions
3	12/03/05 10:15	Selecting chat sessions	Naz: Have anybody here got a problem about the net meeting? I can't connect with the net meeting, maybe because the connection is too slow. Dilla: Yeah...me to. I just asked the technical assistant about it. Naz: What did he say? Dilla: Just ignore it

Table 7.96: Naz's Chat Sessions Support Mechanism

The table above quotes a conversation about a net meeting problem during the learning session. The advantage of the chat tool is that the student is able to receive immediate feedback from the division of labour. However, based on the data tracking record, Naz did not like to use the chat session when discussing his learning problems. He preferred to use this tool to discuss technical problems, but not learning problems.

Private Message

Naz recorded the highest interaction in the use of private messages. The messages were mostly about learning problems. The data below includes two examples of messages sent to the course tutor.

	Date	Activity	Actions
	05/02/05 10:45	Selecting private message	I just tried to put text to my graphics but it not working. Can you please give me tips about how to do it?
	26/01/05 18:32	Selecting private message	How can I convert the graphics format from bmp to jpg and then import it into my poster.

Table 7.97: Naz's Private Message support Mechanism

The table above shows queries about graphics format and text. These messages were sent to the course tutor. These interactions show the important role of the division of labour in developing Naz's ideas about graphics. It is a one-to-one interaction and is different from other tools because the contact is more private and secret. At this stage, the division of labour pays more attention to the students in order to overcome their problems. However, the information given cannot be disseminated or shared with another student. The feedback also contributes to learning about text and graphics formats.

7.4.5 Analysis of a Student Product

An analysis of the assignment reveals that Naz liked to use certain effects in designing his poster, as shown in Figure 7.4. However, the assignment meets the specifications and criteria in terms of resolution, creativity, theme and format.



Figure 7.4: A Sample of Naz's Student Assignment

Table 7.98 shows the criteria of Naz's assignment. It suggests that Naz used the software effectively and understood digital graphics during his learning sessions.

Specifications	Criteria	Naz
1. Original work	Original ideas	√
	Creativity	√
2. Combined with image, illustration and text.	Image, illustrations and text	
	Image and illustrations only	
	Image and text only	√
	Text and illustrations only	
	Text only	

	Image only	
	Illustrations only	
3. Related to multimedia and education area	Multimedia and education	√
	Multimedia only or education only	
	Other areas	
4. Standard format GIF or JPEG	GIF or JPEG	√
	Other formats	
5. Resolution must be 640 x 480	640x480 pixels	√
	Other formats	

Table 7.98: The Evaluation of Naz's Student Product

The data above show that the poster met all the requirements of the assignment. However, the difference is that Naz liked to apply graphics effects in his poster. The poster shows perfect colour contrast and is more creative than those of the other students.

7.4.6 The System and Support Contribution to Learning Outcomes

As discussed in the previous case studies, the analysis of the student product was made to determine the contribution of the system and the support to the learning outcomes. Table 7.99 shows these relationships.

System Contributions to Learning Outcomes	Support Tools Contributions to Learning Outcomes	
<ul style="list-style-type: none"> • Make use of the community to obtain help for the course assignment. • Make strong use of course content. • Make use of the hyperlink and hypertext to acquire knowledge about the course materials. 	<ul style="list-style-type: none"> • Private message 	Asking about: - <ul style="list-style-type: none"> • The use of layer • Graphic format • How to scan photos • Layer concept in Photoshop • Add text on poster • Asking about resolution
	<ul style="list-style-type: none"> • Discussion group 	<ul style="list-style-type: none"> • Asking about installation of Photoshop • Query about Photoshop
	<ul style="list-style-type: none"> • Chat sessions 	<ul style="list-style-type: none"> • Discussion about Graphics size

- | | | |
|--|--|--|
| <ul style="list-style-type: none"> • Concept maps make it easy to follow the sequence of instruction. | <ul style="list-style-type: none"> • Helpline | <ul style="list-style-type: none"> • None |
|--|--|--|

Table 7.99: The relationship between the System, Support Tools and Learning Outcomes for Naz

Table 7.99 illustrates the fact that Naz increased his learning with the use of support tools that obtained help from the community. The user tracking data proved that Naz was not a contributor to the community but a seeker who profited from the benefits given by other students. However, his approach to learning was quite similar to that of Shah. The data also showed the major contribution made by the support tools to his queries. The following section explains Naz's interaction pattern when using the system. It shows how the system contributed to Naz's learning, as shown in Table 7.99.

Naz's Pattern of Usage

The analysis of student interactions is one of the important elements in order to see how students make use of the tools and how they communicate with other course members in the light of learning. The table below illustrates Naz's the interaction pattern during his period of learning.

Asynchronous Tools

The pattern of interaction shows that Naz tended to use asynchronous tools as a medium of communication in discussing his problems. However, the interaction was focused on the use of private messaging to contact the course tutor for discussions about the learning problems. As a result, a high amount of interaction was recorded in communicating with course tutors. In detail, the analysis shows that the contacts were mainly enquiries about course content. Table 7.100 illustrates the transcriptions and type of questions asked to his friends, course tutors and technical assistants.

Tools	Transcriptions	Type of questions	Sent To
Discussion group	Where can I get the installation of Photoshop?	Query about learning	Everyone
	What the different between JPG and BMP? Why don't we use BMP format in our assignment?	Query about learning	Everyone
	How to apply gradient tools to the Text?	Query about learning	Everyone
	Anybody knows how to edit the image from the selection area?	Query about learning	Everyone
	Naz: What is the best animation software on the market right now? Ali: Naz...I think the best ever animation on web is Macromedia Flash. I wish I can learn it one day but now I am too busy with the assignment. No time to learn. Naz: Yes...It good if we can learn the animation. Especially on the web and then we can publish it all over the world.	Query about learning	Everyone
	Naz How to create animation on the web? Do we need special software to do that? Ali: I have no idea...may be you can find the software on Google search engine.	Query about learning	Everyone
	Naz: Anybody familiar with Adobe Photoshop? Ali: Yes... It very user-friendly software...easy to use and easy to understand. You can download the tutorial from this website:- http://www.adobe.com/products/tips/photoshop.html . Happy Browsing! Naz: Thanks Ali	Query about learning	Everyone

	<p>Naz: I have problem with save the graphic file from the Internet...Anybody have any experience?</p> <p>Ali: Naz...Move your cursor (mouse) to the picture you want to save in. Then right click on the mouse and choose save picture as...then choose you directory and click OK.</p>	Query about learning	Everyone
	<p>I am facing a problem with the system when I was browsing it. Every time I log-on to the front page, the scripting runs an error message. I do not know why. Anybody here had the same problem?</p>	Query about learning	Everyone
	<p><i>Course Activity 1</i></p> <p>My point of view is: -</p> <ul style="list-style-type: none"> a) animation is the motion of picture from the graphics. b) Create an animation needs graphic skills. c) To build an animation needs a lot of time than creating a graphics. <p>So, the relationship is animation is totally from the combination of graphics, for instance, 2D cartoon is made from the layer of graphics and they then will combine together to create an animation.</p>	Giving an opinion	Everyone

	<p><i>Course Activity 2</i> Based on my reading, the two formats of graphics always use on the internet is JPG and GIF. This is because these two formats provide a very good quality and low capacity of space. For example, the button in webpage is using the GIF and JPG format. For me I like to use JPEG format because it gives you a very good quality of the image and of course this project we have to use whether JPG or GIF.</p>	Giving an opinion	Everyone
	Anybody knows how to use the digital camera? Please explain to me.	Query about learning	Everyone
Private messages	I really need to know how to start using Photoshop. I have no idea about it.	Query about learning	Course tutors
	How to use layer in Photoshop?	Query about learning	Course tutors
	How can I convert the graphics format from bmp to jpg and then import it into my poster.	Query about learning	Course tutors
	Based on the notes from the course content, we can scan the photo from the scanner. What is the best format to create the photo files?	Query about learning	Course tutors
	Could you please explain to me: - b) How to combine the layer graphics with other graphics files? c) How to put text on graphics	Query about learning	Course tutors
	I just tried to put the text to my graphics but it not working? Can you please give me tips how to do it?	Query about learning	Course tutors
	Can I use the source from the internet as one of the image in my assignments?	Query about learning	Course tutors
	Have you tried to use digital camera? I think it easier to get the instance image.	Query about learning	Amin

	Dilla: have you finish your assignment? Naz: Not, not yet. I am still searching for an appropriate concept of my poster. Still thinking about it?	Query about learning	Dilla
	Do you know what does 640 x 480 means?	Query about learning	Course tutor

Table 7.100: Naz's Interactions using Asynchronous Tools

Table 7.100 shows Naz's interactive pattern when utilising the tools for the benefit of his learning. Most of the postings to the discussion groups were focused on obtaining knowledge about digital graphics. As a result, the type of questions were related to how to gain an understanding of the digital graphics concept. The interaction in the discussion groups also showed that Naz saw the advantage of this tool in order to make a query and share his problems with other students. Table 7.101 below shows Naz's type of interactions with the community.

Tools	Interaction with	Type of Interaction	Number of Interactions
Discussion group	Ali	• Making a query about learning	4
	Everyone	• Making a query about learning (6) • Giving opinion (2)	8
Private messages	Course tutor	• Making a query about learning	8
	Amin	• Making a query about learning	1
	Dilla	• Making a query about learning	1

Table 7.101: Naz's Interactions with the Community using Asynchronous Tools

Table 7.101 shows Naz's contacts with the community using the asynchronous tools and synchronous tools. Data proves that he has a high number of interactions with the course tutor (about nine times). Most of the interactions were gaining help about learning and seeking information. For instance, he made a contact with course tutors about eight times using private messages, nine times with course members and 10 messages to everyone.

The interactions also reveal that Naz tried to gain feedback and support from both discussion groups and private messaging. He had a high interaction with course tutors rather than his friends. He used the flexible access of asynchronous tools by communicating with the community in the environment as his learning strategy.

Synchronous Tools

The analysis of the use of synchronous tools shows that Naz did not prefer to use the helpline to discuss his technical problems. However, he tended to use the chat sessions to make some queries about learning to the course tutor and course members. Table 7.102 shows Naz's transcription using synchronous tools.

Tools	Transcriptions	Type of questions	Sent To
Chat sessions	Naz: Anybody here know how to resize the image? Amin: Yes, What up?	Query about learning	Amin
	I would like to know about the graphics size? How to change it in Photoshop? I need to know it for our assignments.	Query about learning	Course tutors
	Naz: Have anybody here got problem about net meeting? I can't connect with the net meeting, may be because the connection is too slow. Dilla: Yeah...me to...I just asked technical assistant about it. Naz: What did he says? Dilla: Just ignore it.	Query about learning	Dilla

	<p>Naz: Have you started doing your poster? Amin: Not Yet. Naz: I am getting problem in searching the suitable image. Amin: First thing you should have your own concept. Then relate it with the theme. Naz: Yes, I agree with you Amin: What are you planning to do Naz? Naz: May be my poster is about ICT in classroom. That my theme. Amin: That sound good</p>	Query about learning	Amin
Helpline	Netmeeting is not functioning. Anybody realises about this?	Query about a technical problem.	Everyone
	I have problem with scripting error. Who is facing the same problem?	Query about a technical problem.	Everyone

Table 7.102: Naz's Interaction using Synchronous Tools

Table 7.102 shows how Naz used the chat sessions and the helpline in order to gain help. He used the chat sessions to gain help about the course assignment and learning support. Most of the questions asked were about digital graphics. However, he did not like to use the helpline to share his learning problems with other course members.

Naz tended to use private messages to ask for support regarding his learning problem. In other aspects, Naz had less to contribute in giving a response to some other course members but preferred to gain knowledge on his own. In addition, peer support gave Naz advantages in his learning. Naz's interactions with the community using synchronous tools are shown in Table 7.103 below.

Tools	Interaction with	Type of Interaction	Number of Interactions
Chat sessions	Amin	<ul style="list-style-type: none"> Making a query about learning 	2
	Dilla	<ul style="list-style-type: none"> Making a query about learning 	1

	Course tutor	• Making a query about learning	1
Helpline	Everyone	• Making a query about technical problems	2

Table 7.103: Naz's Interactions with the Community using Synchronous Tools

The data shown in table 7.103 above shows that Shah did not like to use the helpline to share his learning problems with other course members. As a result, he posted two queries about technical problems to everyone in the helpline. Shah tended to use private messages to ask for support regarding his learning problems. The data shows that about four interactions were recorded in relation to making queries about learning to the course members and course tutors. It shows that the peer support gave Naz advantages in his learning, especially by using private message tools to discuss learning problems.

The findings also showed that Naz made less use of the synchronous tools rather than the asynchronous tools session to communicate. This is due to the fact that asynchronous tools can be used at anytime. Only six interactions were recorded using the synchronous tools during the learning session.

7.4.7 Conclusions

How Does Naz Learn?

The data analysis shows that Naz interacts differently to the other students. In general, he used the course materials to develop his knowledge of graphics. For instance, from the overall pattern of usage, we can see that Naz explored the course materials about eleven times before using the other tools. This means that, at the beginning of the session, he increased his understanding by reading from the course content. After that, he seems to have frequently used the other tools, including private messages, the helpline, the discussion group and the chat sessions. He used the chat session a few times with Ali as his favourite friend. Naz is a non-sequential learner. He explores the course content but does not follow the sequence of instructions. Like Shah, Naz focuses a lot on his carrying out of the course assignment. However, Naz spent more times exploring the course content.

How Does the System Contribute to Learning?

The two major contributions to learning are the strategies and facilities provided by the system. In relation to the learning strategies, Naz stated that the system offered a self-directed approach to learning. For example, the students can choose their own pace of study while making use of concept maps. The findings also reveal that Naz has gained valuable experience by interacting with the community and this situation made him feel as if he was in the classroom. This aspect was really important for providing him with an effective learning environment during his learning sessions.

The use of communication tools also contributed to his learning and developed his understanding through the receiving of feedback from the community and the division of labour. For instance, in an interaction with the community, he sent a number of messages about software, the graphics concept and the hardware requirements of the course content.

The design of the system also contributed to his learning. Firstly, the navigation of the system provided him with a user-friendly approach and the way the information was presented through concept maps was really useful for him when following the learning sequence. Secondly, the design of the course content also furnished him with an appropriate approach to learning. For instance, the use of hyperlinks for every page helped him understand the basic concept of each topic. In addition, the interview data also revealed the significance of the use of hyperlinks in providing in-depth information about every topic.

How Does the Support Contribute to Learning?

From the analysis, it is clear that Naz preferred to use private messages and discussion groups as support tools. Consequently, he engaged in a great deal of interaction using both. The main contribution of private messages was that of providing him with a platform to share his problems related to learning. For instance, in the interaction with the support system, the findings showed how he made use of this tool. The discussion group also made

a contribution to his learning. For instance, Naz used this tool to communicate with Ali in order to discuss the assignment and the content. The support tools, such as the chat sessions and the helpline also made a significant contribution. The contribution of the helpline was in fact to solve problems regarding learning and technical matters. For instance, in episode four, Naz sent two messages about the net meeting and scripting error. The notion of interaction relates to obtaining help from the community. This can minimise the problems regarding technical difficulties.

7.5 A Comparison of the Students

The finding showed that every student had different types of interaction and numbers of interaction. The types of interactions with total numbers of interaction are shown in the table below.

Type of Interaction	Total
Providing feedback	7
Giving an opinion	7
Making a query about learning	56
Making a query about a technical problem	20
Sharing information	2
Responding to other peoples messages	3

Table 7.104: Overall Types of Interaction among Students

Table 7.104 above shows the number of interactions in relation to the type of interaction that occurred during the learning sessions. It proves that the students preferred to use the synchronous and asynchronous tools to make queries about learning. As a result, about 56 interactions were recorded regarding the queries about learning and 20 interactions were recorded in relation to making queries about technical difficulties. However, less interaction was recorded about providing feedback, giving an opinion and sharing information. It shows that students did not like to share their knowledge with other people but tended to use the tools for gaining help for the benefit of their learning. Therefore, most of the students preferred to use the tools in order to gain knowledge about the course contents. Table 7.105 compares the type of interaction and number of interactions among students.

Type of Interaction	Ali	Shah	Fabila	Naz
Providing feedback	7	0	0	0
Giving an opinion	0	4	0	2
Making a query about learning	8	12	13	24
Making a query about a technical problem	15	3	1	2
Sharing information	2	0	0	0
Responding to other peoples messages	1	1	0	0

Table 7.105: A Comparison of the Type and Number of Interactions for Every Student

As Table 7.105 above shows, analysis of the data from the user tracking module revealed that Ali had a high number of interactions in providing feedback, sharing information with other students, responding to other people's messages and giving an opinion during the learning session. However, Fabila had less interaction among the other students and results showed that about 13 interactions were recorded on making queries about learning. This situation was due to her concerns about learning and she tried to gain knowledge through online communication. Naz had a very high number of interactions making queries about learning compared with the others students. About 24 interactions were recorded during the learning session. Shah recorded 12 interactions on gaining help regarding learning. All students had fewer contributions in sharing information and providing feedback to other student messages, except Ali. The findings show that every student has their own pattern of interaction in order to gain knowledge in learning. As discussed above, Ali had a tendency to provide support to some other course members in relation to learning by providing feedback. However, most of the students made use of the tools for the benefit of their learning by making queries to the course tutor and technical assistants. As a result, a high number of interactions were recorded regarding making queries about learning by the students. This indicates that the tools contributed to their learning by providing a platform for them to communicate and interact.

