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The sensitivity of adaptive systems to users' context

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The sensitivity of adaptive systems to users' context

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CERTIFICATION

I, Wannapa Suratmethakul, declare that this thesis, submitted in fulfillment of the requirements for the award of Honours Master of Information systems, in the School of Economics and Information Systems, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Wannapa Suratmethakul

30 July 2002

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Abstract

The belief that computer systems should be more sensitive to users, and their context, and hence reduce the many frustrations of using these systems, is a matter of concern. The Lumiere Project, which was established at Microsoft research to address this concern, provides the background to the current research. The Lumiere Project developed User Models based on Bayesian Reasoning. The researchers of the Lumiere Project claimed that Bayesian User Models are able to infer users' needs and goals by capturing users' activities and users' queries. A system based on these models, therefore, should provide automated services at the right time when users are frustrated and need assistance from the system. Furthermore, users should be able to use common words in their queries to ask for help from the system.

The current research is an exploratory study that aims to explore the effectiveness of computer systems that are sensitive to users' context. This research uses an interpretive qualitative approach to analyse data collected using laboratory experiments. These involved Usability Testing, questionnaires, and interviews. The system, chosen to be tested, is the Help incorporated in the popular Microsoft Office 2000 products. This Help System implements the User Model developed in the Lumiere Project.

The results indicate that adaptive systems have limited ability to support users' goals and needs. Users will frequently ignore assistance offered by the system and can rarely find useful assistance when they seek it. Furthermore, users have difficulty using common words in help queries because the system misunderstands the words being used in the query. The research also found that some characteristics of users appear to have an influence on the effectiveness of adaptive systems. Expert users, in particular, prefer to explore menus and toolbars on their own rather than ask for assistance from the system.

Future research should involve more study on how aspects of a user's language and user's characteristics can affect the effectiveness of computer systems. Moreover, it would be interesting to study in more depth the definition of context in order to determine how a broader view of context influences adaptive systems

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Chapter 1

Introduction

1.1 Background

The computer has become a part of our everyday lives. It can be seen everywhere: at work, at home, in schools and Universities. People require computer systems which are able to understand what they require in order to accomplish their goals appropriately. There is a belief that, to increase their effectiveness, computer systems should be able to adapt to, and learn from, the situation and user's capabilities. The concept of situation and user capabilities can be expressed in another term that is "context". Context is an environment between the computer and the user and includes place, time, user personality and user experience.

> *"Many of the frustrations of today's software - cryptic error messages, tedious procedures, and brittle behaviour - are often due to the program taking actions that may be right given the software's assumptions, but wrong for the user's actual context. The only way out is to have the software know more about, and be more sensitive to, context".* (Lieberman and Selker, 2000, p.617)

However, the ability of computer systems to be sensitive to context is a matter of concern. The mere provision of more efficient software and the design of excellent

user interfaces do not mean that efficiency of work, and satisfaction of users, are increased. A mode of interaction with the system may be suitable for users in one situation but not for another situation. If a user's mode of interaction is inappropriate, the system interface will become very conspicuous and annoying to them (Lieberman & Selker, 2000). The current research will look for elements of a user's context that appear to be important for effective adaptive systems.

In order to address this concern, Horvitz and his team members at Microsoft Research established the Lumiere project. This project aimed to develop user models to capture users' goals and needs by observing users' behaviour to provide automated assistance to users. The study focused on Bayesian user modelling, an approach that employs probability distributions to infer uncertain relationships. This project produced a Bayesian user model that was embedded in a software application, Microsoft Office'97 and subsequently Office 2000. The aim of this model is to capture the uncertain relationship between the user's goals and needs by observing background, actions, and user queries, while he/ she is using the software application, and this also provides automated assistance to the user. This assistance is provided when the model detects that users appear to be frustrated using the software, for example, repeat of the same ineffective action or pausing for an extensive time. This user model aims to make the system more sensitive to context. It offers assistance automatically to the user when it infers that the user needs assistance, by analysing the user's previous and current actions. It also attempts to provide assistance in response to a query made by the user (Horvitz, et al, 1998) and through an online Help System.

The results of the Lumiere project have been implemented in the Microsoft Office 2000 suite of applications, as the "Office Assistant" agent and associated online help. This package is currently used by all types and categories of users and so is a tool that should demonstrate the practical application of the results of the Lumiere project.

Questions arise as to whether the system does provide appropriate assistance at the correct time when the user really needs that action to accomplish their goal. As the Microsoft Office products are widely used, they provide an ideal opportunity to investigate how a computer application may be able to understand and adapt to the context of the user.

1.2 Research question and objective

This current research is an exploratory study. The aim of the research is to explore the effectiveness of computer systems that are sensitive to the users' context. It is based on, and inspired by, the Lumiere project. Therefore, this research focuses on an existing adaptive system, which was developed from the results of the Lumiere project. The Lumiere project is the basis of the help system in the software product most widely used by the broad spectrum of computer users: Microsoft Office 2000.

The research questions and objectives are stated as follows:

The research questions:

- In what ways are adaptive systems able to understand users' context?
- How can adaptive systems support different users' context in the accomplishment of their various goals?
- Which characteristics of users are likely to have an influence on the effectiveness of adaptive systems?

The research objectives:

- To investigate the most widely used existing adaptive system.
- To evaluate the effectiveness of that adaptive system in assisting the real context of users.
- To describe characteristics of users that appear to affect the effectiveness of adaptive systems.
- To gain an understanding of the limitations of adaptive systems that aim to respond to the requirement of users.

1.3 Overview of the research

As the current research is an exploratory study, it was conducted as follows:

- Literature Review for the research: The Literature Review begins with an examination of adaptive software systems. Then follows an analysis of the Lumiere project, which is the background study for this research, where a

Bayesian user modelling approach was employed to explain how a system could become more sensitive to context. Usability Testing techniques are then explored, followed by a review of literature on characteristics of users influencing their performance when interacting with adaptive computer systems.

- Methodologies of the research: In order to meet the objectives of the research, the methods used in the research are:
    1. *Laboratory experiments*: Usability Testing was used to evaluate the adaptive system with subjects working on typical tasks. The chosen system for this research is Microsoft Office 2000, to implement the model resulting from the Lumiere Project.
    2. *Questionnaires*: There are two kinds of questionnaires used in the research. There is a pre-test questionnaire and a post-test questionnaire to gather information from subjects who participate in the Usability tests.
    3. *Interviews*: An interview was conducted with each subject at the conclusion of the Usability test. This instrument was useful to collect opinions from subjects about the system which was tested.

- Data collection and analysis: This research is an exploratory study and relies heavily on qualitative data analysis. Following the Data Collection stage, the three components of data analysis, according to Miles and Huberman (1994), are Data Reduction, Data Displays, and Conclusion drawing/Verification

(p.10). The Miles and Huberman process is followed in this current research as follows.

In the stage of Data Collection, the activities of each subject during the usability testing were observed and recorded on videotape. Data was also collected from pre-test questionnaires, post-test questionnaires, interviews, and observations.

At the Data Reduction stage, the structured data, where appropriate, was summarised in tables. In addition, the data collected in the form of videotapes and notes of observations were reduced and interpreted in the light of the research questions. This resulted in a series of vignettes, which are then used in the stage of Data Display.