Chapter 8

Conclusions, Suggestions for Future Work and Limitations of the Study

8.0 Introduction

The research focuses on designing, implementing and evaluating an online learning environment for Malaysian teachers learning about digital graphics. Chapter 8 explains the research questions in relation to the findings, the implications of the design approach, its contribution to learning and its relationship to learning and support.

8.1 Research Questions

In the study, the research questions were divided into two categories: design and evaluation. The research questions for the design phase discussed the systematic approach for designing the system, whereas the evaluation phase explained the evaluation of the system.

In the design phase, three research questions have been addressed including:

- a) what are the elements in relation to user needs and requirements in designing the learning and support system?
- b) how is the system designed, based on user-centred constructions, including user context, needs and requirements?
- c) what are the modifications made from the iterative design process?

In the evaluation phase seven research questions were addressed including:

- a) what do students learn from the system?
- b) how do students learn using the system?
- c) how do students make use of the tools in the system?
- d) how do students interact with other users during the learning sessions?
- e) how do students get support during the learning sessions?
- f) what is the contribution of the system to the learning outcomes?

g) what is the contribution of the support to the learning outcomes?

Therefore, I will look across the case studies in order to discuss the research questions of the study. The following paragraph explains the how the results of the study answer the set of research questions in the design and evaluation phase.

8.2 Different Learner Perspectives

The results of the study give an indication that the system was effectively designed to cater for different learner perspectives in the online environment. Moreover, it was successfully designed to fulfil the learner's needs in their context, as every learner has their own way of learning with the system. The results of four case studies show that every learner has different patterns of learning. This includes their learning strategies and patterns of interaction to develop their understanding of digital graphics. Several learning strategies have been explored in each of these case studies, including exploratory, flexible and self-directed learning, as mentioned by the students in the interview sessions. The findings show that the patterns of usage of the students using the system were different from each other. As mentioned in the previous chapter, every learner in the case studies was placed in several categories such as enthusiastic, reluctant and passive for my own convenience. However, this did not reflect any objective judgement on the learners.

For example, Fabila was known as a passive learner since she had the least amount of involvement during the learning session. However, although she was a passive learner she could also use the system for learning. For instance, in the post-course interview session, she mentioned that she did not like to learn using the computer. However, the system provided a printer-friendly version for her to print the entire notes of the course and use it for reference. This scenario shows how the system provided for the user's needs, that had been gathered during the focus group and interview session, in dealing with the different learner contexts.

Other examples from the case studies are Ali (enthusiastic), Shah (Reluctant) and Fabila (passive) who could still learn using the system with their own pace of learning. For

instance, Ali made use of the system to share and contribute knowledge with the other students. However, Shah, Naz and Fabila used the system by interacting with the community just to gain knowledge without sharing it with other students. This provides evidence that they can make use of the system for learning, with different approaches and strategies.

The results of this study answered the research questions, regarding the elements in relation to user needs and requirements, in designing the learning and support system. The list of needs that were obtained from the interview and focus group sessions represented user needs and context. In conclusion, the results of the study showed that the system had successfully provided for the learners' needs, for different learner contexts. This study also suggests that successful design needs to concentrate on context to cope with the different types of learner. The design of the system successfully fulfilled the learner's needs in relation to their ability and competence. In this case, the system provided a flexible learning environment and high interactivity with useful learning strategies. These were mentioned in the interview sessions for the final evaluation. For instance, Shah stated that the system gave him full control of the learning environment in gaining access to the learning material at any time and provided high interaction among the students. This result may be explained by the fact that the system satisfied the learners and fulfilled their needs by providing a flexible learning environment.

8.3 The Implications for the Design Method

Researchers argue that the recent instructional design models have too little user context and do not involve the learner in the design process. Therefore, in order to deal with this issue, the design methods, based on a user-centred approach, were chosen. SUNA and Activity Theory are practical design approaches that have been adopted as a design method in the study. The involvement of the participants in the design process makes a system that is closer to their needs. The recent models of instructional design such as ADDIE and ASSURE are more focused on the systematic approach of designing the system, without implementing user participation and context in the design. Therefore, SUNA and Activity

Theory were implemented in the design process to increase learner participation in the design process, in order to gather their needs in their particular context. For instance, the results of the first iteration and second iteration represented the list of the needs and requirements of the learners. The interaction of the students in the case study revealed that the system successfully helped the learner to understand the basic concept of digital graphics. The outcomes of the activity indicate that all the learners have achieved their learning objectives by integrating their knowledge into the course assignment. The analysis of the interaction between Ali and the tools showed that Ali had made greater use of the asynchronous and synchronous tools in interacting with his friends and course tutors for the benefit of his learning. Firstly by sharing knowledge in discussion groups and secondly by gaining assistance from the course tutors regarding content in private messages. At this point, the system was designed to prepare the student with meaningful interactions that could lead the student to understand the concept of graphics. In addition, it proved that the approach of iterative design, SUNA and Activity Theory were a practical approach to implementing user needs into the system.

As addressed in the literature, the problems of online learning have been reported by many researchers. These include learning, design and technical aspects. The results of the study revealed that the design of a system is concerned with this matter. For instance, the focus groups session and interview session showed that the learners suggested some ideas in dealing with problems. For instance, to avoid the problem of being isolated from the course tutors and other students, one of the students in the focus group sessions suggested the beneficial use of communication tools to highly promote interaction among the students. In this situation, they recommended using synchronous and asynchronous tools to minimise the problem of being isolated. Kim *et al.* (2005) and King (2002) emphasised the active participation of the student, to minimise the lack of contact among them. However, in order to deal with this, good communication tools are needed to ensure the active participation of the student in the learning process. The findings show that all the students used the tools to discuss their problems in learning and understanding the course content. For example, the case study revealed that Ali had made use of the asynchronous tools and synchronous tools to give support and contribute his efforts to his friends regarding learning problems and

technical difficulties. However, the rest of the students used the tools for getting support and technical assistance from the course tutors. In this particular situation, the system provided appropriate tools to minimise the lack of contact problems and immediate feedback, as reported in the literature. At this point, the findings answered the first research question in the design phase about the required elements for user needs in designing the support.

Understanding Learner Interaction Through the Activity Theory Framework

In order to understand the learner interaction during the learning sessions, the Activity Theory framework was used. This framework provided a practical approach to identify what the student learnt, how they learned and what strategy was used. The outcomes of the study gave strong evidence that this method gives advantages in identifying, examining and categorising the learner interaction into the learning context. The Activity Theory framework represents the relationship between student and artefact which is mediated by rules, tools, division of labour and community. In the research, the Activity Theory framework allowed me to examine and analyse the way humans interact in their context and environment. The outcomes of the interactions were classified into four categories for every student such as a) interaction with tools, b) interaction with the community, c) interaction with the rules and d) interaction with the division of labour. The interaction with tools explains the pattern of use of the tools by students during the learning session using asynchronous and synchronous tools. User-tracking data was analysed in order to see this relationship. The interaction with the rules describes the relationship between the subject and the course materials that consider as a rule and curriculum in activity framework. Every student is bound by the curriculum. Therefore, their activities are limited to the curriculum and regulations in order to achieve their learning objectives. The data from the online interviews tells us about their learning experiences and strategies, and it supports the interaction between the subject and the course materials. The interactions with the community explain the relationship between the subject and the community. In order to examine this relationship, synchronous and asynchronous tools were analysed as a communication tool between the students and the community. The relationship between the subject and the division of labour was explained in the interactions with the division of

labour. The analysis of data was focused on support which involved interactions with course tutors and technical assistants as the division of labour in the activity framework. The results of this analysis enable me to explore the whole activity for every user when interacting with tools, rules, division of labour and community. As a result, Figure 8.1 summarises the outcomes of the analysis of the interaction for every student.

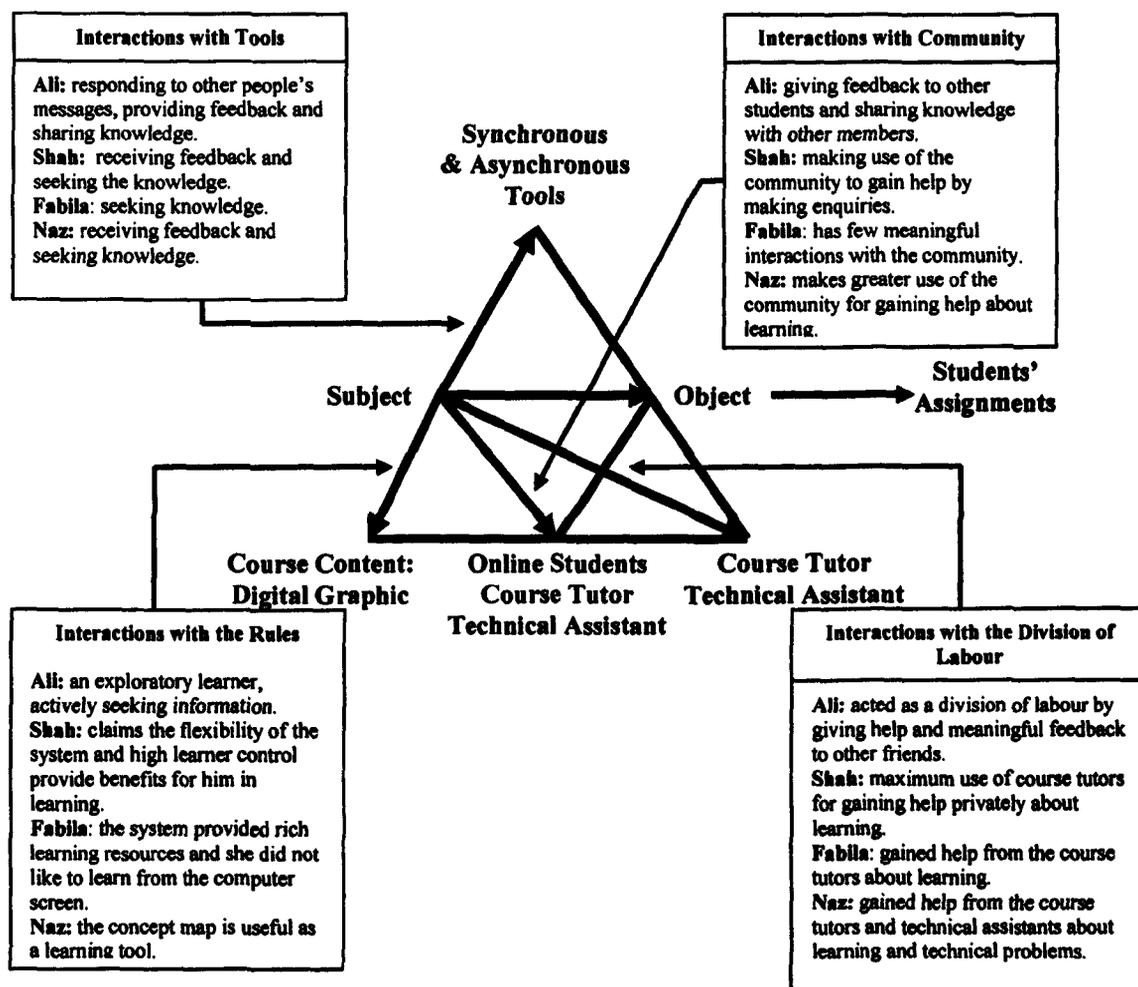


Figure 8.1: The Interaction of Every Subject with the Artefacts

The advantage of using Activity Theory as a framework for analysing human computer interaction is that it can determine the type of activity that the students had, how the activity was carried out and what tools were used. The design approach enabled the system to be

used in different ways by different learners. For example, the outcomes of the activity were that some interactions were identified as shown in Figure 8.1. Every student had their own learning strategy when interacting with the other artefacts around them. Findings showed that Ali, Shah, Fabila and Naz had their own pattern of interaction in learning, using the system. For instance, when communicating using the tools, Ali tended to use the asynchronous tools for giving feedback rather than seeking knowledge, as others did. Ali can also be categorized as an exploratory learner, due to his discovery approach in seeking information (See Table 7.94 in Chapter 7). This can be shown by analysing his interaction with the rules or course content. However, the other learners tended to obtain knowledge by making enquiries to the course tutors, technical assistants and other friends in order to gain knowledge.

Online social interaction allowed users to share their knowledge together, obtain some assistance and provide some feedback. As a result, some interaction patterns occurred regarding how the students communicated with the people in the community. As shown in Figure 8.1, interaction between users with other community members gave some benefit to them in the learning process. For instance, Shah and Naz were successfully using the community to make some enquiries regarding the course content and the assignment. Consequently, they built their understanding about the course content by using the tools to communicate with the community. This was different to Ali who liked to provide feedback and share knowledge with the community rather than seek it. These patterns of interaction are useful to a designer in order to know what kind of learner they have, before finalising their designs and the facilities that are offered.

The findings of the research suggest that an Activity Theory framework was successfully implemented in the research by two different modes; design and evaluation. It reveals that this is an approach where human computer interaction can be applied and evaluated in a very systematic way. However, other development models do not have this approach in identifying the learner interaction in a complex learning environment.

User Centred Design

One of the advantages of user-centred design is that it provides some in depth understanding of the context of the user, since it emphasises the participation of the user in every design stage and at the evaluation of the product (Abrams *et al.*, 2004; Carroll & Rosson, 2007; Luck, 2007). The engagement of the actual user in the design process can guarantee that the product meets the user's requirements and is suitable to be used in their surrounding environment. However, if the design of the system is not concentrated and focused on the user, it will create some frustration and dissatisfaction when using the product. Therefore, the user centred methods were used as a design method in this research. The analyses of the interactions show that this system can cater for different learner perspectives. In this research, the focus of the users is the online learning students. However, other learning tools such as WebCT and MOODLE see the teachers as users (Winter, 2006; Siemens, 2004; Morgan, 2003). Therefore the user-centred design was emphasised, with the student as the user in designing the learning environment.

The Benefits of User Centred Design

The findings of the research reveal some advantages of user-centred design especially in designing the virtual learning environment system. Good design methods will provide a good product. Therefore, some justification was generated from the experience of implementing the user-centred design in this research as follows:

a) Promote Active Involvement of the User in the Design Process

The major advantage of user centred design is that it involves the user from the design process to the evaluation stage (Beyer & Holtzblatt, 1999). This is important since the users know what they want, their desires and their needs, during the development process (Helvert & Fowler, 2003). Therefore, the system was designed around the user contexts and represents their needs, as they were discovered during the design stage, and finally meets their requirements.

b) Improve Learner Satisfaction

The system was designed and based on what learners want with appropriate tools and functions that provide them with flexibility and a capability for using the system. For instance, by preparing a user friendly course design and practical communication tools, it makes the user feel comfortable and satisfies them in the learning session, and can therefore help them to enhance learning. Results show that the design of the system can cater for the multiplicity of learners such as enthusiastic learners, reluctant learners and passive learners. For example, referring to the example in Table 7.94 in Chapter 7, this proves that these kinds of learners can use the system for their learning, with different approaches, by gaining support, providing feedback and sharing their knowledge using asynchronous and synchronous tools.

c) Fulfil What the User Wants

The results of the interviews show that no negative comments were recorded in asking the students about their learning experiences and how they learned using the system. The use of Activity Theory and SUNA as a user centred design approach with practical techniques provided a quick and effective method for identifying user needs in terms of their requirements, context and functionality of the system. This method has been implemented successfully on this system with less dependence on usability testing, and has successfully obtained user needs during the design stage.

8.4 Iterative Design

Iterative design was successfully implemented in order to test the system and make some modifications to the cycle of the iterative process. It responded to the research question regarding the modification of the system throughout the iterative design process. The findings showed that the system had been tested with students who had some experience in online learning. The first iteration revealed that the students gave some feedback and

suggestions for system improvements in relation to their needs and requirements. For the result of the first iteration, the conclusion can be made that the feedback from the students can be categorised into several part as follows a) instructional strategies, b) interface design, c) type of tools to enhance high interaction and d) navigation issues (concept maps).

In the focus group sessions the students reported on the issue of interface design. For example, in the interview session, most of the course tutors agreed that the interface design was not appropriate in terms of the screen design, resolution and the icon. However, this issue was only identified in the interview session and third session of the focus groups. The findings revealed that the students were less concerned about the interface design of the system. For them, the interface design was not important in their learning using the system. However, the literature shows that good interface design should be implemented in online learning courses (Song *et al.*, 2004; Motteram & Foresster, 2005) in order to help the students to focus on their learning. This shows that interface issues were discussed in the interview. Most of the comments from the focus group sessions were broadly discussed, including the type of tools for increasing the amount of interaction among them. For instance, in every session, they suggested the use of video conferencing to promote virtual face-to-face interaction. However, this could not be done since the usability testing in the second iteration reported that video conferencing tools were too slow during the implementation. Most of the suggestions in the focus group sessions emphasised general issues such as lecture timetables, past year questions, announcements and references.