In the final stage of the data analysis, these vignettes were interpreted and integrated to identify elements that related to the research objectives.

- Discussion and conclusion: Issues emerging from the interpretation of the vignettes is then discussed to explain and support the research objectives as well as to provide answers to the research questions. Furthermore, the conclusion also includes a description of the limitations of the research and suggestions for future research on this topic.

This research is used as: 1) an interpretive, qualitative approach to integrate the collected data, 2) to critically evaluate the Lumiere project and 3) to satisfy the stated objectives of the current research.

1.4 The structure of the Thesis

This thesis is organised as follows in order to answer the research questions and to meet the research objectives.

Chapter 2 summarises the relevant literature concerning the main topics of the research. These main topics are Adaptive Software Systems, the Lumiere Project, and the process of Usability Testing, which is used as the experimental technique of the research, as well as the characteristics of users.

Chapter 3 describes the methods and procedure of the research. Laboratory experiments based on Usability Testing, questionnaires and interviews are being used as research methods.

Chapter 4 presents the analysis of the collected data from observations, questionnaires and interviews.

Chapter 5 presents the conclusions of the research and discusses the limitations of the research, as well as suggestions for future research.

1.5 Chapter conclusion

This chapter has described the background, the research question and objective. An overview of the research has been presented to clarify the scope of the research in order to meet the research objectives. It included the arrangement of the remaining chapters in this thesis. The next chapter provides a description of the literature which forms the basis of the research.

Chapter 2

Literature Review

2.1 Introduction

As described in Chapter 1, this research is an exploratory study. It is derived from the Lumiere project which aims to provide an understanding of how systems which are sensitive to context might work and to explore the effectiveness of a system that implements the outcome of the Lumiere project.

This chapter contains a review of literature relevant to the research. It presents details about:

- Adaptive Software Systems.
- The Lumiere project, which forms the basis of the research.
- Usability testing, which is the experimental technique of the research.
- Characteristics of users.

2.2 Adaptive Software Systems

The impact of computer systems on the general population has grown rapidly since the widespread availability and affordability of the personal computer (PC) that occurred in the early 1980's. As more and more people from a variety of

backgrounds came to use the PC, it became apparent that there was a sizeable gap between the design of software systems that ran on the PC and the expectations and skills of the user base. Early research in the field of human-computer interaction (such as Norman 1988) recognised that simply training people to adapt to systems with poorly designed user interfaces was not the solution. What was important was to design and implement usable systems in order to meet users' requirements in order to assist them to accomplish their goals. Each user has changing individual needs, preferences, expertise, and knowledge in using computer systems so that concept of adaptive software systems was appealing.

One of the early attempts at research into adaptive software systems was in the mid 1980's, when Carroll and Carrithers (1984) proposed a Training Wheels approach to help novice computer users learn to use a commercial word processor. They argued that novice users experienced frustration and confusion resulting in errors while using the word processing software because it provided the same interface for every user. The interface, designed for expert users, provided menus with the complete range of options for every user. The Training Wheels interface provided a minimal set of functions by blocking some components that were not typically used by novice users. This was shown to reduce their errors and facilitate their understanding of the system. As the users' expertise increased, they could be given access to a greater range of functions. There was some debate as to whether the user or the system should control this change and as to how the user would respond to changes in the interface controlled by the system.

Although, the Training Wheels interface was not used in a commercial product, the concept of adaptive systems remains in order to study ways to meet the requirements of a wide variety of users. As Kules (2000) suggests, adaptive systems,

> *"monitor the user's activity pattern and automatically adjust the interface or content provided by the system to accommodate such user differences as well as changes in user skills, knowledge and preferences. Adaptable systems allow the user to control these adjustments, often providing guidance or specialized help to the user."*

Today's computer systems have become smarter and more intelligent software agents. Implementation of digital devices provides services to a wide variety of users. Modern adaptive systems are different from the Training Wheels systems keeping the complete system instead of removing or blocking the functions as in the Training Wheels systems. Generally, the approach of current adaptive systems is provided in a stilted form of the intelligent help system. The adaptivity of these systems depends on a user model, which comprises information about the user, therefore, it is able to determine the user's task requirements. (Kules, 2000)

The UM97 Reader's Guide (1997) presents a sample of user model elements and analysis techniques in order to support particular applications as follows:

Typical attributes maintained in the user model are:

- *User preferences, interests, attitudes and goals*
- *Proficiencies (eg., Task domain knowledge, proficiency with system)*

- *Interaction history (eg., Interface features used, tasks performed/in progress, goals attempted/ achieved, number of requests for help)*
- *User classification (stereotype)*

Inputs to the user model are:

- *Explicit preferences, goals from questionnaires*
- *Explicit personal characteristics (eg., job title, level of education)*
- *Self assessments*
- *Specific actions*
- *Vision and gaze tracking*

Techniques for constructing the user model, and analysing a user profile and deriving new facts are:

- *Bayesian (probabilistic)*
- *Logic-based (eg., inference techniques or algorithms)*
- *Machine learning techniques (eg., neural networks)*
- *Stereotype-based*
- *Inference rules*

(as cited in Kules, 2000)

The Lumiere project is one example of using the Bayesian technique to create a user model for an adaptive computer system. The model serves as the basis of the Help system and the Office Assistant (see Appendix F) in the software product Microsoft Office 2000 (Horvitz, et al., 1998). The current research uses the Lumiere project as the background study as explained in the following section.

2.3 The Lumiere project

The Lumiere project is used as the background for this research. It is the basis of the help system in the software product most widely used by the variety of computer users across the world. It was introduced in 1993 at Microsoft Research Redmond, WA to develop methods and a software architecture that were able to provide reasons regarding the goals and needs of users when they work with software (Hedberg, 1998).

The heart of the Lumiere project is *Bayesian user modelling*. Horvitz, et al. (1998) explain that the project concentrated on inferring probability and utility to offer assistance to software users by observing user's behaviour. Bayesian user modelling can infer user's goals and needs by capturing the user's background, user's actions, and user's queries. The model represents the uncertain relationships and dependencies between variables, including probabilities, amongst the goals and needs of a user. It is useful for diagnosing a user's needs as well as providing a basis for constructing new kinds of services and applications in software. Horvitz and his team members performed studies with human subjects in order to understand the needs and behaviour of users when users face problems with the use of a software application. They explained and identified a set of distinctions by observing the users' action such as repeat searching from multiple menus, attempts to return to the previous state, and pausing after each activity. These distinctions are useful evidence for making conclusions about a user's goals and needs. These lead to the construction of Bayesian user models.

As Horvitz and his team members pointed out, the significance of the Bayesian user model is that it has the potential to identify user goals and needs through observation and also provides automated assistance to the software user. This assistance could be offered to a user when he/ she is frustrated using the software. In their opinion, the model could be used to present useful assistance at the right time by balancing the benefits and costs before taking autonomous action to aid the user. It is expected that the user would welcome the assistance from the system.

Heckerman & Horvitz (1998) describe further that when users make explicit requests for assistance from a system, they are able to describe software functionality with common words and phrases, which the users understand, in their queries. This is a useful way to communicate with the system and explain the user's goals. After analysing the words in the queries, the system will provide a return list of the top five help topics that relate to the user needs. The Lumiere project was established to test this in the real world by embedding the models in an implementation of Office '97 (Horvitz, et al, 1998). This approach aims to enhance the efficiency of the software by helping users complete their goals, as described above.

The question then arose as to how the system would understand the right time to offer autonomous assistance to users. This offer of help may distract users while they are completing their tasks because they may not welcome assistance from the system at that time. Additionally, even if the user explicitly requests assistance, the system may provide unrelated help topics to users because of misunderstanding the words

being used in the query. As a result, the users may be distracted from their activities and this will increase the difficulty of using of the software.

2.3.1 Bayesian user modelling

As mentioned above, Bayesian user modelling is the heart of the Lumiere project. This model is employed in the "Office Assistant" and the online help system application being used in the experiments of the current project. While a full discussion of Bayesian theory is beyond the scope of this research, it is important to point out that Bayesian theory can manage the contingencies, probabilities and uncertainties in many situations (Hedberg, 1998).

The Bayesian user model constructed in the Lumiere project will be critically examined for its relevance in light of the results of the experiments as to how adaptive systems can work. The model attempts to capture the uncertain relationship, between the systems functionality and the user's goals and needs by considering user's activity, the user's background, and words in a user's query while the user is using the software. (Horvitz, et al., 1998)

This model contains relationships and dependencies between variables. Horvitz, Breese, Heckerman, Hovel, and Rommelse (1998) explain that Bayesian models are able to make inferences about a user's needs and goals and offer ideal actions based on *probability distributions* over the goals. The user's *goals* and *needs* are considered in order to provide autonomous action to assist them. Goals are known as target tasks

at the focus of a user's attention and needs are information or automated actions that will reduce the time or effort required to achieve the goals.

2.3.1.1Autonomous assistance

The influence diagram Figure 2.1 shows how a user's acute needs are influenced by the user's goals, the competency of the user when using the system and the user's task history. Prior assistance, in the form of online help, and the user's background and experience with the system influence the competency of the user. The diagram shows how a user's needs directly influence a user's activity, such as the user interacting with a mouse or keyboard. The set of active documents, the presence of data structures and the user's activity are influenced by the user's goals. At any time, a user may explicitly request assistance. This is also influenced by the user's needs and will appear in the form of a user's query (Horvitz, et al., 1998).

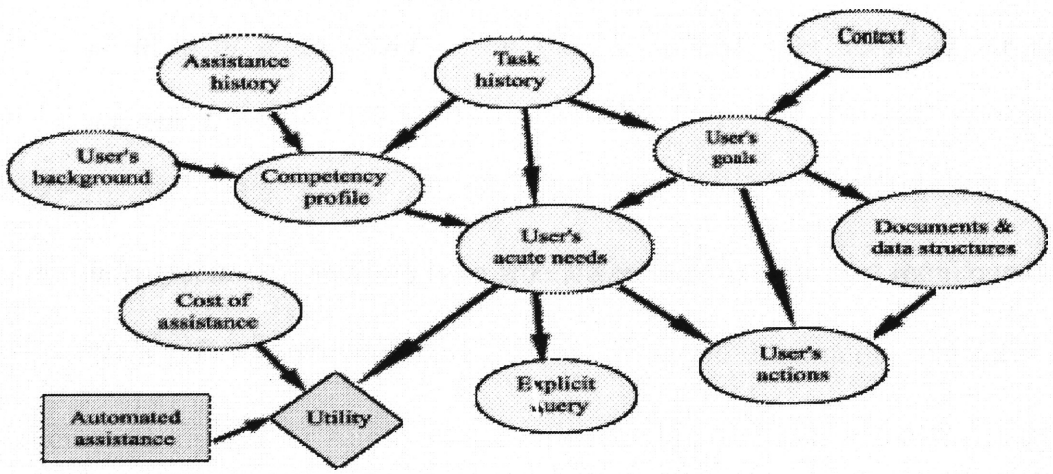

Figure 2.1: An influence diagram for providing intelligent assistance (Horvitz, et al., 1998,figure 1, p.257).

The overall purpose of this diagram is to provide automated assistance to optimise the user's expected utility. To do this, the system needs to balance the benefits and costs of the actions before offering such actions (Horvitz, et al., 1998). "*The value of actions depend on the nature of the action. the cost of action, and the user's needs*" (Horvitz, et al., 1998, p. 257).

Observing the user's activities identifies the classes of evident distinctions. These classes of evidence are useful for making inferences about the user's problems as well as making an evaluation of the user's need for assistance. The classes are:

- *Search: Repetitive, scanning patterns associated with attempts to search for or access an item or functionality. Such distinctions include observation of the user exploring multiple menus, scrolling through text, and mousing over and clicking on multiple non-active regions.*

- *Focus of attention: Selection and/ or dwelling on graphical objects, dwelling on portions of a document or on specific subtext after scrolling through the document.*

- *Introspection: A sudden pause after a period of activity or a significant slowing of the rate of interaction.*

- *Undesired effects: Attempts to return to a prior state after an action. These observations include undoing the effect of recent action, including issuing an*

undo command, closing a dialog box shortly after it is opened without invocating an operation offered in the context of the dialog.

- *Inefficient command sequences: User performing operations that could be done more simply or efficiently via an alternate sequence of actions or through easily accessible shortcuts.*

- *Domain-specific syntactic and semantic content: Consideration of special distinctions in content of structure of documents and how user interacts with these features. These include domain-specific features associated with the task.*

(Horvitz, et al., 1998, p.258)

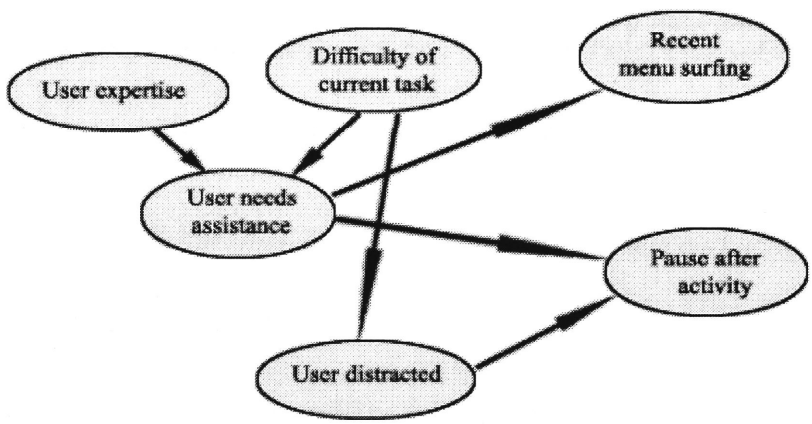

Figure 2.2: A portion of a Bayesian user model for inferring the likelihood that a user needs assistance, considering profile information as well as observations of recent activity (Horvitz, et al., 1998, figure 2, p.259).

Figure 2.2 presents a small Bayesian user model to define appropriate variables and the state of variables in order to build a more effective user model. It is focused on clearly defining the specific quantity of time described to be a *Pause after activity*

(Horvitz, et al., 1998). Once defined, the system can then detect a *Pause after activity* and use this as the trigger to offer help.