One important issue that was discussed during the first iteration was navigational issues. Dunlap (1997) suggested that a navigational tool is a significant element to assist the student exploring the rich hypermedia and hypertext system. The findings showed that most of the students raised this issue and suggested the best navigational tools for the system. For example, the most significant finding is the use of concept maps for the navigational methods for the main menu of the system. One of the course tutors suggested that every page must have a navigational menu to help students to explore the system during the learning process. Therefore, this suggestion was implemented into the system during the

development process. The finding from the first iteration concluded that the support mechanism could be categorised into several sections such as a) technical support, b) learning support and c) emotional support.

In every session of the focus groups and interviews, the type of technical support was discussed by the students and course tutors. The literature shows the importance of technical support in dealing with student problems (Valentine, 2000; Valenta *et al.*, 2001). One of the findings discusses the issue of how to provide effective help for the student with technical support. The students suggested that guideline pages and a technical assistant must be provided in order to deal with the technical problems. The second category of support is learning support. In the first iteration, learning support was known as the strategy provided by the students and course tutors in the learning session. The findings showed that most of the strategies to support learning were focused on the collaboration among students, interactivity, the use of hypermedia and hypertext, the role of the course tutor as moderator and monitor of student progress, and on providing an active learning environment. For instance, in order to provide an active learning environment, the task or course activity should be given to the student. The role of course tutors are very important in monitoring their performance and assisting them with any problems that relate to their learning.

Conole (2004), Huang (2002) and Gold (2001) emphasised student centred activity and the active participation of the student in the learning process for promoting meaningful learning. Web technologies such as e-mail, discussion groups and chat sessions allow the student to be actively involved in the course activity (Wilson & Lowry, 2000; Misra, 2002). The findings from the first iteration proved that the course tutors did recommend these strategies to be included in the system for supporting the student in the learning process.

One interesting finding in the first iteration was emotional support. Most of the sessions suggested counsellor tools to support students' motivation and self-confidence during the learning process. The findings showed the significance of this type of support to the

students. However, the counsellor tools could not be implemented due to expertise constraints. The findings were in line with the literature on the importance of coaching the student in online learning. Scutt (2003) emphasised that student interaction should be supported by coaching them in learning. Therefore, the system implemented the role of course tutor and technical assistant as a moderator for assisting the student with technical and learning problems. This aspect was suggested by most of the students in the first iteration.

The second iteration was purposely to test the system usability. The results of the second iteration showed that the system was in good working order. However, some functions in the system were running very slowly, caused by a faulty network connection. For instance, the video conferencing tools were too slow due to the slow network connection. In the second iteration, the major problem when usability testing, was the network connection. The result is inline with the literature regarding the hardware problems as discussed by Valenta (2002), Rivera and Rice (2002) and Valentine (2002). The usability testing revealed that the system was successfully developed and tested. This indicates that the list of user needs was effectively implemented into the system without any errors. The second iteration process was significant to get data on the students' feedback from the usability testing.

In general, the advantage of the iterative designed process in improving and modifying the system provided a practical approach in identifying user needs. It answered Question 3 in the design phase.

8.5 The System Contribution to Learning

The data showed that the system had contributed to the students' learning of digital graphics. The findings in each of the case studies indicated that the students had achieved their learning objectives. The analysis of the assignments proves that all the students successfully met the specifications of the assignment. For example, the results of Ali's case study revealed that he had good knowledge, skills and creativity with digital graphics. His

assignment met all the criteria in relation to the theme, graphics resolution and formatting. Another finding proved that Shah had acquired a knowledge of graphics during the learning session. He applied the standard graphics format and the right resolution in the poster. However, in terms of creativity, he was less creative because he did not use any other graphics effect in the assignment. Others learners like Fabila and Naz t also acquired several skills from the system, in understanding the concept of graphics, formatting and resolution. Therefore, the posters met all the requirements of the assignment. The analysis of the assignment indicated that the system did contribute to student learning. Thus, it answered the research question as to how the students learnt and how the system contributed to their learning in the evaluation phase.

The Activity Theory approach in analyzing the data about how the students learnt, their interaction with the community, the administrator and the course materials, offered useful guidelines for me to understand the contribution of the system, as well as the support system, to the learners. In addition, this contribution can be identified by analyzing the user-tracking data and seeing at every second how the students make use of the system for learning. In the first case study, Ali was categorized as an enthusiastic learner because of his active engagement in giving feedback, answering queries and sharing information with the other students. For instance, he made use of the synchronous and asynchronous tools to develop his understanding about the content and share the knowledge with other students.

However, the second case study showed the different learning patterns of a learner with less involvement in sharing knowledge but highly active in seeking it for his own benefit. I identified this kind of learner as reluctant. Even though, Shah was a reluctant learner, he could still make use of the tools in the system to actively gather knowledge from the course content and interact with the course tutors. This finding indicated that the system contributed to learning for a different type of student. The final example is Fabila, who was a passive learner and had no interest in learning to use the computer. However, the system was able to help her in learning by offering the complete course content in a printer-friendly version. In the interview Fabila commented on how she dealt with this matter by using the tools for printing the notes from the course content. However, the user tracking

results also showed her interaction with the course tutor for gaining help with her learning. These scenarios proved that the system did contribute to learning and to support this argument the analysis of the student product showed that the students gained knowledge of digital graphics at the end of the learning session. These findings answer the research question in relation to how the students learnt and how they made use of the tools.

Again, we can see the Activity Theory approach in analyzing the data from user interaction, which gives an in-depth understanding of the user himself. In this situation, we were able to discover the contribution of the system in promoting learning. One of the students also suggested that a rich learning environment encouraged them to actively seek information by exploring the links provided by the system. The system also offered a platform to apply these learning approaches to gain knowledge. The results of the interview sessions showed evidence that the system gave a useful experience to the students during the learning session. Numerous learning strategies were identified such as flexible learning, self-directed and discovery learning. This shows that the design of the system emphasises active participation among the students by exploring the hypermedia environment, sharing ideas and promoting high collaboration among them.

The findings in the investigation of the student learning strategies revealed that each student in the case studies has his/her own strategy for interacting with the system during the learning sessions, as discussed in the previous paragraph. The literature suggests that in the online learning environment, the students engage in the activities (Conole, 2004) and the interaction with friends and course tutors (Rovai, 2004) are an important aspect, since it allows the student to discuss the issues, debate ideas and receiving feedback (Misra, 2002). The finding showed that all the students in the case studies spent their time by interacting with other people. However, the type of interactions was different. For instance, Ali interacted with his friends for sharing knowledge and assisting the other students with learning problems. The rest of the students only interacted with the course tutors and technical assistants to gain knowledge. In this particular situation, the system contributed to learning by providing a platform for them to receive feedback, post ideas and share

knowledge. The findings show evidence of how students interact with other users and the contribution of the system to their learning.

8.6 Support Contribution to learning

The literature reveals the importance of user support in the online learning environment (Tait, 1995; Lewis, 1995; Robinson, 1995; Willis & Dickinson 1997; Weston *et al.*, 1999; Stokes, 2000; Arif, 2001; Scrum & Hong, 2002; King, 2002; Song *et al.*, 2004; Motteram and Forester, 2005; Kim *et al.*, 2005). However, there are many types of student support in the online learning environment. In this research, the support is categorized into two types: learning support and technical support.

The findings show that the support provided in the system contributed to student learning in every case study. However, the diversity of interaction can be classified according to how the students utilized this support to overcome their problems in the online learning environment. The case studies showed that every student had their own way of using the support tools for learning. In the first case study, Ali used the synchronous and asynchronous tools to share information with other students who actively participated and engaged in the learning sessions. The user tracking data revealed that Ali made use of chat sessions; private messages, the discussion group and helpline to give learning support to his friends. For instance, in the discussion groups, Ali posted several messages to solve problems regarding the course content. However, in the second case study, Shah used the support for his own benefit, without sharing any knowledge with other students. At this particular stage, the findings revealed that the support tools such as private messages and the helpline had been used for gathering knowledge and receiving feedback from the course tutors and other friends. Another example is in dealing with learning problems about the assignment. Shah contacted the course tutors using a private message to get feedback. These two scenarios demonstrated the two different approaches that the support has provided in the system in order to contribute to the students' learning. This strategy is in line with Laurillard's approach for learning that emphasized the role of dialogue and the importance of feedback for developing the student concept (Laurillard, 1993). For example,

the chat session and discussion groups have been effectively used by Ali and Shah to interact within each other. However, Shah's interaction is focused on receiving feedback while Ali's is more on giving feedback. This kind mechanism demonstrates that the support tools did contribute to learning by offering a dynamic platform to promoting interaction for the students in discussing, giving and receiving feedback. Meaningful interaction is seen as part of the learning process, where the student can freely converse and reflect on their ideas with others.

The analysis of the user tracking data revealed that most of the students used the tools in dealing with learning problems. For instance, Shah used the private message tools to query the use of the scanner and graphics editing during his learning session. Fabila utilized the helpline to ask about how to create text in graphics. This shows that the support tools became a mediator to provide meaningful interactions that contributed to students' learning. This particular situation is inline with the role of the tools as a mediator in the activity system in order to achieve the objective (learning outcome).

One interesting finding about the learning support is that the role of course tutors and technical assistants was extensively used during the learning process. For instance, the reluctant learners (Shah & Naz) and the passive learner (Fabila) made great use of the course tutors and technical assistants in asking about and querying the content, assignment and technical aspects. It indicates that the role of the moderator is significant and needs to be implemented in the design as one of the support tools. This issue is supported by the literature. According to Schut (2003) and McLaughlin and Marshall (2000), the coaching and mentoring should be provided between the teacher and student in virtual interactions. In the research, the types of coaching and mentoring have been adapted to the course tutors and technical assistants. These findings answer the research question as to how students get support during the learning sessions.

The findings also showed how technical support assists the student in dealing with technical problems (Weston *et al.*, 1999; Scrum & Hong, 2002; Arif, 2001; Stokes 2000; Ward & Newlands, 1998; Valenta *et al.*, 2001; Valentine, 2002). One of the common

problems the student had in the learning session was the scripting error. All the students in the case studies had mentioned this problem in the interview sessions. Therefore, the system offered platforms such as the helpline, private messages, chat sessions and the discussion group for them to discuss, minimise the problem and express their difficulties.

Many researchers suggest the significance of technical support in dealing with students' frustration. Therefore, the system provides the appropriate technical assistance, as suggested by the literature. The study proves that the technical support that had been integrated into the system was effectively used by the student in order to minimize this problem. The tools like the helpline, private messages, discussion groups and chat sessions allowed the student to discuss technical difficulties. For instance, the analysis of the user tracking showed that Naz, Ali and Shah discussed the scripting error and slow network connection during the learning session. As mentioned above, these tools can minimize student anxiety and make them feel comfortable in dealing with technical difficulties.

A major contribution of this research is to provide effective learner support to the online students based on the user, their needs and desires, particularly in the Malaysian context. The support system built for the purpose of this research could be used by distance-learning students to minimise their problems, especially when dealing with technological difficulties and learning problems. The evidence from the case studies reveal that the students did openly discuss their experiences when having technical difficulties and learning problems, during the learning process. The findings answer the research question about how the support tools contributed to the learning outcomes.

8.7 Suggestions for Future Work

Design

Findings from this research may give some input into the design process of the learning system, based on the analysis of the details of students' interactions with the system. The findings may provide an effective guideline to designers in designing courseware based on

SUNA and Activity Theory approaches. In addition, the use of a scenario to describe the context and the user roles can be easily transformed to the specific requirements of the system. It may help designers to manage their own development processes. Therefore, it is very important for the research student and other organisations to carry out these studies in different knowledge domains. Findings can also be used as a guideline in designing other software products. For instance, the same approach can be used to design other technology-based products, e.g. Mobile learning or M-Learning.

Evaluation

The study is limited by the small size of the respondents. A larger population of respondents should be involved in the research. This can give more feedback in order to identify the effectiveness of the learning system and support. The subjects were student-teachers and most of them were adult learners. Therefore, it is important to evaluate and implement the system to fresh undergraduate students in order to examine the way they learn and their learning outcomes. In particular, this will give us a view about two different types of student in their interactions with the system.

Learning and Support

Several components were identified as user needs and requirements during the iterative evaluation process. However, some of these suggestions were not all implemented during the development phase. For example, one of the findings suggested the importance of an online counsellor in order to motivate the online learner. However, this tool was not added to the system due to lack of expertise. Future research may be able to highlight this tool as one of the support tools in online learning.

Future work should emphasise evaluating the system with larger student numbers and in different learning contexts and environments. By expanding the number of users, the data from the evaluation will be very broad and it will present a high number of interactions using the tools. It will provide a variety of strategic uses during the learning session and

may help the designer to examine the meaningful strategies to enhance learning. For instance, it could give some feedback on the number of learning strategies that are used during the learning session and how the learning strategy can give an advantage to students and help them in improving their learning. In addition, the findings can reflect on the effectiveness of the system in delivering and enhancing learning to the online student.

The design methodology can be extended into the learning context by using this approach to design and evaluate classroom activities. For instance, the design methods involve the use of Activity Theory to design and evaluate the students' activities in the online learning environment. However, in other perspectives it can be applied in designing and evaluating classroom learning activities by utilising the Activity Theory framework to organise, prepare and understand the learner before any activity is made. In this learning context, tools can represent the paper, pen, whiteboard or other equipment that help the learner to achieve the outcomes in the activities. Community can be the group of learners who are involved in the activity such as the learner and teacher, while the division of labour represents the teacher who facilitate the activities. In this situation, rules refer to regulations and procedures to make learning activities more effective and fruitful with meaningful discussions, suggestions and arguments. The outcomes of these activities may help teachers to evaluate the interactions between the learners in the group and therefore give some feedback regarding the effectiveness of the activities. Numerous studies have been made in evaluating and designing the activity for learning context using Activity Theory framework (Lim & Chai, 2004; Lim & Hong, 2003).

Another aspect that should be taken into account is the use of FAQ's. In future work, the system could be improved by preparing the efficient use of FAQ's. FAQ's can therefore divide into two main aspects such as learning FAQ's and technical FAQ's, not just focused on FAQ's about using the system, as in the present research. FAQ's must be detailed and can be a practical guideline for the student to manage their problems when they are online without communication with other people.

The findings from the research can be used to design and develop an effective Intelligent

Tutoring System for web-based learning in the future. By implementing these features, it can assist the student and future student to use the system efficiently. In this research, the results show that there were three types of users that have been identified from the analysis of the user-tracking module. The prospective system may possibly predict the type of users and then provide course materials, learning strategies, tools and a graphical user interface based on the user model. The user modelling system refers to the system that can build and sustain the models of the students (Paiva *et al.*, 1994). For instance, if users tend to be an enthusiastic person, the system will then provide tools for them to communicate with other course members, share information together and help each other in their learning. However, if the user is a reluctant user, the system will assist them to learn and provide a facilitator to support them during the learning session. In order to implement these in the intelligent tutoring system, the student model can be categorised into three types such as a) the enthusiastic student, b) the reluctant student and c) the passive student. The enthusiastic student model will be provided with exploration tools and will be prepared with the platform for them to communicate with other course members. The reluctant student model will be provided with peer support and facilitator support in their learning environment. Finally, the passive student will be supported with extra course materials, less communication tools and full support from peers and facilitators. In addition, the teacher model in the Intelligent Tutoring System can also be implemented in a future system based on the findings in the research. The teacher model can be adapted from the results of the interactions between the course tutors and technical assistants with the students, in relation to what kind of feedback the course tutor should give regarding the queries about learning and technical problems. They can be the moderator and facilitator who support the student by giving feedback with learning problems and technical difficulties during the learning session (White *et al.*, 1999). In conclusion, future work should include these elements in designing the Intelligent Tutoring System especially for web-based learning for the benefit of students' learning.

A future system may implement the intelligent agent to facilitate the student in their learning. Diagnostics provided by the system show that there is a different role for the facilitator among the community including the course tutor, technical assistant and the

student himself. It also shows what supports are characteristic among the students. These tend to provide a meaningful interaction that can offer an effective learning environment. An active student has a tendency to offer support in learning and technical difficulties. For example, the analysis of Ali's interactions revealed that his role in a learning session is more in giving feedback and sharing knowledge among the students. In addition, the role of the technical assistant gives advantages for the student to express their problems to the right channel and the right person. Diagnostics from the findings can give advantages to students and future students by implementing these characteristics in pedagogical agents that can facilitate the learner to deal with the learning and technical aspects by providing support and giving meaningful feedback in relation to the problem. The intelligent agents can predict the student's problem and provide appropriate feedback to him or her.

The analysis of interactions also reveals the importance of the peer support aspect in an online learning environment. An online learning environment provides flexibility to the students to communicate, with easy access to navigation tools, and promotes sharing amongst them. Learners are engaged in the learning process by participating in the course activity, discussing the course content with other members and making enquiries to the community. The learning environment of the system also promotes peer support to the student and takes advantage of each others ability in providing support and the contribution of each member (Rovai, 2004). Peer support enables the students to provide feedback, gain help among themselves and take responsibility for their learning. These findings give some useful feedback about the role of students in the online learning environment. Therefore, future work should emphasise the role of the student and how they can give benefit from the learning of other students. For instance, the Intelligent Tutoring System can be implemented in the student model, in designing for e-learning in the future. Some considerations can be made in the student model based on the findings in the research. For example, the student model can evaluate each learner performance and interaction to determine his or her abilities and skills. Then, the Intelligent Tutoring System can monitor the learner's sequence of actions and predict the type of learner and finally suggest the appropriate tools and course materials that can be used by the learners during the learning sessions.