The set of relationships in the diagram represents the dependency between a pause after activity and the likelihood that a user would need assistance. User expertise and the difficulty of the task also influence the state of the *User needs assistance component*. The state of desiring assistance may be detected from a recent search through multiple menus or when the user pauses the activity. However, a user will also pause his/ her activities if he/she is distracted by other events unrelated to the user's task. Sometimes the difficulty of a task also directly influences the *User distracted* component and causes Pause after activity (Horvitz, et al., 1998). So, although the system can detect the pause, it cannot detect its cause or context, which may be significant in determining whether help is needed.

2.3.1.2 Explicit request for help

The words in a user's query when asking for help were also highlighted as an important issue. When people face problems using the software, they do not use technical terms to ask for help. They describe the problems or unfamiliar software functions with common words they understand in an attempt to communicate with the system.

Heckerman and Horvitz (1998) explained that a Bayesian network is employed to understand and interpret queries written by software users in an attempt to explain

unfamiliar ideas and concepts in order to search for information to assist in achieving their goals with the software. The Bayesian approach models the relationship between words in a user's queries and a user's informational goals. Its approach to inferring the users' goals and needs centres on the structure of probabilistic knowledge bases for elucidating user queries.

A Bayesian term-spotting methodology was introduced to infer and assess a user's goal from the user's query in order to construct knowledge bases, which will provide an appropriate help topic. This allows users to ask for assistance by typing natural free-text in their queries (Heckerman, & Horvitz, 1998). Terms in the query, are considered in conditions as follows:

- *Root forms of words*: To reduce the number of terms when users make queries root forms are used as input for finding an appropriate help topic. For example, the words "printing", "printed", "print" were reduced to the basic root "print". (Heckerman, & Horvitz, 1998, p.232)

- *Leak term:* Of all the terms that are present in the query for each user's goal, it must be determined whether these terms precisely link to the goal or not as displayed in Figure 2.3. Heckerman and Horvitz (1998, p.233) expressed four possible outcomes for each help topic and term in the knowledge base as follows:

    1. *A user goal has links to a term that is not in the query.*
    2. *A user goal has links to a term that is in the query.*

3. *A user goal does not have links to a term that is in a query.*

4. *A user goal does not have links to a term that is not in the query.*

(Heckerman & Horvitz, 1998, p. 233)

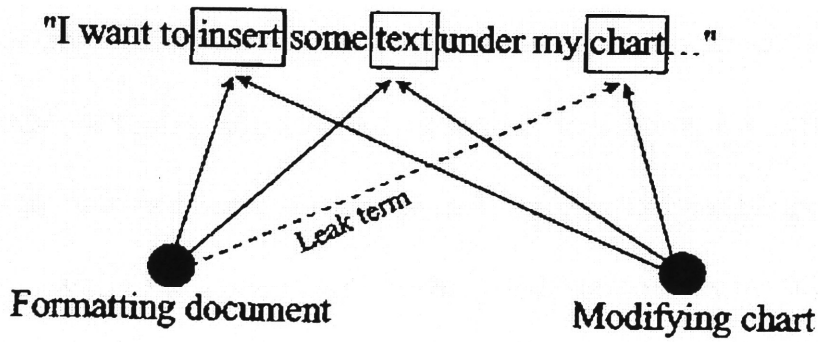

Figure 2.3: At run time, terms in the knowledge base are spotted. Leak terms are used for the probability of words in the knowledge base being seen, conditioned on help topics that are not directly linked to the term (Heckerman & Horvitz, 1998, figure 5, p.233).

- *Additional abstraction of terms:* This is provided to minimize the number of assessments and links by developing a *Metanym.* It includes phrases that indicate the same basic concept similar to the concepts of synonyms. For instance, the terms "*delete*", "*remove*", "*kill*", "*get rid of*", "*lose*", and "*erase*" may be used to explain the same basic meaning. Therefore, metanym would just refer to the concept of "*deleting*" to reduce the number of links and assessments (Heckerman & Horvitz, 1998, p.233).

- *Modelling language about existing and desired states:* Interpreting a user's query by distinguishing existing and desired objects or states, the Bayesian approach was developed to model terms used in the sense of the definite and

the indefinite. It detects the type and number of functional words such as articles, conjunctions, prepositions, and possessives. Evidence is provided by the functional words to infer the probability that objects are being referred to in the existing state. This can improve the performance of the system to provide appropriate help topics related to the creation of new objects in order to modify existing objects. As describes in Figure 2.4, after a query is analysed, the functional words "some" implies non-existence of the object "rows". While the preposition "under" and the possessive "my" indicate an existing object "chart" (Heckerman & Horvitz, 1998, p.234).

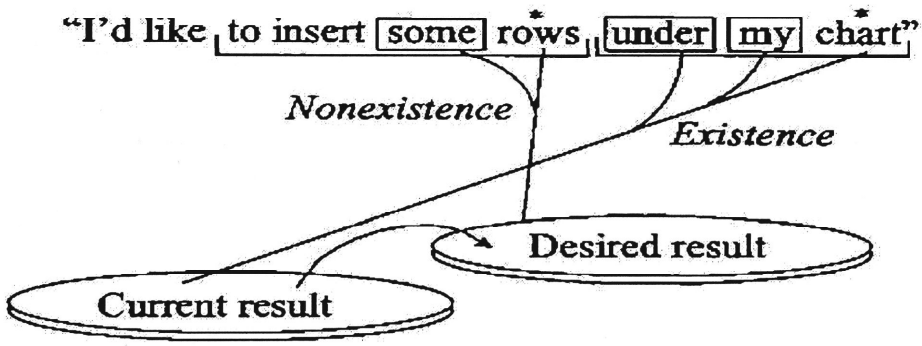

Figure 2.4: A Bayesian approach to considering indefiniteness in queries for assistance. We identify clauses and compute the probability of indefinite usage of terms based on adjacent function words (Heckerman & Horvitz, 1998, figure 6, p.234).

- *Disambiguating noun and verb usages:* In English, there are many words that can be used as nouns and verbs. It depends on the structure of the phrase or sentence. Heckerman and Horvitz (1998, p.235) gave an example that *Consider the "print" appearing in the phrase "How do I print this? (Verb form) or the phrase "How can I make this print darker? (Noun form).* To enhance the

accuracy of the Bayesian term – spotting, consideration of the probability and links of the noun form of words and the verb form of words are separated. (Heckerman & Horvitz, 1998, p.235).

After the system analyses the words in the queries, as described above, it will provide a return list of the top five help topics to users (Heckerman & Horvitz, 1998, p.235).

2.3.1.3 Overall architecture

The Bayesian user models in Figure 2.1 and 2.2 can be briefly explained in the overall architecture in Figure 2.5. Bayesian user models are employed as the basis of the application, which is called "the Office Assistant" in Microsoft Office 2000 (see Appendix F).