A future system should emphasise the role of the pedagogical agent as a mediator and assistant in monitoring student's engagement in web-based activity using the communication tools. Students enjoy using the asynchronous tools rather than synchronous tools. This is due to the flexibility of the tool as a medium of communication, since it offers non-real time interaction which gives the student the flexibility of sending and receiving messages at anytime. As online students, most of them were very tight with their schedules and timetables. Therefore, asynchronous tools offer the advantage of communicating with the community at anytime and anywhere. The analysis of the interaction reveals that the students have a larger number of interactions using the asynchronous tools such as private messages and discussion groups. It proves that asynchronous tools contribute more to a student's learning rather than synchronous tools. In order to make the system more effective in future, the pedagogical agent can be implemented to facilitate and monitor the student dialog, collaboration and knowledge building using asynchronous and synchronous tools (Mørch *et al.*, 2006). The agent may give guidelines, suggestions and feedback to make the dialog more valuable and significant, especially in their learning, facilitate collaboration and assist the community to build up the knowledge sharing practices among the students (Roda *et al.*, 2003).

8.8 Limitations of the Study

There are several important limitations in the research regarding internal and external validity. Firstly, the sample of the study was small. In future, the follow-up study could have a larger sample of students with different demographic backgrounds.

Evaluations only focus on how the student learnt, what they learnt and the contribution of the system and support system to their learning. It did not examine the effectiveness of the whole system. For example, the evaluation focused only on the course activity and student products. There were no pre-tests and post-tests implemented during the evaluation.

However, the purpose was to monitor and analyse the interaction of the subject in the activity system and their learning outcomes. Therefore, only four case studies have been selected and it is not possible to make generalisations from the whole findings. Another limitation in the study is that there was no control group during the evaluation session with

which to examine the effectiveness of the system. All subjects engaged in the treatment groups only and there were no results to compare between a control group and treatment group.

The methodologies of the study used only qualitative approaches (interviews, focus-groups and user tracking) and no quantitative methods were incorporated. Possibly, the combination of both techniques would generate better results. Finally, this study only focussed on technical support and learning support. Although the subjects mentioned emotional support, for instance providing counsellor tools in the system, this was not implemented due to time constraints. In future studies it might be possible to implement this tool into the system.

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APPENDICES

APPENDIX A1 : SAMPLE OF FUNCTION HIERARCHY

No	Activity	Actions	Operations
1	Registering New Student	1.1 Log-on to website	1.1.1 Hyperlinks to the URL address
			1.1.2 Display frontpage of the website
		1.2 Enter the student information, username and password	1.2.1 Display registration form, submit and reset button
		1.3 Submit student information	1.3.1 Post student information to server
			1.3.2 Update student information, username & Password
			1.3.3 Check the overlapping username and password
			1.3.4 Record database
			1.3.5 Approve Registration
		1.4 Read New Username and Password	1.3.6 Display Username and Password to student
			1.1.1 Hyperlinks to the URL address
			1.1.2 Display frontpage of the website
			1.2.1 Display Username and password box
			1.3.1 Update username and password
			1.3.2 Enter the online course
2	Choosing a Course	2.1 Select the course content	2.1.1 Display Syllabus, Content, Glossary and Search
		2.2 Select Syllabus hyperlinks	2.2.1 Access Syllabus Page
		2.3 Read Syllabus	2.3.1 Display Syllabus contains course information, requirement & evaluation
		2.4 Select Content hyperlinks	2.4.1 Access Content Page
		2.5 Read Content	2.5.1 Display weekly sub-topic
		2.6 Select Glossary hyperlinks	2.6.1 Access Glossary page
		2.7 Read Glossary	2.7.1 Display glossary
		2.8 Select Search hyperlinks	2.8.1 Access Search Page
		2.9 Enter the keywords	2.9.1 Display search box with a button
		2.10 Submit Keywords	2.10.1 Post search keywords to server
			2.10.2 Search the related keywords

			2.10.3 Update search database
		2.11 Read the search results	2.11.1 Provide search results
3	Do Course Activity	3.1 Select Evaluation Tools hyperlinks	3.1.1 Display Course Activity, Assignment
		3.2 Select Course Activity	3.2.1 Access Course Activity Page
		3.3 Read Course Activity	3.3.1 Display Course Activity Page
		3.4 Use Newsgroup	3.4.1 Access Newsgroup
			3.4.2 Display list of student, discussion topic, starter and date
		3.5 Read Discussion Materials in Newsgroup	3.5.1 Display the name of sender, topic and discussion texts
		3.6 Submit Discussion Materials	3.6.1 Post discussion materials to server
			3.6.2 Update discussion materials database
			3.6.3 Record database
		3.7 Read the submitted materials	3.7 Display submitted materials
		3.8 Use Chat	3.8.1 Access to Chat Page
		3.9 Read Chat instruction	3.9.1 Display chat instruction
		3.10 Enter nickname	3.10.1 Display Nickname box with submit button
		3.11 Submit nickname	3.11. 1 Post nickname to chat server
			3.11.2 Update Nickname
			3.11.3 Approve student nickname
			3.11.4 Show message
		3.12 Log-on to chat session	3.12.1 Display chat windows
			3.12.2 Show active online users
		3.13 Participate in chat session	3.13.1 Show message box
		3.14 Send text message to online students	3.14.1 Post text to chat server
			3.14.2 Record text to database
			3.14.3 Display text in chat box
		3.15 Use Whiteboard	3.15.1 Access Whiteboard
			3.15.2 Show virtual whiteboard page
			3.15.3 Provide specific tools for virtual whiteboard
		3.16 Use e-mail	3.16.1 Access to E-mail page
		3.17 Sending message to students	3.17.1 Display textbox with such field (To, cc, bcc, Subject)

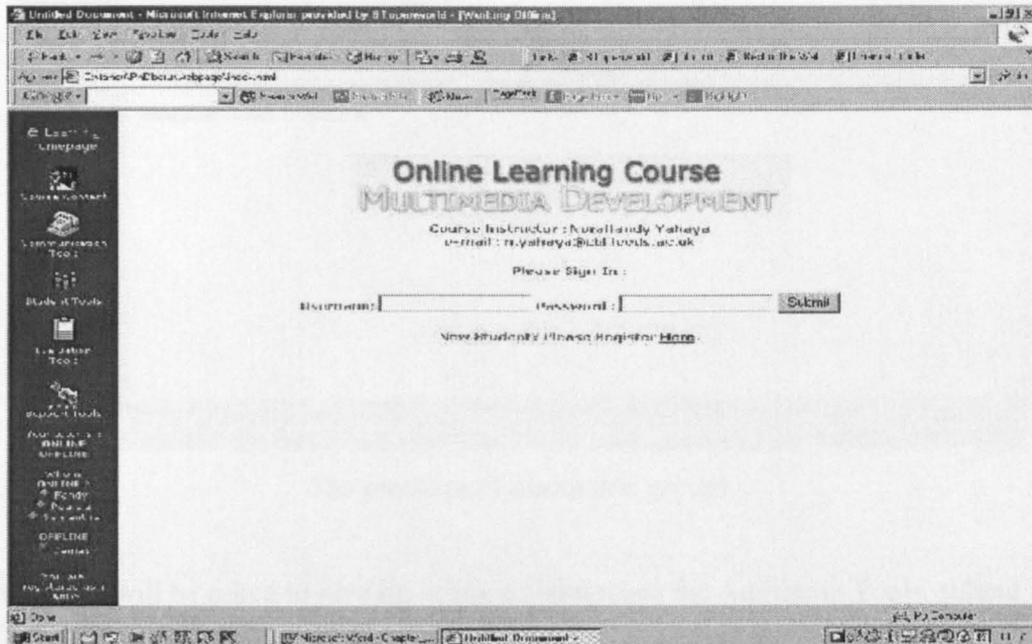
		3.18 Enter an e-mail address, subject, text and attachment	3.18.1 Display an email interface
			3.18.2 Provide an email dialog box
		3.19 Submit e-mail to server	3.19.1 Post email to server
			3.19.2 Update e-mail
			3.19.3 Record e-mail database
			3.19.4 Approve e-mail
			3.19.5 Show message
		3.20 Surf/explore the URL resources	3.20.1 Access to student learning resources page
			3.20.2 Display the URL addresses with the active hyperlinks
		3.21 Enter the URL address	3.21.1 Display textbox and submit button
		3.22 Submit student resources	3.22.1 Post URL addresses to server
			3.22.2 Update URL addresses
			3.22.3 Record database
		3.23 View Student Presentation	3.23.1 Display student presentation page
		3.24 Upload presentation file	3.24.1 Post file to server
			3.24.2 Record file
			3.24.3 Approve submission
		3.25 Browse student hompages	3.25.1 Show list of student hompages
		3.26 Submit homepage address	3.26.1 Post URL address to server
			3.26.2 Record database
4	Do an evaluation	4.1 Select self-test hyperlinks	4.1.1 Access to self-test page
		4.2 Read instruction	4.2.1 Display self-test page
		4.3 Answer the question	4.3.1 Display the questions with radio button and submit button
		4.4 Submit answers	4.4.1 Post answers to server
			4.4.2 Record database
			4.4.3 Calculate the right and wrong answer
			4.4.4 Provide result
		4.5 Get self test result	4.5.1 Display result

Support System

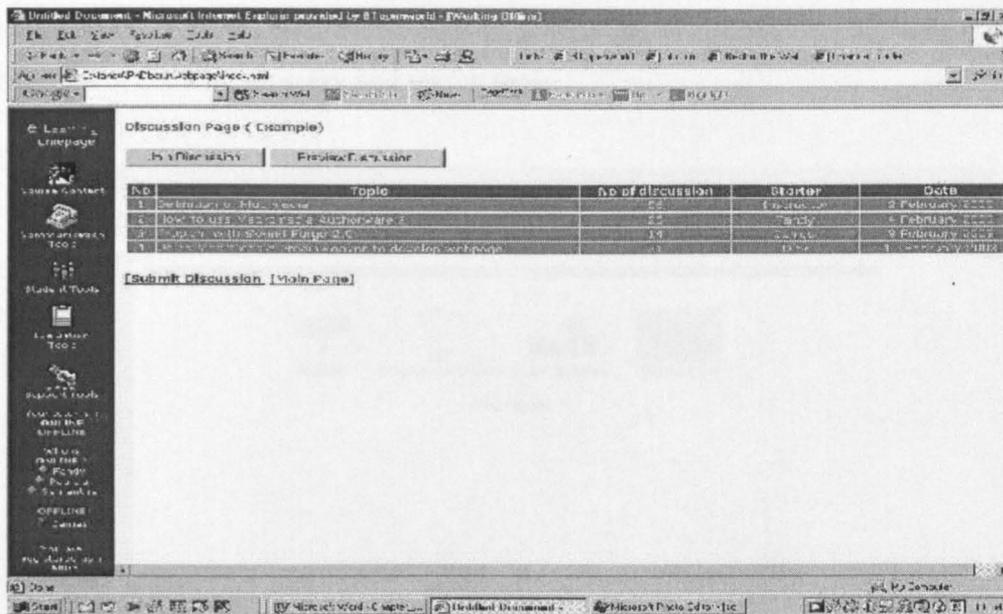
No	Activity	Actions	Operations
1	Support[Registering New Student]	1.1 IF [Unable to log-on to website]	1.1.1 Display Error
			1.1.2 Access to Troubleshooting Database
			1.1.3 Suggest to Contact Administrator
		1.2 IF [Failed submission]	1.2.1 Check Error
			1.2.2 Display Error
			1.2.3 Suggest to contact administrator
	Support [Registering Old Student]	1.3 IF [Lack of Technical Skills]	1.2.4 Access to Helpline
			1.2.5 Access to Troubleshooting Database
		1.1 IF [Failed to log-on the system]	1.3.1 Access to Online Training Module
			1.1.1 Check the Username and Password
			1.1.2 Display message 'Please Check Your Username & Password
			1.1.3 Access to Troubleshooting Database & FAQ
			1.1.4 Contact Technical Assistant
2	Support[Choosing a Course]	2.1 IF [Lack of Skills]	2.1.1 Access to Online Training
			2.2 IF [Don't know how to use Search Tool]
		2.2.2 Access to Helpline	
		2.3 IF [Lost in Space]	
			2.3.2 Access to Helpline
		2.4 IF [Unable to use Glossary]	2.4.1 Access Helpline
			2.4.2 Access to Troubleshooting Database
			2.5 IF [Unable to use the appropriate keywords]
		2.5.2 Access Technical Assistant	
		3	Support [Course Activity]	3.1 IF [Lack of Skill using e-mail]	3.1.1 Access to Online Training Module
3.1.2 Access to Troubleshooting Database			

		3.2 IF [Lack of Skill using newsgroups]	3.2.1 Access to Online Training Module
			3.2.2 Access to Troubleshooting Database
		3.3 IF [Lack of Skill using Chat]	3.3.1 Access to Online Training Module
			3.3.2 Access to Troubleshooting Database
		3.4 IF [Lack of Skill using whiteboard]	3.4.1 Access to Online Training Module
			3.4.2 Access to Troubleshooting Database
		3.5 IF [Unable to do Assignment]	3.5.1 Access to Helpline
			3.5.2 Access to Online Training Module
		3.6 IF [Unable to Understand / Do Course Activity]	3.6.1 Access to Helpline
			3.6.2 Contact instructor
		3.7 IF [Unable to Get the Student Result]	3.7.1 Access to Helpline
			3.7.1 Access to Troubleshooting Database
		3.8 IF [Unable to Submit Student Webpage]	3.8.1 Access to Helpline
			3.8.2 Access to Troubleshooting Database
		3.9 IF [Unable to Submit Presentation Materials]	3.9.1 Access to Helpline
			3.9.2 Access to Troubleshooting Database
		3.10 IF [Unable to Access to Learning Resources]	3.10.1 Access to Helpline
			3.10.2 Access to Troubleshooting Database

APPENDIX A2: SCREENSHOT OF THE MOCK DESIGN

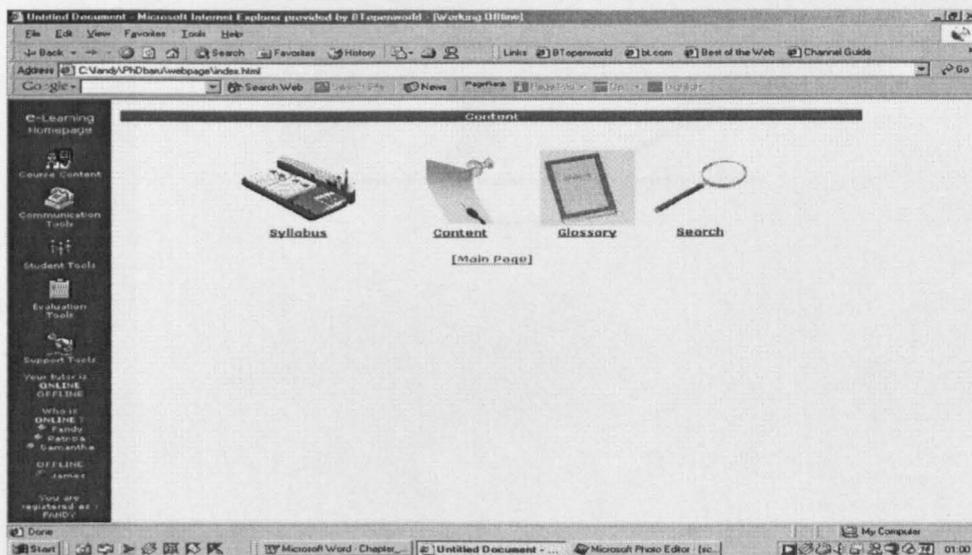


Mock Design of Main Menu



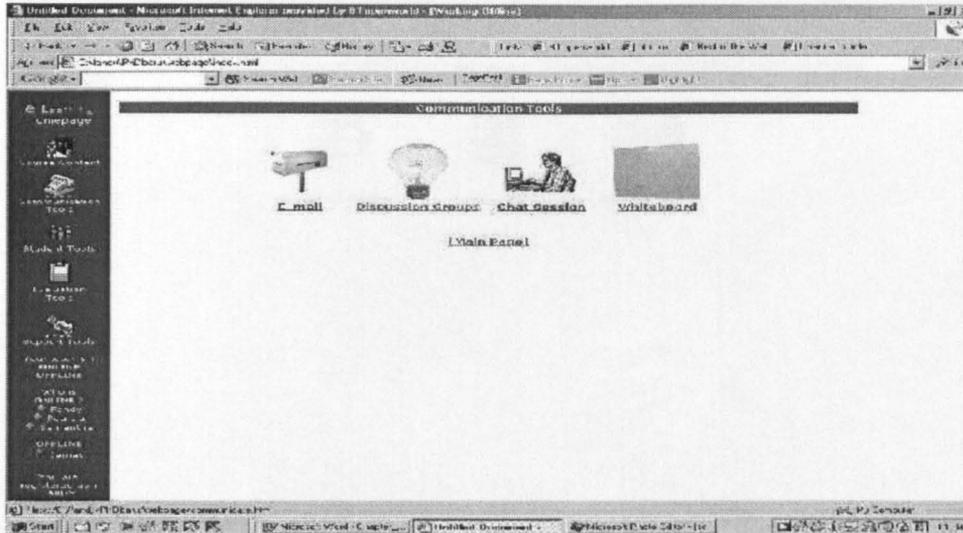
The interface of discussion groups.

The learner will be asked to give his opinion about using the Authoring Tools, submit it to discussion groups, read the other users' submissions and finally critique other users' opinions.



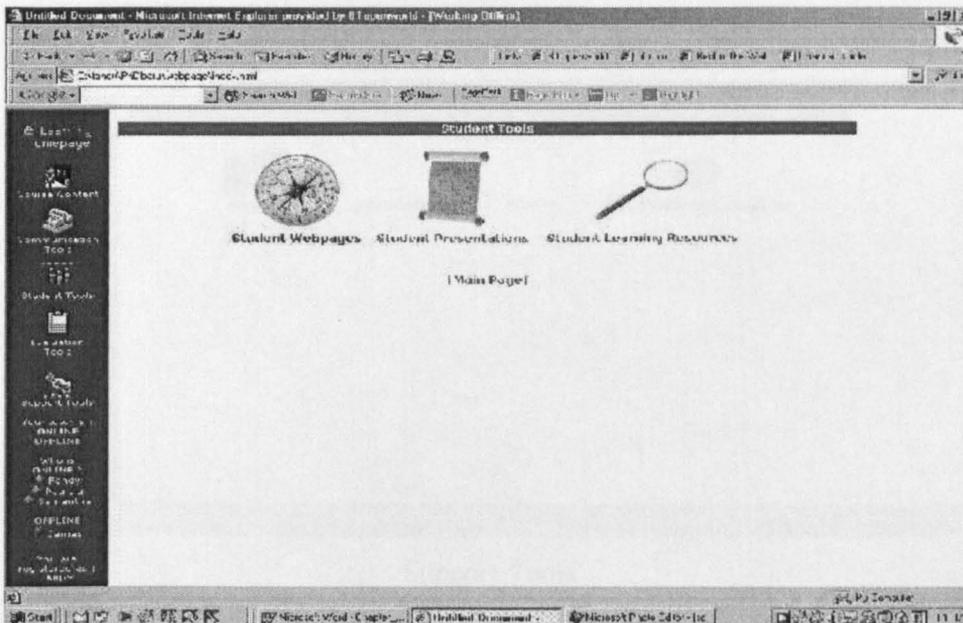
Course Content

The example above shows the 'course content' sub-menu, which includes the course syllabus, course content, glossary and search tools.



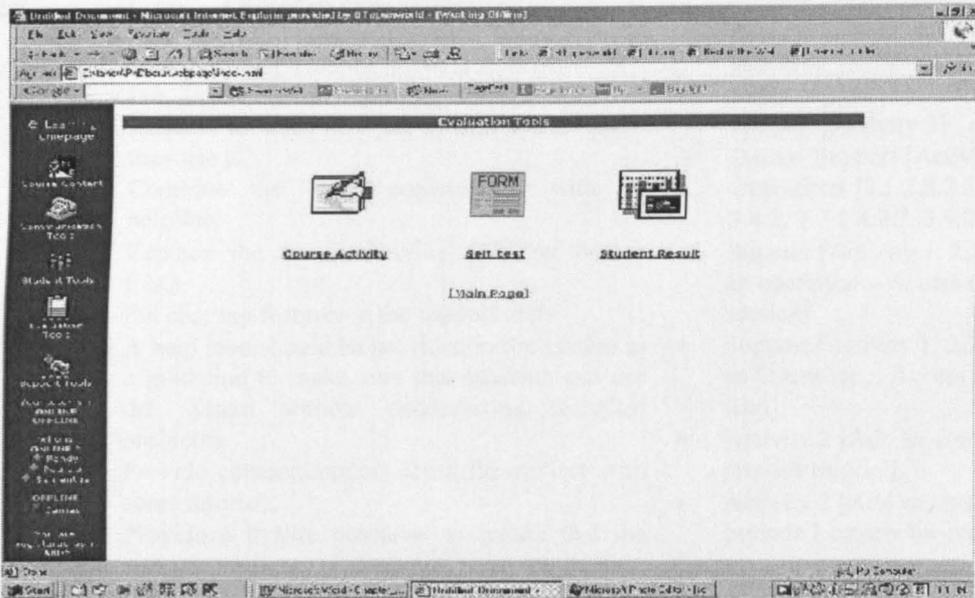
The 'Communication Tools'

Communication Tools contain e-mail, discussion groups, Chat Session and Whiteboard.



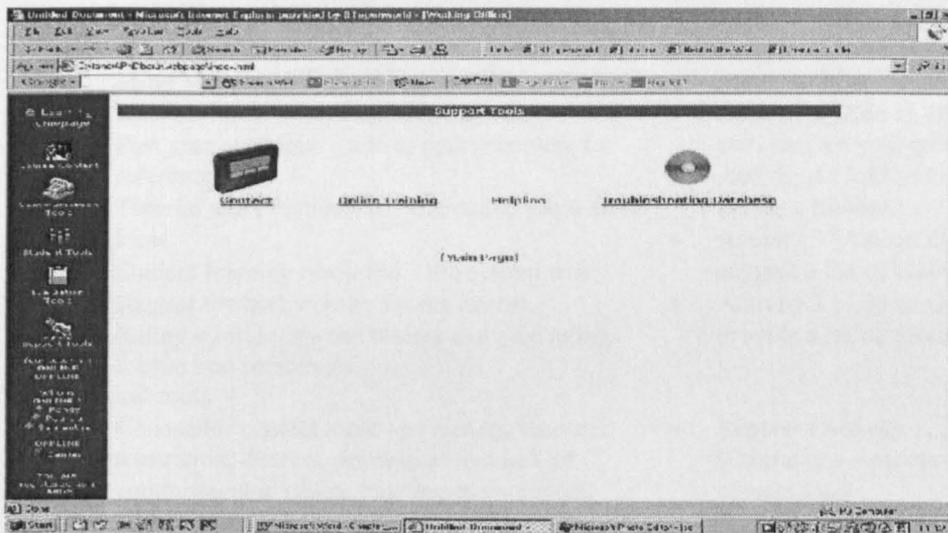
The 'Student Tools'

The Student Tools contain Student WebPages, Student Presentations and Student Learning Resources.



The Evaluation Tools

The Evaluation Tools contains course activities, self test facilities and student results.



Support Tools

Support tools include Contact Person, Online Training, Help-line and FAQ Database

Appendix B1: Summarise of the Focus Groups Results

Session	Feedback and Suggestion	Function Hierarchy
1	<ul style="list-style-type: none"> • Add a video conferencing tool in order to get closer to other distance learning students. • Put in an online learning tutorial to allow students to learn how the system works before they use it. • Combine the video conferencing with the helpline. • Replace the troubleshooting database with a FAQ • Put chatting features in the support tools • A help icon should be provided in the system as a guideline to make sure that students can use the system without encountering technical problems. • Provide content support about the subject with some tutorials. • Provide a lecture timetable to ensure that the students can contact lecturers at an appropriate time. 	<ul style="list-style-type: none"> • Activity 3 [Add an Operation - access to Video conferencing] • Support [Activity 1, 2, 3] • Support [Activity 3] • Delete Support [Activity 3], Operations [3.1.2,3.2.3,3.3.2, 3.4.2, 3.7.1,3.8.2, 3.9.2] • Support [Activity 1, 2,3] [Add an operation – Access to chat session] • Support [Activity 1, 2,3] [Add an Operation – Access to Help icon] • Activity 2 [Add an Operation – provide tutorial] • Activity 2 [Add an Operation – provide Lecturer timetable]
2	<p>System</p> <ul style="list-style-type: none"> • Add a video conferencing tool to the communication tools menu. • Evaluation issue – suggest the use of video conferencing during the evaluation to avoid cheating. • Mind Mapping in content menu – ensure that the students know what they have learned. • Past year questions – add to course content for reference. • Tutorial and Practice – to be added to evaluation tools • Student learning resources – the system will suggest the best website for the course. • Rating by friends – the student can give ratings for the best references. <p>Support tools</p> <ul style="list-style-type: none"> • Counsellor contact tools – to manage students' frustration, distress, depression and lack of commitment in online learning environment. • Video conferencing tools – to get closer to friends and tutors in order to deal with frustrations due to being isolated. • SMS (Short message service) – should be provided to make sure that the students do not lose contact among themselves. • Step by step guidance on how to use the system in digital video – to avoid problems when using the system. • Up-to-date technology in the online training module 	<ul style="list-style-type: none"> • Activity 3 [Add an Operation - access to Video conferencing] • Activity 2 [Add an Operation - access to Video conferencing] • Activity 2 [Add an Operation - access to Mind Mapping] • Activity 2 [Add an Operation – provide past year questions] • Activity 4 [Add an Operation – access a tutorial] • Activity 3 [Add an Operation – suggest a list of best website] • Activity 3 [Add an Operation – provide a rating tools for student] • Support [Activity 1, 2, 3]- [Operations – access counselor contact tool] • Support [Activity 1, 2, 3]- [Operations – access Video conferencing tool] • Support [Activity 1, 2, 3]- [Operations – Provide a SMS services in Contact menu] • Support [Activity 1]-[Operations – Provide a guidance during registration] • Support [Activity 1, 2, 3]- [Operations – Provide a page

-
- Online training –including installation information for any software.
 - Tracking device – the system can record students' navigation and lecturers can monitor them.
- about recent technologies in online training]
 - Support [Activity 1, 2, 3]- [Operations – Provide a page about software installation]
 - Support [Activity 1, 2, 3]- [Operations – Provide a tracking device for students once they are online
-

3

System :-

- Past year questions – add past year questions to content menu.
 - Printer-friendly version - content should be offered in a printer-friendly version to allow students to print the course modules easily.
 - Announcements – put any important announcements on the front page.
 - References – provide links to the related online journals
 - Lecturer timetable – to enable students to communicate with lecturers at certain times.
 - Active students – should be rewarded for their coursework.
 - Interface Design – highlight the support tools (put in pop-up windows)
 - Interface Design – change the colour of the system.
- Activity 2 [Add an Operation – provide past year questions]
 - Activity 2 [Add an Operation – provide a printer friendly version]
 - Activity 2 [Add an Operation – provide an announcement in course content]
 - Activity 2 [Add an Operation – provide links to related journal]
 - Activity 2 [Add an Operation – provide Lecturer timetable]
 - Activity 3
 - Activity 1,2,3
 - Activity 1,2,3

Support tools :-

- Counsellor support tools – similar to the previous evaluation.
 - Video conferencing module
 - Intensive Training Course –technical training course to support the students before they are enrolled in the e-learning course.
 - Guideline Tool – this tool must be provided on the registration page. The tool will include step-by-step guidelines on how to use the module.
 - Tracking device – Give active students some rewards (a percentage of their coursework)
 - FAQ – if the students have a problem, they can manage it by using the FAQ without contacting the tutor or technical support staff.
 - Dual versions of online training - English and Malay versions
 - Highlight the support tool - support tool should be located on the registration page.
 - SMS (Short Message Services) – avoid lack of feedback.
 - Expertise Column – add a menu for contacting an expert in the relevant subject area.
- Support [Activity 1, 2, 3]- [Operations – access counsellor contact tool]
 - Support [Activity 3]
 - Support [Activity 1]-[Operations – Provide a guidance during registration]
 - Support [Activity 1, 2, 3]- [Operations – provide a guideline tool]
 - Support [Activity 1, 2, 3]- [Operations – Provide a tracking device for students once they are online]
 - Support [Activity 1, 2, 3]- [Operations – Provide a FAQ page]
 - Activity 1 -[Operations – Provide two versions of system]
 - Activity 1
 - Support [Activity 1, 2, 3]- [Operations – Provide a SMS services in Contact menu]
 - Activity 2 -[Operations – Provide an expert column]
-

Appendix B2: Interview session 1,2 & 3

Interview session 1

Feedback and Suggestion	Function Hierarchy
System	
<ul style="list-style-type: none"> • Ensure that the students have a basic knowledge of using the e-mail, discussion board and other tools • Add course references menu in Course Content – Book, Journal or Online Proceeding. • Add some latest issues related to the weekly topics in the course content – support student with new issues in recent technologies. • Filter the topic in discussion groups – tutor should be given an authority to filter the topic in discussion groups. • Add video conferencing menu – increase interaction between student and lecturer. • Add the digital video in classroom learning session. • Create some topic in student presentation related to the task. • Provide a tracking devices for the student – to asses them. • Put past year questions in Evaluation Tools. • Review student mistakes in answering the past year questions. • Create a statistical figure to compare student results. 	<ul style="list-style-type: none"> • Support [Activity 1, 2, 3]-[Operations – provide a guideline tool] • Activity 2 [Add an Operation – provide links to related journal] • Support [Activity 1, 2, 3]-[Operations – Provide a page about recent technologies in online training] • Activity 3 [Add an Operation – provide topic filter by tutor] • Activity 3 [Add an Operation - access to Video conferencing] • Activity 2 • Activity 3
Support system	
<ul style="list-style-type: none"> • Useless icons in support menu – change and standardise the icons. • The colour in a contact menu is not appropriate – change with a contrast colour. • Delete a telephone icon in contact menu – replace with hyperlink text only. • Provide the students with the skills to gain knowledge about Internet – add in Online training module. • Provide the student with guidance on how to filter the information to support their learning. • Offer an external module to learn the internet – make a hyperlink with other related websites. Highlight the important skills that the student should have to use the system – create skill levels. • Put helpline in front page. • Remove troubleshooting database. • Replace troubleshooting database with a discussion group- use discussion groups to talk about student problems. 	<ul style="list-style-type: none"> • Support [Activity 1, 2, 3]-[Operations – Provide a tracking device for students once they are online] • Activity 4 [Add an Operation – provide past year questions] • Activity 4 [Add an Operation – provide a page of a student mistake] • Activity 4[Add an Operation – provide statistical figure] • Support [Activity 1,2,3] • Support [Activity 1,2,3] • Support [Activity 1,2,3] • Support [Activity 1, 2, 3]-[Operations – provide a guideline tool] • Support [Activity 1, 2, 3]-[Operations – provide a guideline tool] • Support [Activity 1, 2, 3]-[Operations – provide a guideline tool] • Activity 1 [Operations – move helpline in frontpage] • Delete Support [Activity 3], Operations [3.1.2,3.2.3,3.3.2, 3.4.2, 3.7.1,3.8.2, 3.9.2] • Support [Activity 1,2,3]
Interface design	
<ul style="list-style-type: none"> • Unbalanced screen design – redesign the screen with 	

<ul style="list-style-type: none"> • some graphics. • Screen is too empty – put graphic in every menu. • Screen resolution is not suitable – use high resolution screen. • The icon is too small – increase size of the icons. • Who is online – centralize it. 	<ul style="list-style-type: none"> • Activity 1,2,3,4
Learning Strategies	
<ul style="list-style-type: none"> • Put a learning objective in every module • Ensure that the students collaborate using the communication tools in order to achieve their objective. • The use of hypermedia and hypertext learning techniques in order to create the course content. • Make a user-friendly system with high interactivity. 	<ul style="list-style-type: none"> • Activity 1 [Operations - access to Learning Objectives] • Activity 2 • Activity 1,2,3,4 • Activity 1,2,3,4

Interview session 2

Feedback and Suggestion	Function Hierarchy
System	
<ul style="list-style-type: none"> • Front page looks like a Web CT • Front page is too empty • Change the green and yellow colour – choose a contrast colour. • Add references in course content – type of references (book, website, online journal) • Put course work on the subject in Syllabus. • Provide a video conferencing tool • Provide a moderator for discussion groups and chat sessions – moderator can be a class leader. • Remove whiteboard – whiteboard is not necessary to teach multimedia courses. • Provide a digital video – as a medium in learning multimedia. • Student presentation is a good idea in sharing information among the students. • Create a student tracing device – one of method to evaluate the students. • Add FAQ sessions in evaluation tools – review of common mistakes done by students in past year questions. 	<ul style="list-style-type: none"> • Activity 1,2,3,4 • Activity 1,2,3,4 • Activity 1,2,3,4 • Activity 2 [Add an Operation – provide links to related references] • Activity 2 [Add an Operation – provide a coursework] • Activity 3 [Add an Operation - access to Video conferencing] • Activity 3 [Add an Operation – provide topic filter by tutor] • In Activity 3, Delete Actions 3.15, Operations 3.15.1, 3.15.2, 3.15.3 • Activity 2 • Activity 3 • Support [Activity 1, 2, 3]-[Operations – Provide a tracking device for students once they are online] • Activity 4 [Add an Operation – provide a page of a student mistake]
Support tools	
<ul style="list-style-type: none"> • Add short message services (SMS) in contact menu. • Change the telephone icons in Contact Menu – replace with related graphics. • Inconsistent usage of colour – green and yellow are not suitable. • Provide student status in contact menu – for example, busy, online, away or ready to help. • Divide the send message to two categories – for example, send to all and send to specific person. • Remove helpline. 	<ul style="list-style-type: none"> • Support [Activity 1, 2, 3]-[Operations – Provide a SMS services in Contact menu] • Support [Activity 1,2,3] • Support [Activity 1,2,3] • Support [Activity 1, 2, 3]-[Operations – Provide Student Status in Contact menu] • Support [Activity 1, 2, 3]-[Operations – divide send message in Contact menu] • Avoid