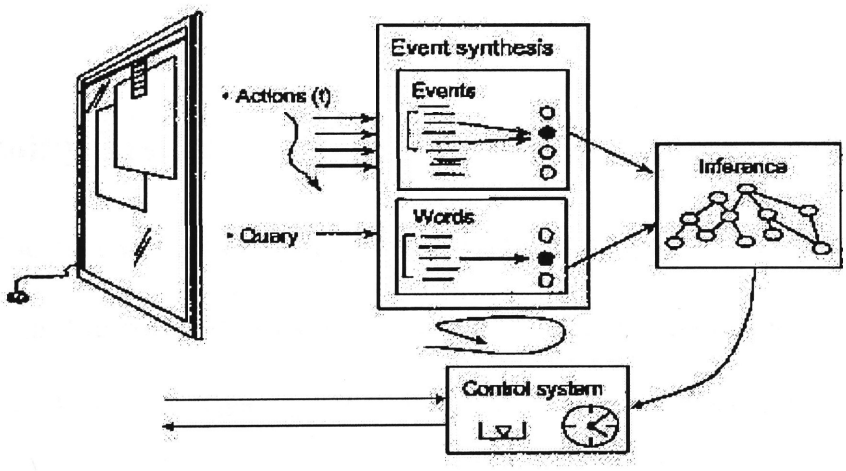

Figure 2.5: A high-level view of the architecture of Lumiere/Excel. Events are transformed into observations represented in the Bayesian model. A control system works to periodically analyse an event queue and perform inference on findings. (Horvitz, et al., 1998, figure 6, p.261)

Events from the interface are converted into time-stamped observations to be analyzed and then input to a Bayesian model. As described in section 2.3.1.1 and 2.3.1.2, the system observes the user's activities to identify the classes of evidential distinctions. These classes are useful for making inferences about the user's problems as well as making an evaluation of the user's need for assistance. A user's activity that provides evidence of the need for help are, for example, searching repeatedly, pause after activity, and return to a prior state after activity. The model infers a probability distribution over user needs. After interpreting the user's activity, the system infers the likelihood that a user needs assistance at the present time as well as reasoning about the probability distribution over user problems. This probability is used to control the autonomous display of assistance. Alternatively, if a query is made, the Bayesian term-spotting approach and the posterior probabilities from the event synthesis are integrated. Then the help topics are provided to the user, if the result of the query is available. (Horvitz, et al., 1998)

2.4 Usability Testing

To meet the research objectives, as addressed in chapter 1, laboratory experiments were used as the methodology for this research. The experiments are based on the technique of Usability Testing. The aim of Usability Testing is to evaluate whether or not a system provides efficient performance to meet the requirements of users.

2.4.1 Definition of usability

Usability of computer systems, according to Shackel (1991), can be defined as "*the capability in human functional terms to be used easily and effectively by the specified range*

of users, given specified training and user support, to fulfil the specified range of tasks, with the specified range of environmental scenarios"(as cited in Lingaard, 1994, p.19). Preece, et al.(1994) also propose that "*Usability, a key concept in HCI, is concerned with making systems easy to learn and easy to use*"(p.14). Lindgaard (1994) has suggested "*Usability is related to human performance in the specific tasks supported by the computer system and to the user's attitude towards the system...*"(p.21).

Usability can be categorised and reviewed in the literature as five attributes which are:

1. Learnability (Lindgaard, 1994; Nielsen, 1993; Preece et al., 1994; Rubin, 1994)
2. Effectiveness (Lindgaard, 1994; Rubin, 1994)
3. Memorability (Nielsen, 1993)
4. Flexibility (Lindgaard, 1994; Preece et al. 1994)
5. Satisfaction or Attitude (Lindgaard, 1994; Nielsen, 1993; Preece et al., 1994; Rubin, 1994)

Learnability: "*The system should be easy to learn so that the user can rapidly start getting some work done with the system*" (Nielsen, 1993, p.26).

Effectiveness: "*Effectiveness refers to levels of user performance, measured in terms of speed and/or accuracy, in terms of proportion of task(s), proportion of users, or probability of completion of a given task*" (Lindgaard, 1994, p. 29).

Memorability: "*The system should be easy to remember, so that the casual user is able to return to the system after some period of not having used it, without having to learn everything all over again*" (Nielsen, 1993, p.26).

Flexibility: "The extent to which the system can accommodate changes to the tasks and environments beyond those first specified" (Preece, et al., 1994, p.401).

Satisfaction: "*The system should be pleasant to use, so that users are subjectively satisfied when using it; they like it*" (Nielsen, 1993, p.26).

2.4.2Usability testing

Nielsen (1993) states that Usability Testing is the principle method to provide information on how users employ computers and the problems they have when using the computers (p. 165).

Ferre et al. (2001) state that "*the term usability testing describes the activity of performing usability tests in a laboratory with a group of users and recording the results for further analysis*"(p.27).

There are many different purposes of conducting usability testing. It might be to improve and develop existing software product or to ascertain the problems users have when running a system. An accurate analysis of usability, including using appropriate methods and tools to gather information, is important in order to improve an existing system or a further version of a system. Furthermore, this method is employed in business to compare the usability of several systems before making a

decision to buy or use one of these systems (Lindgaard, 1994, p. 24). Lindgaard (1994) suggests "*whatever the reason for, or purpose of, a usability study or evaluation may be, it must be clear what is done, why it is done and what might be gained from it*". (p.24)

The aims of the current research are to investigate and evaluate the effectiveness of an existing adaptive system, to describe characteristics of real users and to understand the limitations of an existing adaptive system in helping in the real context of users, as stated in chapter 1. To meet these aims, this research employed laboratory experiments, using usability testing, as a method.

Lindgaard (1994) proposes that a laboratory experiment is " *a tool which allows a thorough and systematic investigation of a well-defined, specified and detailed research question, pursued in a rigorous fashion under well-controlled conditions.*" And it is not "*a data-gathering tool for addressing global and general issues in broad terms. Nor is it a means by which to 'prove' that something is 'right' or 'best'.*" (p.187)

There are six stages of conducting a usability test, which are:

- *Developing the test plan*: It is a basic element of the test. It contains details and a reason for the usability testing. The test plan includes the purpose of the test, problem statement and objectives, the user profile, the method or design of the test, the task list, the test environment and equipment, the test monitor rule, the collected data, and the report contents.

- *Selecting and acquiring participants*: It is the stage to consider characteristics of users, who are real users using a product or system, to be the test participants. It can be called the user profile.
- *Preparing the test materials*: The test materials are important to conduct the test. They will be used to communicate with the participants and to collect the data from the test. These materials should be developed well in advance before conducting the test. The test materials, for example, are pre-test questionnaire, post-test questionnaire, task scenarios, and data collection instruments.
- *Conducting the test*: After preparing the test plan, selecting the participants, and having the required test materials, the actual test can be conducted.
- *Debriefing the participant*: This stage is the session to reveal the participants' problems that occurred while they performed the test. The participants are requested to explain and expose their thought process and rationale behind their actions.
- *Transforming data into findings and recommendations*: It is a stage to analyse the data from the test and develop recommendations and produce the final report.

(Rubin, 1994, p.79)

Before conducting the actual experiment, it is suggested to have one or more pilot tests in order to try out the test procedure, the test materials, and the time period to carry out the test including problems that may occur during the test. As a result, many ambiguities will be removed (Lindgaard, 1994, p.214; Nielsen, 1993, p.174).

Nielsen (1993) suggests that to carry out one or two pilot tests will be enough, although large tests may need more pilot tests (p.174).