-
- Provide guidelines on how to use the system itself – for example, how to upload the files.
 - Put other links in Online Training Module for the students to learn other software, such as ICQ, Yahoo Messenger and etc.
 - Add an advanced search in troubleshooting database.
- Instructional Strategies**
- Emphasise collaboration among students- for example, give them a course activity, solve it in group using communication tool and present it in student presentation tool.
 - Tutor should act as moderator and monitor student progress.
- Support [Activity 1, 2, 3]-[Operations – provide a guideline tool]
 - Support [Activity 1, 2, 3]-[Operations – provide a guideline tool]
 - Avoid
 - Activity 1,2,3,4
 - Activity 1,2,3,4
 - Activity 1,2,3,4
-

Interview session 3

Feedback and Suggestion	Function Hierarchy
<p>System</p> <ul style="list-style-type: none"> • Front page is too empty and not attractive - put a related graphic. • Font in main menu change the font colour and increase the font size. • Main menu such as Course Content, Student Tools, unbalanced – increase the icons. • Icons – standardise the icons • Telephone icon is not suitable – change it with related icon. • Course Content – divide into 15 learning modules. • Put the latest tips and tricks in course content for the student to support their learning. • Put a lecturer timetable and references in Syllabus. • Change the icons – for example, the course content icons are not related. • Put a contact in Syllabus • Put Navigation Menu in every page – to ensure the students will not be lost in space. • Remove a Whiteboard and Chat session in Communication Tools • Add video conferencing tool • Suggest the use of video conferencing during the evaluation to avoid cheating. • Add student bibliography in Student Homepages. <p>Support Tools</p> <ul style="list-style-type: none"> • Colour combination (Green and Yellow) in Contact menu is not suitable. • Put a video conferencing tool in contact menu. • Provide online training in digital video – How-to tutorial in ScreenCam software. • Put the online training in front page- first time user should be provided with Online Training about how to use the system. • Provide a questionnaire for the students to examine 	<ul style="list-style-type: none"> • Activity 1 • Activity 1 • Activity 1,2,3,4 • Activity 1,2,3,4 • Activity 1,2,3,4 • Activity 2 [Add an Operation – divide into 15 learning modules] • Activity 2 [Add an Operation - access to tips and tricks of learning multimedia] • Activity 2 [Add an Operation –provide Lecturer timetable] • Activity 2 • Avoid • Activity 2 [Operations –provide navigation menu in every page] • In Activity 3, Delete Actions 3.15, Operations 3.15.1, 3.15.2, 3.15.3 • Activity 3 [Add an Operation - access to Video conferencing] • Activity 4 [Add an Operation - access to Video conferencing] • Activity 3 • Support [Activity 1,2,3] • Support [Activity 1, 2, 3]-[Operations – provide a video conferencing tool] • Support [Activity 1, 2, 3]-[Operations – provide a guideline tool] • Support [Activity 1]-[Operations – Provide a guidance during registration] • Support [Activity 1]-[Operations – Provide

their skill level – the system then will suggest the training for them in online training.

- Remove Troubleshooting Database – not necessary. Cover it with Online Training and Helpline.

Instructional Strategies

- Provide an active learning environment – for example, student actively involved in learning session; collaboration among them to complete the task or course activity.
-

a questionnaire during registration]

- Delete Support [Activity 3], Operations [3.1.2,3.2.3,3.3.2, 3.4.2, 3.7.1,3.8.2, 3.9.2]

- Activity 1,2,3,4

Appendix B3 : Results of Usability Testing and System-Functionality

No of Activity	Features	Operation & Action	Respondents (based on User Tracking Results)							
			1		2		3		4	
			Yes	No	Yes	No	Yes	No	Yes	No
1	Student Registrations	• User registration	√		√		√		√	
		• User log-out	√		√		√		√	
2	Content	• Display course content	√		√		√		√	
		• Retrieve course content	√		√		√		√	
		• Course content navigation	√		√		√		√	
3	Glossary	• Display multimedia glossary links	√		√		√		√	
		• Browse the glossary	√		√		√		√	
		• Submit search for the glossary	√		√		√		√	
		• Displays glossary	√		√		√		√	
4.	Search	• Display Search Box	√		√		√		√	
		• Provide search options	√		√		√		√	
		• Submit search	√		√		√		√	
		• Display results	√		√		√		√	
5.	Discussion groups	• Create New Topic	√		√		√		√	
		• Send a New Topic	√		√		√		√	
		• Retrieve the new topic	√		√		√		√	
		• Respond to the old topic	√		√		√		√	
6.	Chat Session	• Log-on to chat session	√		√		√		√	
		• Send message to the board	√		√		√		√	
		• Exit Chat Session	√		√		√		√	
7.	Video Conferencing	• Log-on to video conferencing	√		√		√		√	
		• Connecting to V-C	√		√		√		√	
		• Call a friends	√		√		√		√	
		• Send a message	√		√		√		√	
		• Log-out VC	√		√		√		√	
8.	Student WebPages	• Retrieve list of members	√		√		√		√	
		• Display members	√		√		√		√	
9.	Student presentations	• Upload File to server	√		√		√		√	

		• Display confirmation	√	√	√	√
		• View Files	√	√	√	√
10.	Learning Resources	• Add New Links	√	√	√	√
		• Submit New Links	√	√	√	√
		• Retrieve New Links	√	√	√	√
11.	Course Activity	• Browse Course Activity	√	√	√	√
12.	Contact	• Read Private Message	√	√	√	√
		• Send Private Message	√	√	√	√
		• View Confirmation	√	√	√	√
		• Retrieve Sent Messages	√	√	√	√
13	Online Training	• View Online Training Content	√	√	√	√
14	FAQ	• Retrieve FAQ question	√	√	√	√
		• Show FAQ Q & A	√	√	√	√
15	Helpline	• View Help Content	√	√	√	√
		• Send Help	√	√	√	√
		• View Message by user	√	√	√	√

Appendix B4: Suggestions and Improvements from Subject 1 & 2

Subject 1

Feedback and Suggestion	Remarks
Student Registration <ul style="list-style-type: none"> • Provide step-by-step guidelines on how to use the system for first time user. • Give description for every button & icon and how to use it. • Provide minimum computer requirements/specifications of to use the system • Suggestions: <ul style="list-style-type: none"> • Provide pop-up windows for help. • Offer the students a foundation course – ‘ Learning using technology’ 	<ul style="list-style-type: none"> • Activity 1 • Actions 1.1, 1.2 and 1.3 • Operations 1.1.1 –1.3.6
Web links <ul style="list-style-type: none"> • Create Digital Library to help students search their references. 	<ul style="list-style-type: none"> • Activity 3, Action 3.1
Course Content <ul style="list-style-type: none"> • Make the learning very flexible. Provide several weeks to complete the course. For example, in order to complete the course the students must spend 2-3 hours per week. • Link very important words with glossary. • The content should be very detailed for online students. • Provide an exercise for every topic i.e. objective questions in order to obtain feedback from the student about their performance. • Avoid designing the course content like a textbook. Put some graphics and animation with colour. • Provide very detailed and friendly guidelines. 	<ul style="list-style-type: none"> • Activity 2 • Actions 2.4, 2.5 • Operations 2.4.1, 2.5.1
Discussion Groups <ul style="list-style-type: none"> • Provide moderator for the newsgroups. • Somebody has to correct them if the students make mistakes when discussing learning. • Give label to priority messages in the discussion groups. 	<ul style="list-style-type: none"> • Activity 3 • Actions 3.5,3.6 • Operations 3.4.1 – 3.6.3
Chat Sessions <ul style="list-style-type: none"> • Create a general chat session in which the students can discuss anything. • Provide a counselling session indirectly through chat sessions. 	<ul style="list-style-type: none"> • Activity 3 • Actions 3.8-3.11
Video Conferencing <ul style="list-style-type: none"> • Good accessories for the students. • Provide the guidelines on how to use it. 	<ul style="list-style-type: none"> • Activity 3 • Actions 3.27
Glossary <ul style="list-style-type: none"> • Put a photo for every term in the glossary. 	<ul style="list-style-type: none"> • Activity 2 • Actions 2.6, 2.7 • Operations 2.6.1,2.7.1
Helpline <ul style="list-style-type: none"> • Very good but it is too small. 	<ul style="list-style-type: none"> • Activity 1, 2, 3
Online Training <ul style="list-style-type: none"> • Should be one big module for online training • Provide a starter pack for the first-time user about how to use the system. 	<ul style="list-style-type: none"> • Activity 1, 2, 3

Subject 2

Feedback and Suggestion	Remarks
Course Content <ul style="list-style-type: none"> • Show the weekly content step by step. • For example, the weekly topics will be shown to the student step by step. The moderator will activate them once the students enter the following week. • Provide step-by-step guidelines on how to use the system for first time user. 	<ul style="list-style-type: none"> • Activity 2 • Actions 2.4, 2.5 • Operations 2.4.1, 2.5.1
Course Content <ul style="list-style-type: none"> • Provide an automatic Refresh function on the website every 10-15 minutes. • It will help the student to become up-to-date with the information from the website. For example, See friends and who's online. 	<ul style="list-style-type: none"> • New Operation.
Online Training <ul style="list-style-type: none"> • Provide the minimum technical requirements for the students to use the system. What should a student have to learn using the system? • Online Training as a one stop-learning portal for the students. • Provide the learning skills i.e. How to learn using the system. • Suggestion: <ul style="list-style-type: none"> • Offer the students a manual of 'how to learn' in a printed version as guidance on how to use the system. It could be a step-by-step approach. 	<ul style="list-style-type: none"> • Activity 1, 2, 3
Video Conferencing <ul style="list-style-type: none"> • Too slow • Not very helpful • It is no more than just having fun 	<ul style="list-style-type: none"> • Activity 3 • Actions 3.27
Helpline and Contact <ul style="list-style-type: none"> • Very good • Promote sharing in learning • Decrease the stress • Promote human touch and emotion in e-learning. 	<ul style="list-style-type: none"> • Keep it
General suggestion on research. <ul style="list-style-type: none"> • Provide a Guided Evaluation, which can guide the student to give very relevant information when evaluating the system. • It will help the students to follow and understand what they are evaluating. • This will ensure the reliability of data. 	

Appendix B5: Justifications for Iterative Evaluation of Focus Group sessions

No	Suggestions and Improvements	Accepted	Rejected	Justifications
1	Add a video conferencing tool so as to get closer to other distance-learning students.	√		<ul style="list-style-type: none"> • Add Video conferencing tools
2	Put in an online learning tutorial to allow students to learn how the system works before they use it.	√		<ul style="list-style-type: none"> • Online Training Module
3	Replace the troubleshooting database with an FAQ	√		<ul style="list-style-type: none"> • Suggested by the course tutors.
4	Put a chatting features in the support tools	√		<ul style="list-style-type: none"> • Add chat channel for the students' problem.
5	A help icon should be provided in the system as a guideline to make sure that students can use the system without encountering technical problems.	√		<ul style="list-style-type: none"> • FAQ on FrontPage.
6	Content support with some tutorials about the subject.	√		<ul style="list-style-type: none"> • Add hyperlinks
7	Provide a lecturer timetable to ensure that the students can contact lecturers at an appropriate time.	√		<ul style="list-style-type: none"> • Provided in the system • Add lecturer timetable
8	Evaluation issue – suggest the use of video conferencing during the evaluation to avoid cheating.		√	<ul style="list-style-type: none"> • Too complicated • Technology limitation
9	Mind Mapping in content menu – ensure that the students know what they have learned.	√		<ul style="list-style-type: none"> • Add concept maps
10	SMS (Short Message Services) – avoid lack of feedback.		√	<ul style="list-style-type: none"> • Technology limitation
11	Expertise Column – add a menu for contacting an expert in the relevant subject area.	√		<ul style="list-style-type: none"> • Technical Assistant and online course tutors
12	Counsellor support tools – similar to the previous evaluation		√	<ul style="list-style-type: none"> • Limitation of Study
13	Interface Design – highlight the support tools (put in pop-up windows) Interface Design – change the colour of the system.	√		<ul style="list-style-type: none"> • Put Support tools at the front page
14	Past years' questions – add to course content for reference.		√	<ul style="list-style-type: none"> • Not appropriate • Decline by the course tutors
15	Tutorial and Practice – to be added to evaluation tools		√	<ul style="list-style-type: none"> • Add Course activity
16	Student learning resources – the system will suggest the best website for the course.	√		<ul style="list-style-type: none"> • Hyperlinks on every topic of learning.
17	Rating by friends – the student can give ratings for the best references.		√	<ul style="list-style-type: none"> • Not appropriate
18	Counsellor contact tools – to manage students' frustration, distress, depression and		√	<ul style="list-style-type: none"> • Good suggestion but not

	lack of commitment in online learning environment.			implemented due to time expertise limitation for counselling.
19	Step-by-step guidance on how to use the system in digital video – to avoid problems when using the system.		√	<ul style="list-style-type: none"> • Good suggestion but has to avoid due to time constraint.
20	<ul style="list-style-type: none"> • Up-to-date technology in the online training module • Online training –include installation information for any software • Intensive Training Course –technical training course to support the students before they are enrolled in the e-learning course. 	√		<ul style="list-style-type: none"> • Add Online Training Module
21	Tracking device – the system can record students' navigation and lecturers can monitor them.	√		<ul style="list-style-type: none"> • Add User-tracking for the evaluation only.
22	Printer-friendly version - content should be offered in a printer-friendly version to allow students to print the course modules easily.	√		<ul style="list-style-type: none"> • Add user-friendly icon in every topics.
23	Dual versions of online training - English and Malay versions		√	<ul style="list-style-type: none"> • Only design the system in English.
24	Highlight the support tool - support tool should be located on the registration page.	√		<ul style="list-style-type: none"> • Put support tool on the registration page.
25	Announcements – put any important announcements on the front page	√		<ul style="list-style-type: none"> • Add announcement on the front page
26	References – provide links to the related online journals	√		<ul style="list-style-type: none"> • Student learning resources
27	Active students – should be rewarded in their coursework.	√		<ul style="list-style-type: none"> • Active learning for course activity
28	<ul style="list-style-type: none"> • Guideline Tool – this tool must be provided on the registration page. The tool will include step-by-step guidelines on how to use the module. • FAQ – if the students have a problem, they can manage it by using the FAQ without contacting the tutor or technical support staff. 	√		<ul style="list-style-type: none"> • Add FAQ to be replaced with the troubleshooting database

Appendix B6: Justifications for the First Iterative Evaluation of the Interview sessions

No	Suggestions and Improvements	Accepted	Rejected	Justifications
1	<ul style="list-style-type: none"> • Ensure that the students have a basic knowledge of using the e-mail, discussion board and other tools. • Provide guidelines on how to use the system itself – for example, how to upload the files. • Put other links in Online Training Module for the students to learn other software, such as ICQ, Yahoo Messenger, etc. • Tutor should act as moderator and monitor student progress 	√		Add online training about Internet
2	Add course reference menu to Course Content – Book, Journal or Online Proceeding.	√		Add student learning resources
3	Add some of the latest issues related to the weekly topics in the course content – support student with new issues in recent technologies.	√		Add the guidelines for the students.
4	<ul style="list-style-type: none"> • Filter the topic in discussion groups – tutor should be given authority to filter the topic in discussion groups. • Provide a moderator for discussion groups and chat sessions – moderator can be a class leader • Tutor should act as moderator and monitor the student progress 	√		The role of Technical Assistant and Moderator
5	Add video conferencing menu – increase interaction between student and lecturer.	√		Add video conferencing tool is the communication tools
6	Add the digital video in classroom learning session.		√	Technology limitation Slow network connection
7	Create some topic in student presentation related to the task.	√		User tracking module is provided for the evaluation
8	Provide tracking devices for the student – to assess them.	√		
9	Put past years' questions in Evaluation Tools.		√	<ul style="list-style-type: none"> • Not appropriate • Decline by the other course tutors
10	Review a student mistake in answering past years' questions.		√	
11	Create a statistical figure to compare student results.		√	Evaluation will be based on the student assignment
12	Useless icons in support menu – change and standardize the icons.	√		Change the icon
13	Provide the students with the skills to gain knowledge about Internet – add in Online training module.	√		Add Online training module
14	Provide the student with guidance on how	√		Online training using the

	to filter the information to support their learning.			search engine
15	Offer an external module to learn the internet – make a hyperlink with other related websites. Highlight the important skills that the student should have to use the system – create skill levels.	√		Online training - provide with the hyperlinks to another topics
16	Put helpline on front page.	√		Put helpline at front page
17	Remove troubleshooting database.	√		Replace the troubleshooting database with FAQ
18	Replace troubleshooting database with a discussion groups- use discussion groups to talk about student problems.	√		Create student problem topics in discussion groups
19	Interface design Unbalanced screen design – redesign the screen with some graphics.	√		Use theme to balance the screen design
20	Screen is too empty – put graphics in every menu.	√		Use theme to balance the screen design
21	Screen resolution is not suitable – use high-resolution screen.	√		Use appropriate theme that is suited to screen.
22	The icon is too small – increase size of the icons.	√		Increase the text size
23	Who is online – centralize it.	√		Highlight who is online by putting them on the FrontPage
24	Instructional Strategies Put learning objectives in every module	√		Create the objectives of the course
25	Ensure that the students will collaborate using the communication tools in order to achieve their objective	√		Provide Communication tools to engage students with the activity.
26	The use of hypermedia and hypertext learning techniques in order to create the course content.	√		Add hypermedia and hypertext concept in course materials
27	Make a user-friendly system with high interactivity.	√		Concept maps and hypertext for easy navigation.
28	Put course work of the subject in Syllabus.	√		Add the course activity in Syllabus
29	Remove whiteboard – whiteboard is not necessary to teach multimedia courses.	√		Withdraw whiteboard from the system.
30	Provide a digital video – as a medium in learning multimedia.		√	Technology constraint will bring slow network connection.
31	Add short message services (SMS) in contact menu.		√	Technology constraint
32	Provide student status in contact menu – for example, busy, online, away or ready to help.	√		Add who is online by status
33	Divide the send message into two categories – for example, send to all and send to specific person.	√		Add private message
34	Remove helpline.		√	Helpline cannot be removed.
35	Instructional Strategies	√		Course designed based

	Emphasis on collaboration among students- for example, give them course activity, solve it in group using communication tool and present it in student presentation tool.			on the course activity and the evaluation is based on the assignments.
36	Course Content – divide by sub-topic in the learning modules.	√		The course content to be designed with sub-topics for easy navigation for the student.
37	Put the latest tips and tricks in course content for the student to support their learning.	√		Online Training and FAQ
38	Put a lecturer timetable and references in Syllabus.	√		Add online training
39	Change the icons – for example, the course content icons are not related.	√		Add Student learning resources
40	Put Navigation Menu in every page – to ensure the students will not be lost in space.	√		Add concept maps and frame for easy navigation.
41	Remove a Whiteboard in Communication Tools	√		Withdraw whiteboard from the system.
42	Suggest the use of video conferencing during the evaluation to avoid cheating.		√	The evaluation based on the student assignment.
43	Add student bibliography in Student Homepages.	√		Student Homepage already created during the registration.
44	Provide online training in digital video – How-to tutorial in ScreenCam software.		√	Technology limitation
45	Put the online training in front page- first time user should be provided with Online Training about how to use the system.	√		Add the online training to front page.
46	Provide a questionnaire for the students to examine their skill level – the system then will suggest the training for them in online training.		√	Good suggestion, however the online training is enough for the student to explore the skills.
47	Remove Troubleshooting Database – not necessary. Cover it with Online Training and Helpline.	√		Have been rejected by three respondents Withdraw from the system.
48	Instructional Strategies Provide an active learning environment – for example, students actively involved in learning session; collaboration among them to complete the task or course activity.	√		Active learning in exploring the hypermedia and hypertext environment.
49	<ul style="list-style-type: none"> • The colour in a contact menu is not appropriate – change with a contrasting colour. • Front page is too empty and not attractive - put a related graphic. • Font in main menu – change the font colour and increase the font size. • Unbalanced main menu, such as 	√		Use the theme change in Front-page

	<p>Course Content, Student Tools – increase the icons.</p> <ul style="list-style-type: none"> • Colour combination (Green and Yellow) in Contact menu is not suitable. • Front page is too empty • Change the green and yellow colour – choose a contrasting colour. • Icons – standardise the icons 			
50	<p>Delete the telephone icon in contact menu – replace with hyperlink text only. Telephone icon is not suitable – change it with related icon.</p>	√		Put a small icon and hyperlinks

Appendix B7: Justifications for the Second Iterative Evaluation of the Interview sessions

No	Suggestions and Improvements	Accepted	Rejected	Justifications
1	Remove video conferencing tool	√		<ul style="list-style-type: none"> • Video conferencing tools are too slow. • Not very helpful in learning
2	Student Registration <ul style="list-style-type: none"> • Offer the students a foundation course – ‘ Learning using technology’ 	√		<ul style="list-style-type: none"> • Online learning module
3	Web links Create Digital Library to help students search their references	√		<ul style="list-style-type: none"> • Weblinks as a digital library
4	Course Content <ul style="list-style-type: none"> • Link very important words with glossary. 	√		<ul style="list-style-type: none"> • The used of hyperlinks.
	<ul style="list-style-type: none"> • Provide an exercise for every topic i.e. objective questions in order to obtain feedback from the student about their performance. 		√	<ul style="list-style-type: none"> • The evaluation is based on course activity.
	<ul style="list-style-type: none"> • Provide very detailed and friendly guidelines. 	√		<ul style="list-style-type: none"> • Online training
	Discussion Groups <ul style="list-style-type: none"> • Provide moderator for the newsgroups. 	√		<ul style="list-style-type: none"> • Technical Assistant provided
	<ul style="list-style-type: none"> • Somebody has to correct them if the students make mistakes when discussing learning. 	√		<ul style="list-style-type: none"> • Technical Assistant as moderator.
	<ul style="list-style-type: none"> • Give label to priority messages in the discussion groups. 	√		<ul style="list-style-type: none"> • Included in the modules
	Chat Sessions <ul style="list-style-type: none"> • Create a general chat session in which the students can discuss anything. 	√		<ul style="list-style-type: none"> • Create one general chat session room
	<ul style="list-style-type: none"> • Provide a counselling session indirectly through chat sessions. 		√	<ul style="list-style-type: none"> • Good suggestion but not implemented due to time expertise
	Glossary <ul style="list-style-type: none"> • Put a photo for every term in the glossary. 		√	<ul style="list-style-type: none"> • Rejected due to photo has been included in the course content.
	Course Content <ul style="list-style-type: none"> • Provide step-by-step guidelines on how to use the system for first time user. 	√		<ul style="list-style-type: none"> • Guideline for first time user.
	Course Content <ul style="list-style-type: none"> • Provide an automatic Refresh function on the website every 10-15 minutes. 	√		<ul style="list-style-type: none"> • Put the refresh function module

	Online Training <ul style="list-style-type: none">• Offer the students a manual of 'how to learn' in a printed version as guidance on how to use the system. It could be a step-by-step approach.• Should be one big module for online training• Provide a starter pack for the first-time user about how to use the system.		√	<ul style="list-style-type: none">• Provide 'printer-friendly' button.
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APPENDIX C1: Sample of Ali's User Tracking

Discussion Groups Sessions

No	Date	Activity	Actions	Commentary
1	10/01/2005 17:45	Selecting Discussion Groups	View Forum Index	<ul style="list-style-type: none"> • Ali is reading the main category of forum.
2	10/01/2005 17:46		Read Forum Topic	<ul style="list-style-type: none"> • Ali is viewing the main menu of forum. Topics Course Activity 1.
3	11/01/2005 17:48		Read Selected Topic	<ul style="list-style-type: none"> • Ali is reading the specific topic for Course Activity 1
4	10/01/2005 17:47	CA11 (1)	Post Selected Topics Topic: An Opinion about relationship between graphics and animation.	<ul style="list-style-type: none"> • Ali is posting the new topic to the forum. This is an opinion about graphics and animation. See Transcription: CA11
5	19/01/2005 11:38	Selecting Discussion Groups	View Forum Index	<ul style="list-style-type: none"> • Ali is reading the main category of forum.
6	19/01/2005 11:39		Read Forum Topics	<ul style="list-style-type: none"> • Ali is viewing the main menu of forum. Topic for Course Activity 1
7	19/01/2005 11:39		Read Selected Topics • Topic: Course Activity 1	<ul style="list-style-type: none"> • Ali is reading the specific topic for Course Activity 1 posting by the other student
8	19/01/2005 11:39		View Forum Index	<ul style="list-style-type: none"> • Ali is reading the main category of forum
9	19/01/2005 11:39		Read Selected Topics • Topic: Graphics on Web	<ul style="list-style-type: none"> • Ali is reading the specific topic posting by the other student
10	19/01/2005 11:40		Read Selected Topics • Topic: Graphics Quality	<ul style="list-style-type: none"> • Ali is reading the specific topic posting by the other student
11	19/01/2005 11:40		Read Selected Topics • Topic: Graphics Quality	<ul style="list-style-type: none"> • Ali is reading the specific topic posting by the other student
12	19/01/2005 11:40		Read Selected Topics • Topic: Graphics	<ul style="list-style-type: none"> • Ali is reading the specific topic posting by the other student
13	19/01/2005 11:40		Read Selected Topics • Topic: Graphics	<ul style="list-style-type: none"> • Ali is reading the specific topic posting by the other student
14	19/01/2005 11:42		Read Forum Topics	<ul style="list-style-type: none"> • Ali is viewing the main menu of forum. Topic for Course Activity 1
15	19/01/2005 11:42		Read Selected Topics Topic: Graphics Quality	<ul style="list-style-type: none"> • Ali is reading the specific topic. The topic is about 'Animation' in Course Activity 1

16	19/01/2005 11:44		Read Selected Topics Topic: Graphics Quality	<ul style="list-style-type: none"> Ali is reading the specific topic. The discussion topics is about 'Graphics' in Course Activity 1.
17	19/01/2005 11:44		Read Selected Topics Topic: Animations	<ul style="list-style-type: none"> Ali is reading the specific topic. The discussion topic is about 'Animation' in Course Activity 1.
18	19/01/2005 11:45		Read Selected Topics Topic: Animations	<ul style="list-style-type: none"> Ali is reading the specific topic. The discussion topic is about 'Animation' in Course Activity 1.
19	19/01/2005 11:45		Read Selected Topics	<ul style="list-style-type: none"> Ali is reading the specific topic.
20	19/01/2005 11:55		Read Forum Topics	<ul style="list-style-type: none"> Ali is viewing the main menu of forum
21	19/01/2005 11:55		Read Selected Topics	<ul style="list-style-type: none"> Ali is reading the specific topic
22	19/01/2005 11:55		Read Selected Topics	<ul style="list-style-type: none"> Ali is reading the specific topic
23	19/01/2005 12:00		Read Forum Topics	<ul style="list-style-type: none"> Ali is viewing the main menu of forum
24	19/01/2005 12:00		Read Selected Topics	<ul style="list-style-type: none"> Ali is viewing the main menu of forum
25	19/01/2005 12:01	CA31(2)	Post New Topics Topic: About scripting error.	<ul style="list-style-type: none"> Ali is posting the new topic to the discussions. This is a query from Ali about scripting error. See Transcription: CA12
26	19/01/2005 12:08		View posted discussions	<ul style="list-style-type: none"> Ali is reading the posted discussions.
27	19/01/2005 12:08		Read Forum Topics	<ul style="list-style-type: none"> Ali is viewing the main menu of forum
28	19/01/2005 12:08		Read Forum Topics	<ul style="list-style-type: none"> Ali is viewing the main menu of forum
29	19/01/2005 12:08		Read Forum Topics	<ul style="list-style-type: none"> Ali is viewing the main menu of forum
30	25/01/2005 04:40	Selecting Discussion Groups	View Forum Index	<ul style="list-style-type: none"> Ali is viewing the main menu of forum
31	25/01/2005 04:40		Read Forum Topics • Topic: Course Activity 2	Ali is viewing the main menu of forum
32	25/01/2005 04:40		Read Selected Topics • Topic: Course Activity 2	Ali is reading the specific topic
33	25/01/2005 04:40		View Forum index	
34	25/01/2005 04:40		Read Selected Topics • Topic: Course Activity 2	Ali is reading the specific topic
35	25/01/2005 04:44		Read Selected Topics • Topic: Course Activity 2	Ali is reading the specific topic
36	25/01/2005 04:44		Read Selected Topics • Topic: Course Activity 2	Ali is reading the specific topic
37	25/01/2005 04:44		View Forum Index	Ali is viewing the main menu of forum
38	25/01/2005 04:45		View Forum Index	Ali is viewing the main menu of forum

39	25/01/2005 04:45		Read Forum Topics	Ali is reading the specific topic
40	25/01/2005 04:45		Read Selected Topics	Ali is reading the specific topic
41	25/01/2005 04:45		Read Selected Topics	Ali is reading the specific topic
42	25/01/2005 04:45		Read Selected Topics	Ali is reading the specific topic
44	25/01/2005 04:49	CA32 (3)	Post Topics Topic: Query about unstable chat sessions.	Ali is posting the topics. This is a query about 'Chat session'. See transcription CA32.
45	25/01/2005 04:49		Read Forum Topics	Ali is viewing the main menu of forum
46	25/01/2005 04:50		Read Selected Topics	Ali is reading the specific topic
47	25/01/2005 04:50		Read Selected Topics	Ali is reading the specific topic
48	25/01/2005 04:50		Read Selected Topics	Ali is reading the specific topic
49	25/01/2005 04:55	CA33 (4)	Post topics. Topics: Query about scripting error.	Ali is posting the topics. This is a query about scripting error. See transcriptions CA33.
51	25/01/2005 05:17		Read Forum Topics	Ali is viewing the main menu of forum
	25/01/2005 05:17		Read Selected Topics	Ali is reading the specific topic
	25/01/2005 05:18	CA12 (5)	Reply the selected topics. Topics: Giving feedback about animation.	Ali is replying specific topics. This is a feedback from Ali about 2d animation. See transcriptions CA12.
52	25/01/2005 18:23	Selecting Discussion Groups	View Forum Index	Ali is reading the main category of forum.
53	25/01/2005 18:23		Read Forum Topic	Ali is viewing the main menu of forum
54	25/01/2005 18:24		Read Selected Topic	Ali is reading the specific topic
56	25/01/2005 18:33	CA41 (6)	Post Discussion Topic: Query about course assignment; Ready made Graphics.	Ali is posting the query in the course assignment topics. This is a query about ready made graphics on the Internet. See transcriptions CA41.
57	25/01/2005 18:33		View Posted Topics	Ali is viewing the posted topic
58	25/01/2005 18:34		View Forum Index	Ali is viewing the main menu of forum
59	25/01/2005 18:34		View Forum Index	Ali is viewing the main menu of forum
60	25/01/2005 18:34		Read Forum Topic	Ali is viewing the main menu of forum
61	25/01/2005 18:36		View Forum Index	Ali is viewing the main menu of forum
62	25/01/2005 18:37		View Forum Index	Ali is viewing the main menu of forum
63	25/01/2005 18:37	CA42 (7)	Reply the selected topics Topic: A query about graphics	Ali is replying specific topics. This is a feedback from Ali about Adobe Photoshop. Ali also provides a links about

			software, Adobe Photoshop.	the software. See transcriptions CA42.
64	25/01/2005 18:37		Read Forum Topic	Ali is viewing the main menu of forum
65	25/01/2005 18:38		View Forum Index	Ali is viewing the main menu of forum
66	25/01/2005 18:39		Read Forum Topic	Ali is viewing the main menu of forum
67	25/01/2005 18:39		Read Forum Topic	Ali is viewing the main menu of forum
68	25/01/2005 18:41	CA13(8)	Reply the selected topics Topic: Feedback about the best animation software in the market.	Ali is replying specific topics. This is a feedback from Ali about the best animation software at the market. See transcriptions CA13.
69	25/01/2005 19:02	CA14 (9)	Posting New Topics Topics: Opinion about animation and graphics principles.	Ali is posting new topic to the discussion groups. This is an opinion about graphics and animation. See transcriptions CA14
70	25/01/2005 19:03		View Posted Topics	Ali is viewing posted topics
71	25/01/2005 19:04		View Forum Index	Ali is viewing the main menu of forum
72	27/01/2005 05:18	Selecting Discussion Groups	View Forum Index	Ali is viewing the main menu of forum
73	27/01/2005 05:29		Read Forum Topic	Ali is viewing the main menu of forum
74	27/01/2005 05:29		Read Forum Topic	Ali is viewing the main menu of forum
75	27/01/2005 05:30		Read Selected Topics	Ali is reading the specific topic
76	27/01/2005 05:30		Read Selected Topics	Ali is reading the specific topic
77	27/01/2005 05:32	CA34 (10)	Reply Selected Topics Topic: Helping Naz to save the graphic file from internet.	Ali is replying specific topics. This is a feedback from Ali about the guide how to save a file from the website. See transcriptions CA34.
78	27/01/2005 05:32		Read Posted discussions	Ali is reading the replied topic.
79	27/01/2005 05:46	CA15 (11)	Reply Selected Topic. Topic: Query from Dilla about animation software.	Ali is replying selected topics. This is suggestion about the low end animation software. See transcriptions CA15.
81	27/01/2005 05:47		Read Selected Topics	Ali is reading the specific topic
82	27/01/2005 05:47		Read Selected Topics	Ali is reading the specific topic
83	27/01/2005 05:48		Read Forum Topic	Ali is viewing the main menu of forum
84	27/01/2005 05:48		Read Forum Topic	Ali is viewing the main menu of forum
85	27/01/2005 05:48		Read Selected Topics	Ali is reading the specific topic
86	27/01/2005 05:48		Read Selected Topics	Ali is reading the specific topic

87	27/01/2005 05:49	Read Selected Topics	Ali is reading the specific topic
88	27/01/2005 05:49	Read Selected Topics	Ali is reading the specific topic
89	27/01/2005 05:52	Read Forum Topic	Ali is viewing the main menu of forum
90	27/01/2005 05:52	Read Forum Topic	Ali is viewing the main menu of forum
91	27/01/2005 05:53	Read Selected Topics	Ali is reading the specific topic

Appendix C2: Sample of Shah's User Tracking

	Shah	Activity	Actions	Commentary	
1	27/12/2004 14:08	Selecting Course Materials	View Concept Maps	Shah is sending message to the discussion groups Shah is sending message to Private Message Shah is reading the course content Shah is sending message to Helpline Shah is participating in Chat Sessions	
1	27/12/2004 14:10		Read Course Content		
1	27/12/2004 14:13		.....	
1	27/12/2004 14:13		.....	
1	27/12/2004 14:14		Read Course Content		
1	27/12/2004 14:58	Selecting Course Materials	View Concept Maps		
1	27/12/2004 14:58		Read Course Content		
1	27/12/2004 15:01		.....	
1	27/12/2004 15:01		.....	
1	27/12/2004 15:01		.....	
1	27/12/2004 15:02		.....	
1	27/12/2004 15:02		Read Course Content		
2	28/12/2004 18:04	Selecting Course Materials	View Concept Maps		Shah is reading the course content
2	28/12/2004 18:14		Read Course Content		
2	28/12/2004 18:14		Read Course Content		
3	07/01/2005 15:52	Selecting Course Materials	View Concept Maps	Shah is reading the course content	
3	07/01/2005 15:52		Read Course Content		
3	07/01/2005 15:52		.....	
3	07/01/2005 15:53		.....	
3	07/01/2005 15:54		.....	
3	07/01/2005 15:54		.....	
3	07/01/2005 15:54		.....	
3	07/01/2005 15:54		.....	
3	07/01/2005 15:55		.....	
3	07/01/2005 15:55		.....	
3	07/01/2005 15:55		.....	
3	07/01/2005 15:56		.....	
3	07/01/2005 15:57		.....	