During the test plan stage, the number of the tests to be carried out is considered. Nielsen (2000) proposes, " *the best results come from testing no more than 5 users and running as many small tests as you can afford*". After testing the second user, it will be discovered that some actions of this user are the same as the first user. There is some overlap of actions between the first user and the second user. Similarly, the third user will do many actions that have already been observed with the first user or the second user. These actions may be observed repeatedly with all users in the test. However, there will be a small amount of new data from the third user. Nielsen (2000) mentions, "*As you add more and more users, you learn less and less because you will keep seeing the same things again and again. There is no real need to keep observing the same thing multiple times, ...*"

In the current research, the usability tests were carried out in a specifically equipped Usability Laboratory. Subjects are chosen and notified that the software application is being tested not themselves. Information about the experiment is explained to them clearly including how much time they will have to complete the experiment. A scenario of a given task is described to the subjects so that they understand what they are going to do. Generally, a time period for completing the given task is not more than three hours. For the current research, the time period is about 30 minutes. It is observed from the pilot test. This is acceptable for subjects because they are normally volunteers doing the experiment (Shneiderman, 1998, p.129, 131).

Subjects, who participate in the experiment, are considered as real users (Dumus, Redish, 1993, p.23). The word " users" in this research means people who employ the computer systems to accomplish their work.

During a Usability Test the subject's behaviour and activities are observed and recorded while he/ she is working on a given task. This is done in order to explain and provide understanding what the subject is doing. Videotaping plays a major role in Usability Testing as the observer may miss some important situation while he/ she is taking notes or coding data in a complicated situation that is difficult to record manually. Videotaping provides correct and dependable data. It can capture events from the screen as well as the environment around a testing room (Lindgaard, 1994, p. 99; Shneiderman, 1998, p. 131).

Questionnaires and interviews are used as tools to gather additional information from subjects. There are two kinds of questionnaires given to subjects. They are Pre-test questionnaires and Post-test questionnaires. Data collected from each pre-test questionnaire provides the subject's background and demography, whereas data collected from a post-test questionnaire and interview presents a subject's opinion about a given task and the system being used in the experiment. Interviews are done as soon as possible after finishing a given task.

In the current research, the data collected from observing, video recording, questionnaires and interviews are analysed and interpreted to support the objective of the research.

2.4.3 Thinking aloud technique

Thinking aloud is an efficient Usability technique. Subjects who participate in an experiment are invited to express their thoughts, opinions, and feeling while they are performing a given task. They are made to feel comfortable, to speak out and explain what are they going to do or why they are doing that. They are encouraged to express their opinions or suggestions (Shneiderman, 1998, p.130).

The strength of this technique is to collect the abundance of qualitative data from a small number of users. It contains the users' comments, which are vivid and explicit. (Nielsen, 1993, p.195)

This technique was used in the current research. During the tests, subjects were encouraged to speak out when they wanted to express their opinion or comment including explaining the reason why they did these actions or to explain their aims.

2.5 User's characteristics

Characteristics are an important issue for usability, and include demographic information, skills, knowledge, and personality traits of the user who is a real user of the software or the product (Rubin, 1994, p. 120).

Rubin (1994) proposes the characterization as in table 2.1. It presents details of user characteristics such as age, gender, attitude, knowledge, and user's competence. It includes learning style preferences of the user when he/ she performs a task. These

preferences may include Trial and error, consultation with others, and reading of documentation (pp. 120 – 123).

Table 2.1: Generic User Characterization (Rubin, 1994, p. 121)

Personal History	Age Gender Attitude toward computers of your type of product Left or right handed (could affect mouse usage for example) Learning style (read then do, try then do, or learn by doing, etc.) Attitude toward high technology
Education History	Highest grade completed Subjects studied Major
Computer Experience	Total time using Frequency of use Types of computers/peripherals used Operating systems used Types of screen interaction used (GUI vs. DOS)
Product Experience	Total time used Frequency of use Types of tasks performed and frequency Types/brands used (are they users or non-users of your company's product?)
Occupation History	Current and past job titles Responsibilities Training Classes taken Time with current company

Preece (1993) states that users are a different group of people. They differ from one another:

- *Physically, in terms of height, weight, reach, left- or right- handedness, dexterity, visual acuity, general health and fitness, and so on*
- *In their experience and know ledge of the task they want to do and of computer systems*
- *Psychologically: they may be adventurous or timid, learn fast or slowly, have good memories or bad memories*

- *Socio-culturally, in terms of background, educational attainment, age, gender, race and ethnic background.*

(p. 16)

These factors can affect the way user will perform with a computer system (Preece, 1993, p. 16)

Nielsen (1993) classifies users by their expertise. There are three dimensions to be considered which are: experience with the system, experience with computers in general, and experience with the task domain as shown in figure 2.6. (p.43).

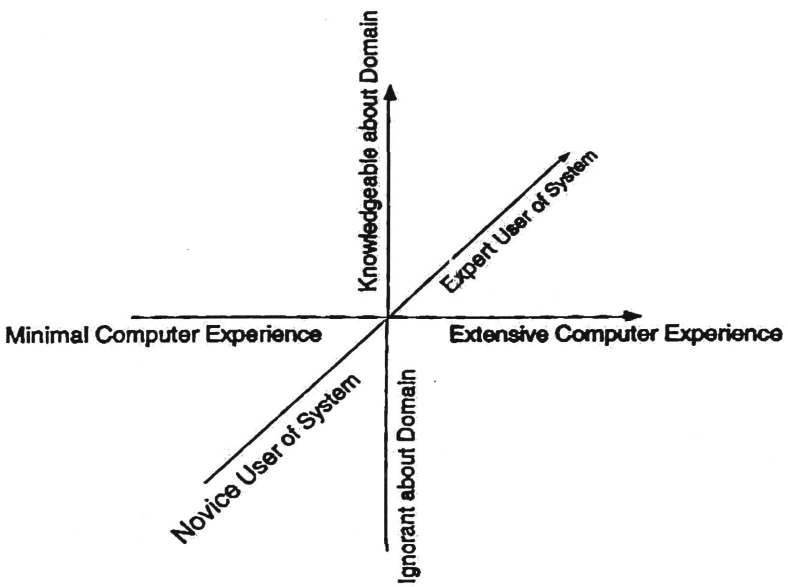

Figure 2.6: The three main dimensions on which users' experience differs: knowledge about computers in general, expertise in using the specific system and understanding of the task domain. (Nielsen, 1993, figure 3, p.44)

Other authors have classified users into two groups based on their experience with the systems, which are:

- Novice or first time users: This group has less knowledge or experience about tasks or the systems. They may be nervous when using the systems and have frequent have problems using it (Allwood, 1986; Shneiderman, 1998, p.68).

- Experienced users: This group is experienced and are well acquainted with the tasks and the systems. They attempt to find a way to complete their work expeditiously (Shneiderman, 1998, p.68).

A user's characteristics are an important component of the context of that user. These characteristics are: demographic information (Preece, 1993; Rubin, 1994), user's expertise (Allwood, 1986; Nielsen,1993; Preece,1993; Rubin,1994; Shneiderman,1998), attitude (Rubin, 1994), knowledge (Preece,1993; Rubin,1994), and learning style (Preece,1993; Rubin,1994).

Demographic information such as age, gender, language, education, and occupation can be revealed through questionnaires. However, user's expertise, learning style and attitude can be observed during performance of the test and the interview session. Learning style and attitude of user are the characteristics that relate to user personality.