3	07/01/2005 15:58		Read Course Content	
3	07/01/2005 15:58		Read Course Content	
4	08/01/2005 14:50	Selecting Private Message	PM:I am confusing with the raster image and vector image. Can we say that vector image generates from the drawing using the computer software ?	Shah is sending message to Private Message
4	08/01/2005 14:51		View Private Message	
4	08/01/2005 14:51		Send Private Message	
4	08/01/2005 14:52		.....
4	08/01/2005 14:52		.....
4	08/01/2005 14:53		.....
4	08/01/2005 14:53		Read Private Message	
4	08/01/2005 14:54		View Private Message	
5	11/01/2005 16:21	Selecting Course Materials	View Concept Maps		Shah is reading message to the discussion groups Shah is reading the course content
5	11/01/2005 16:22		Read Course Content	
5	11/01/2005 16:23		.....
5	11/01/2005 16:25		.....
5	11/01/2005 16:25		.....
5	11/01/2005 16:26		.....
5	11/01/2005 16:26		.....
5	11/01/2005 16:26		.....
5	11/01/2005 16:37		.....
5	11/01/2005 16:38		Read Course Content	
5	11/01/2005 16:38		Read Course Content	
5	11/01/2005 17:36	Selecting Discussion Groups(DGR)	View Forum Index	
5	11/01/2005 17:37		Read Forum Topics	
5	11/01/2005 17:37		.....
5	11/01/2005 17:47		.....
5	11/01/2005 17:48		.....
5	11/01/2005 17:49		.....
5	11/01/2005 17:52		.....
5	11/01/2005 17:55		.....

5	11/01/2005 17:56		
5	11/01/2005 17:58		
5	11/01/2005 18:01		
5	11/01/2005 18:02		Read Forum Topics	
5	11/01/2005 18:02		Read Forum Topics	
6	12/01/2005 16:36	Selecting Discussion Groups(DGR)	View Forum Index	Shah is reading message to the discussion groups
6	12/01/2005 16:36		Read Forum Topics	
6	12/01/2005 16:39		.....
6	12/01/2005 16:40		.....
6	12/01/2005 16:40		.....
6	12/01/2005 16:41		.....
6	12/01/2005 16:41		.....
6	12/01/2005 16:41		.....
6	12/01/2005 16:42		.....
6	12/01/2005 16:42		.....
6	12/01/2005 16:43		.....
6	12/01/2005 16:43		.....
6	12/01/2005 16:43		.....
6	12/01/2005 16:43		.....
6	12/01/2005 16:44		Read Forum Topics	
6	12/01/2005 16:44		Read Forum Topics	
				Shah is reading message to the discussion groups Shah is sending message to Private Message Shah is reading the course content

Appendix C3: Sample of Fabilah User Tracking

No	Date	Activity	Actions	Commentary
1	03/01/2005 14:22	Selecting Course Materials	View course content.	Fabila is reading the course content
1	03/01/2005 14:45		Read Course Content	
1	03/01/2005 14:45		-----	
1	03/01/2005 14:46		-----	
1	03/01/2005 14:47		-----	
1	03/01/2005 14:47		-----	
1	03/01/2005 14:48		-----	
2	07/01/2005 18:14	Selecting Course Materials	View course content.		Fabila is reading the course content Fabila is sending message to the discussion groups
2	07/01/2005 18:16		Read Course Content	
2	07/01/2005 18:17		-----	
2	07/01/2005 18:17		-----	
2	07/01/2005 18:19		-----	
2	07/01/2005 18:19		-----	
2	07/01/2005 18:20		-----	
2	07/01/2005 18:24		-----	
2	07/01/2005 18:26		-----	
2	07/01/2005 18:26		-----	
2	07/01/2005 18:27	Selecting Discussion Groups(DGR)	View Forum Index	
2	07/01/2005 18:27		Read Forum Topics	
2	07/01/2005 18:27		-----	
2	07/01/2005 18:27		-----	
2	07/01/2005 18:27		-----	
2	07/01/2005 18:30		-----	
2	07/01/2005 18:30		-----	
2	07/01/2005 18:31		-----	
2	07/01/2005 18:32		-----	
3	16/01/2005 14:22	Selecting Course Materials	View course content.	Fabila is reading the course content

3	16/01/2005 14:24		Read Course Content	Fabila is sending message to the discussion groups
3	16/01/2005 14:24		-----	
3	16/01/2005 14:28		-----	
3	16/01/2005 14:30		-----	
3	16/01/2005 14:30		-----	
3	16/01/2005 14:33		-----	
3	16/01/2005 14:33		-----	
3	16/01/2005 14:34		-----	
3	16/01/2005 14:36		-----	
3	16/01/2005 14:36		-----	
3	16/01/2005 14:37		-----	
3	16/01/2005 14:37		-----	
3	16/01/2005 14:38		-----	
3	16/01/2005 14:39	Selecting Discussion Groups	DG:Hello! Anybody knows about the references about Photoshop except in this course. Please share with us here.	
3	16/01/2005 14:39		View Forum Index	
3	16/01/2005 14:39		Read Forum Topics	
3	16/01/2005 14:40		-----	
3	16/01/2005 14:40		-----	
3	16/01/2005 14:40		-----	
3	16/01/2005 14:40		-----	
3	16/01/2005 14:44		-----	
3	16/01/2005 14:47		-----	
3	16/01/2005 14:48		-----	
3	16/01/2005 14:49		-----	
3	16/01/2005 14:51		-----	
3	16/01/2005 14:52		-----	
3	16/01/2005 14:53		-----	
3	16/01/2005 14:54		-----	
3	16/01/2005 14:55		-----	
3	16/01/2005 14:55		-----	

4	28/01/2005 13:39	Selecting Discussion Groups(DGR)	View Forum Index
4	28/01/2005 13:40		Read Forum Topics
4	28/01/2005 13:40		-----
4	28/01/2005 13:40		-----
4	28/01/2005 13:41		-----
4	28/01/2005 13:41		-----
4	28/01/2005 13:42		-----
4	28/01/2005 13:42		-----
4	28/01/2005 13:42		-----
4	28/01/2005 13:43		-----
4	28/01/2005 13:44		-----
4	28/01/2005 13:44		-----
4	28/01/2005 13:44		-----
4	28/01/2005 13:44		-----
4	28/01/2005 13:47		-----
4	28/01/2005 13:47		-----
4	28/01/2005 13:48		-----
4	28/01/2005 13:48		-----
4	28/01/2005 13:48		-----
4	28/01/2005 13:50	Selecting Helpline	HL:I got problem when using this system. Errors occur when I go to frontpage.
4	28/01/2005 13:52		View Helpline
4	28/01/2005 13:56		Send message in Helpline
4	28/01/2005 13:56		-----
4	28/01/2005 13:58		-----
5	30/01/2005 11:40	Selecting Discussion Groups	DG:I am searching the book regarding to digital graphics and Photoshop in Malay. Please send private message if you know about this.
5	30/01/2005 11:43		View Forum Index
5	30/01/2005 11:43		Read Forum Topics
5	30/01/2005 11:45		-----
5	30/01/2005 11:46		-----

Fabila is reading message to the discussion groups
 Fabila is sending message to Helpline
 Fabila is reading the course content

Fabila is sending message to the discussion groups

5	30/01/2005 11:47		-----	
5	30/01/2005 11:48		-----	
5	30/01/2005 11:49		-----	
5	30/01/2005 11:52		-----	
5	30/01/2005 11:56		-----	
5	30/01/2005 11:57		-----	
5	30/01/2005 11:58		-----	
5	30/01/2005 11:59		-----	
5	30/01/2005 11:59		-----	
5	30/01/2005 11:59		-----	
5	30/01/2005 12:00		-----	
5	30/01/2005 12:01		-----	
5	30/01/2005 12:02		-----	
5	30/01/2005 12:06		-----	
5	30/01/2005 12:29		-----	
5	30/01/2005 12:29		-----	
5	30/01/2005 12:29		-----	
5	30/01/2005 12:35		-----	
5	30/01/2005 12:36		-----	
5	30/01/2005 12:36		-----	
5	30/01/2005 12:36		-----	
5	31/01/2005 13:27	Selecting Course Materials	View course content.	Fabila is reading the course content
5	31/01/2005 13:28		Read Course Content	Fabila is sending message to the helpline
5	31/01/2005 13:29		-----	
5	31/01/2005 13:29		-----	
5	31/01/2005 13:29		-----	
5	31/01/2005 13:32		-----	
5	31/01/2005 13:33		-----	
5	31/01/2005 13:33		-----	
5	31/01/2005 13:34		-----	
5	31/01/2005 13:35		-----	
5	31/01/2005 13:35		-----	

5	31/01/2005 13:36		-----	
5	31/01/2005 13:37		-----	
5	31/01/2005 13:38		-----	
5	31/01/2005 13:39	Selecting Helpline	HL:Please help me. I am having difficulties in creating text in my graphics. I see the tools and try it but the text not appeared.	
5	31/01/2005 13:42		View Helpline	
5	31/01/2005 13:44		Send message in Helpline	
5	31/01/2005 13:44		-----	
5	31/01/2005 14:00		-----	
5	31/01/2005 14:00		-----	
5	31/01/2005 14:03		-----	
7	01/02/2005 17:35	Selecting Discussion Groups	DG:I am a little bit confusing about the course activity. Why related with animation. This is two different topics. Anyway, anybody who knows the answer please send me private message. (Smile emotion)	Fabila is reading the course content Fabila is sending message to the discusion groups Fabila is sending message to Private Message

Appendix C4: Sample of Naz's User Tracking

	Naz	Activity	Actions	Commentary	
1	28/12/2004 10:42	Selecting Course Materials	View course content.	Naz is reading the course content	
1	28/12/2004 10:42		Read Course Content		
2	29/12/2004 17:32	Selecting Course Materials	View course content.	Naz is reading the course content	
2	29/12/2004 17:33		Read Course Content		
3	02/01/2005 14:08	Selecting Course Materials	View course content.	Naz is reading the course content	
3	02/01/2005 14:10		Read Course Content		
3	02/01/2005 14:13		-----		
3	02/01/2005 14:13		-----		
3	02/01/2005 14:14		-----		
3	02/01/2005 14:14		-----		
4	05/01/2005 18:14	Selecting Course Materials	View course content.	Naz is reading the course content	
4	05/01/2005 18:14		Read Course Content		
4	05/01/2005 18:14		-----		
5	11/01/2005 16:21	Selecting Course Materials	View course content.	Naz is reading the course content	
5	11/01/2005 16:22		Read Course Content		
5	11/01/2005 16:23		-----		
5	11/01/2005 16:25		-----		
5	11/01/2005 16:25		-----		
5	11/01/2005 16:26		-----		
5	11/01/2005 16:26		-----		
5	11/01/2005 16:37		-----		
5	11/01/2005 16:38		-----		
5	11/01/2005 16:38		-----		
6	12/01/2005 17:36	Selecting Course Materials	View course content.		Naz is reading the course content
6	12/01/2005 17:36		Read Course Content		
6	12/01/2005 17:39		-----		
6	12/01/2005 17:40		-----		
6	12/01/2005 17:40		-----		
6	12/01/2005 17:41		-----		
6	12/01/2005 17:41		-----		

6	12/01/2005 17:41		-----	
6	12/01/2005 17:42		-----	
6	12/01/2005 17:42		-----	
6	12/01/2005 17:43		-----	
6	12/01/2005 17:43		-----	
6	12/01/2005 17:43		-----	
6	12/01/2005 17:43		-----	
6	12/01/2005 17:44		-----	
6	12/01/2005 17:44		-----	
7	13/01/2005 17:51	Selecting Course Materials	View course content.	Naz is reading the course content
7	13/01/2005 17:51		Read Course Content	
7	13/01/2005 17:52		-----	
7	13/01/2005 17:52		-----	
7	13/01/2005 17:53		-----	
7	13/01/2005 17:54		-----	
7	13/01/2005 17:56		-----	
7	13/01/2005 17:56		-----	
8	15/01/2005 18:36	Selecting Course Materials	View course content.	Naz is reading the course content
8	15/01/2005 18:43		Read Course Content	
8	15/01/2005 18:44		-----	
8	15/01/2005 18:45		-----	
8	15/01/2005 18:45		-----	
9	17/01/2005 09:21	Selecting Course Materials	View course content.	Naz is reading the course content
9	17/01/2005 09:24		Read Course Content	
9	17/01/2005 09:25		-----	
9	17/01/2005 09:41		-----	
10	18/01/2005 17:59	Selecting Chat Sessions	CS3 Naz :Anybody knows about what software is good for graphics? Ali : Yes... I am using Adobe Photoshop 5.5. It very easy and simple. Naz : where can I get the copy?	Naz is participating in chat sessions.

10	18/01/2005 18:35	Selecting Course Materials	View course content.	Naz is reading the course content
10	18/01/2005 18:40		Read Course Content	
11	19/01/2005 10:33	Selecting Course Materials	View course content.	Naz is reading the course content
11	19/01/2005 10:34		Read Course Content	
11	19/01/2005 10:34		-----	
11	19/01/2005 10:34		-----	
11	19/01/2005 10:35		-----	
11	19/01/2005 10:35		-----	
11	19/01/2005 10:35		-----	
11	19/01/2005 10:35		-----	
11	19/01/2005 10:36		-----	
11	19/01/2005 10:36		-----	
11	19/01/2005 10:37		-----	
11	19/01/2005 10:38		-----	
11	19/01/2005 10:38		-----	
11	19/01/2005 10:40		-----	
11	19/01/2005 10:42		-----	
11	19/01/2005 10:42		-----	
11	19/01/2005 10:43		-----	
11	19/01/2005 10:43		-----	
11	19/01/2005 10:44		-----	
11	19/01/2005 10:44		-----	
11	19/01/2005 10:46		-----	
11	19/01/2005 10:46		-----	
11	19/01/2005 10:47		-----	
11	19/01/2005 10:47		-----	
11	19/01/2005 10:48		-----	
11	19/01/2005 10:49		-----	
11	19/01/2005 10:50		-----	
11	19/01/2005 10:51		-----	
11	19/01/2005 10:52		-----	

11	19/01/2005 10:52		-----	
11	19/01/2005 10:53		-----	
11	19/01/2005 10:57		-----	
11	19/01/2005 10:58		-----	
11	19/01/2005 10:58		-----	
11	19/01/2005 10:58		-----	
11	19/01/2005 11:00		-----	
11	19/01/2005 11:02		-----	
11	19/01/2005 11:03		-----	
12	20/01/2005 11:40	Selecting Discussion Groups	DG : Where can I get the installation of Photoshop?	Naz is sending message to the discussion groups
12	20/01/2005 11:41		View Forum Index	
12	20/01/2005 11:42		Read Forum Topics	
12	20/01/2005 11:43		-----	
12	20/01/2005 11:45		-----	
12	20/01/2005 11:46		-----	
12	20/01/2005 11:50		-----	
12	20/01/2005 11:52	Selecting Private Message	PM:I really need to know how to start using Photoshop. I have no idea about it.	
12	20/01/2005 11:54		-----	
13	21/01/2005 12:21	Selecting Course Materials	View course content.	Naz is reading the course content
13	21/01/2005 12:22		Read Course Content	Naz is sending message to the discussion groups
13	21/01/2005 12:22		-----	
13	21/01/2005 12:23		-----	
13	21/01/2005 12:24		-----	
34	15/03/2005 18:25			