2.6 Chapter conclusion

This chapter reviewed the relevant literature. The definition of Adaptive systems was described. The Lumiere project was presented including a brief explanation of the Bayesian user model. The definition and process of usability testing was explained, including the characteristics of users. The next chapter will describe the research method and procedures of this research.

Chapter 3

Research Method and Procedures

3.1 Introduction

The previous chapters have presented the objectives of the research and the relevant literature. These details have encouraged the author to study and evaluate an existing adaptive system by using a Usability Testing technique. This chapter will describe methods and procedures used for the experimental phase of the research.

3.2 Research method

The effectiveness of an existing adaptive system to handle unanticipated situations for a variety of users is interesting. In order to evaluate the effectiveness of the system and meet the aims of the research, the methods, which are employed for the research, are

- Laboratory experiments
- Questionnaire and interview

Laboratory experiments (Usability Tests) were conducted in a formal Usability Laboratory (see Appendix G). An existing adaptive system is being used as a tool. For this research, the system to be studied is *Microsoft Office 2000*.

Ten subjects were chosen to participate in the experiments to cover a diverse group of the user population for this software system. As mentioned in the literature review of Usability Testing in Chapter 2, as few as five subjects can give meaningful results from a Usability Test so that the choice here of 10 gives some measure of justification of the interpretive results. As described in chapter 1, this research will look for elements of the users' contexts that appear to influence the effectiveness of adaptive systems. The subjects were chosen in order to provide as diverse as possible characteristics of gender, language, user experience, and user personality. Each subject was asked to do the given task (see Appendix A which presents the instruction and task sheet). During each Usability test, the observer recorded the subject's activities using video camera and these recordings were interpreted with what they had done on the screen. Videotape, including both screen capture and camera output, were analysed by interpretation after each Usability test. There was one pilot test conducted for developing the experimental procedure before starting the tests proper.

Questionnaires: Subjects were provided with a pre-test questionnaire (see Appendix B) and asked to complete this questionnaire before starting the Usability test. The pre-test questionnaires are used to collect the information about the subjects in order to classify their prior experience with the system being used in the test.

After finishing the test, subjects were asked to complete a post-test questionnaire (see Appendix C). The post-test questionnaires are used to collect the information about

the opinions of the subjects with the given task and the system itself, including System Help.

Interviews: Each subject was interviewed with the same questions (see Appendix D) by the observer after the Usability test. These were used in conjunction with the post-test questionnaires to gather their opinion about the system that was used in the test and to get their suggestions for improvement to System Help.

3.3 Procedures of the research

The Usability tests were conducted to evaluate the effectiveness of the adaptive system. Thinking aloud technique was encouraged during the test because this technique allows users to express their thoughts, feelings and opinions about a given task and also the system that is being used in the experiment, as described in chapter 2 (Shneiderman, 1998, p. 130).

The procedures of the study comprise the following:

- Development of the experimental procedure
- Observation
- Data recorded and analyzing

3.3.1 Development of the experimental procedure

Before starting the actual Usability test, there was one pilot test for developing the experimental procedure. A pilot test is helpful for finding any problems that might

occur during the experiment because it can be used for establishing instructions, questionnaires, questions, given tasks, and an acceptable time for doing the task.

There are four main points to focus for developing the Usability test as follows:

- Tool
- Given task
- Questionnaires
- Questions for interview

Tool: This research is to study the effectiveness of an existing adaptive systems. The existing adaptive system that has been chosen for the experiment is *Microsoft Office 2000*. The main reason for choosing this application was that it was based on the Bayesian user model developed by the Lumiere project. An additional reason was that many people are familiar with this application.

Given task: To evaluate the effectiveness of the existing adaptive system, users were asked to perform a task using the chosen application. The given task was classified into 5 sub tasks (see Appendix A), which are:

- Typing: Users were asked to do typing of one paragraph.
- Creating a table: Users were asked to create one table.
- Creating a graph: Users were asked to create one graph, which derived data from the table.
- Creating a text border: Users were asked to create a border for text.

- Creating a page border: Users were asked to create a page border.

From experience gained in the pilot test, these given sub-tasks were considered not too complicated for subjects who were asked to use functions in the software to accomplish the whole task. All of subjects are volunteers, so a reasonable time was allocated to do the Usability test. The time period for completing the task was 30 minutes. It was found that subjects became bored if it took longer than 30 minutes.

A scenario was designed and explained to subjects. This was they were being asked to produce a document, exactly as shown on the accompanying sheet, using Microsoft Word 2000. (See Appendix A)

Questionnaires: There were 2 sets of questionnaires, the pre-test questionnaires and the post-test questionnaires.

- **Pre-test questionnaires** were provided to subjects who were asked to complete it before doing the Usability test. The aim of this questionnaire was to gather information about subjects called a user profile. This information was helpful to classify subjects' experience with the system that was being used in the test. The questionnaire was divided into 3 parts. The first part was about demographics. The second part was about their experience with computers. The last part was about their experience with the system that was being used in the test (See appendix B).

- **Post-test questionnaires** were given to subjects when they finish their tasks to gather their opinions about the tasks and System Help (See appendix C).

The questionnaires were developed and checked before being used in the pilot test. The clarity of each question in the questionnaires was evaluated in the pilot test as well as the number of questions. If questions in the questionnaires are unclear for subjects or there are too many questions to complete, the subjects will become annoyed. However, these questions appear to cover essential information to be collected from the subjects. There are 18 questions for the final Pre-test questionnaire (See Appendix B) and 5 questions for the final Post-test questionnaire (See Appendix C).

Questions for the interviews: There were 6 questions (See Appendix D) used to interview each subject after completing the post-test questionnaire. This activity allowed subjects to express their feelings about the system used as well as to make their suggestions. The questions focused on:

- Problems when using the system to complete the given task.
- Opinions about System Help.
- Suggestions for developing the system in order to meet user requirements.

The pilot test indicated that it would be useful to allow subjects to express their ideas in this way because they may have valuable comments that they want to share after completing the post-test questionnaire.

3.3.2 Observation

The experiment involved Usability Testing of the nominated task with each subject using a thinking aloud technique. It was conducted at a Usability Laboratory (see also Appendix G). In the testing room, there are 2 video cameras and one computer which are connected through a quad box (see appendix H) to a video player in another room which records the subjects' activities during the test. The environment in the room and events on the screen of the computer are recorded together on one tape which then are displayed as four quadrants on the television screen.

Each Usability test involves one subject at a time. To keep the environment of the experiment constant, all subjects used the same computer in the same room and did the same task. The observer sits in the room with the subject during the test to encourage the subject completing the given task. Furthermore, each of the subjects is encouraged to speak with the observer when he/she gets frustrated. The observer may ask the subject what they are trying to do at that time as well as for his/her feelings. However, the observer does not give any suggestions and does not reply to subjects if they ask about how to do the given task. During the test, the observer observes and records the subject's activities and notes what they have done on the screen. They also record time taken by the subject to carry out all sub tasks. After the test has been done, each subject was asked to complete the post-questionnaire and was then interviewed by the observer. The interviews will be recorded on the videotape used in the test. The videotape of each subject was then analysed.

3.3.3 Data recorded and analysis

After finishing the test for every subject, the videotape was replayed to record the time taken, to document subjects' activities, and to transcribe the answers to each question in the interview.

Subject's activities: The observer recorded the activities of each subject during the Usability test. The observation sheet (see table 4.2- 4.6 on page 46 – 52) was created for recording the data and comparing the activities of each subject. The observation sheet presents the sequence of subjects, their activities, and observer's comments about how subjects coped with problems when they had frustration using the software including how the software responded to their actions and their queries.

Interview: Answers to each question from the interviews were recorded in the interview answer sheet separately. It was then easy to analyse and compare the answers for each subject for each question (see appendix E).

Analysis: The current research is an exploratory study using an interpretive qualitative approach to integrate and analyse the collected data from the usability tests.

Miles and Huberman (1994) propose all data or raw experience from people, objects, and situations are qualitative (p.9). These data are converted into words, which are based on '*observation, interviews, or documents*' (Miles and Huberman, 1994, p.9).

They usually require some processing to correct, edit, or transcribe before analysis (Miles and Huberman, 1994, p.9).

Strengths of qualitative data, as suggested by Miles and Huberman (1994), are

> " *... the data was collected in close proximity to a specific situation, rather than through the mail or over the phone. The emphasis is on a specific case, a focused and bounded phenomenon embedded in its context. The influences of the local context are not stripped away, but are taken into account. The possibility for understanding latent, underlying, or non-obvious issues is strong. Another feature of qualitative data is their richness and holism, with strong potential for revealing complexity; such data provide "thick descriptions" that are vivid, nested in a real context, ...* "(p.10).

From the definition and strengths of qualitative analysis as Miles and Huberman state, the qualitative data analysis, therefore, is applicable for the current research.

The analysis process consists of three components: Data reduction, Data display, and Conclusion drawing/ verification (Miles and Huberman, (1994), p. 10).

- Data reduction is the process of focusing, selecting, and organizing raw data (Miles and Huberman, 1994, pp. 10 – 11). In this research, the collected data from the questionnaires, the Usability tests, and the interviews were summarized.

- Data Display is organized data, which is summarized from data reduction stage, to display the data and allow conclusion drawing or taking action (Miles and Huberman, 1994, p. 11). The current research used vignettes to display the data that was summarized from the collected data and then integrated and interpreted to create a series of vignettes. . Miles and Huberman (1994) describe a vignette as:

> "*a focused description of a series of events taken to be representative, typical, or emblematic in the case you are doing. It has a narrative, storylike structure that preserves chronological flow and that normally is limited to a brief time span, to one or a few key actors, to a bounded space, or to all three*" (p.81).

The series of vignettes were analysed to identify elements within the data that give insights into the research questions and the research objectives as mentioned in chapter 1.

- Conclusion drawing/ verification presents the verified analysis produced when data collection has finished (Miles and Huberman, 1994, p.11). For the current research, the results from vignettes were discussed and concluded to verify and support the research questions and objectives as well as a future issue for further study.

3.4 Chapter conclusion

This chapter described the method and procedures used in the research. The experiments, questionnaires and interviews were the methods used in the research to assess the effectiveness of the adaptive system. The experiment was based on Usability Testing and was conducted at the Usability Laboratory.

The analysis of the data will be discussed in the following chapter. The analysis interprets and integrates the collected data from the methods as explained in this chapter.

Chapter 4

Data Analysis

4.1 Introduction

The current research is an exploratory study that aims to explore the effectiveness of an existing adaptive system, which was developed from the user model of the Lumiere project. Laboratory experiment, Questionnaires and Interviews were employed as the research techniques.

Data Collection as described in Chapter 3, began when subjects were asked to complete the pre-test questionnaire before doing the experiment. The post-test questionnaire was given to subjects after they had finished the given tasks. Subjects could also express their opinion during the experiment as well as answering questions during the interview. Furthermore, videotapes were being used to record subjects' activities and the comments made during doing the given task as described more detail in chapter 3 (see appendix A) during the experiment. The given task was classified into 5 sub-tasks of typing, create a table, create a graph, create a text border, and create a page border. These subtasks were produced in Word processing using MS Word 2000.

The pre-test questionnaire was given to subjects to gather their information about demography, experience using computer and using MS Word 2000, and which help function they usually use when they have problems using the software. The post-test questionnaire and questions during the interview collected opinions of subjects about the given task, System Help, and the software that had been used in the experiment. Videotapes of each subject were replayed to observe his or her activities.

The qualitative data analysis was employed in this research. It presented three components of data analysis process as propose by Miles and Huberman (1994), which are Data Reduction, Data Display, and Conclusion Drawing/ Verification (p.10) as described in chapter 3.

4.2 Data Reduction

The following is the data summarized to highlight the main observations made during the usability test, the pre-test questionnaire, and the post-test questionnaire.

4.2.1 The summary of the questionnaires and the observations

The summary of the data from the pre-test questionnaire, the post-test questionnaire, and the observations are presented in table 4.1. It provides each subjects' demography, expertise using computers and the selected software, and time taken to carry out all subtasks.

Table 4.1: The summary of data from the post-test questionnaire and the post-test questionnaire and the observational notes.

Subject	Gender	English/Non- English Speaking background	Experience with a computer	Experienced with the software	Difficult sub task encountered	Time taken to finish the given task (Mins.)
1	Male	Non- English Speaking	Experienced	Experienced	Graph and border	14.51
2	Male	Non- English Speaking	Experienced	Experienced	Graph	15.41
3	Female	Non- English Speaking	Novice	Novice	Graph and border	37.25 (Not finish the task because it was more than 30 mins)
4	Male	Non- English Speaking	Experienced	Experienced	-	13.05
5	Female	Non- English Speaking	Novice	Novice	Graph	18.03 (Not finish the task because she asked to give up)
6	Male	Non- English Speaking	Experienced	Experienced	Border	19.13
7	Female	English Speaking	Experienced	Experienced	-	12.30
8	Female	English Speaking	Novice	Novice	Graph and border	28.32
9	Male	Non- English Speaking	Experienced	Experienced	-	18.29
10	Female	English Speaking	Novice	Experienced	Graph	15.17

4.2.2The performance of subjects

From the main observations, there are five sub-tasks that subjects had to perform in the test (see Appendix A). The data was summarised into tables 4.2 to 4.6 to reveal each subjects' performance for each subtask as follows:

Table 4.2: Typing Task

Subject	Observation
1	Quite good and fast.
2	Quite good
3	The subject does not know too much about menus, how to set a font size and where the cursor should be. While she sets a format before typing, there is a bulb appear. But she ignores it.
4	Quite good
5	No problem with typing
6	Quite good
7	Quite good
8	No problem with typing
9	No problem with typing
10	Good

Table 4.3: Table Creation Task

Subject	Observation
1	The subject searches for the table menu and he finds it. The Office Assistant appeared to give a suggestion while he is setting the table. However, he ignores it.
2	The subject chooses the table menu straight away without searching from other menus.
3	The subject explores every menu but hesitates to click on any menu. She repeats doing this several times. She finds the table menu but does not know which sub menu she should click on. She tries twice to find the right sub menu and she finds it. She can create a table. A bulb appears while she is filling in data but she ignores it.
4	The subject chooses the table menu straight away without searching from other menus.
5	The subject searches from several menus and is aware of which menu should be selected but cannot find sub menu to insert the table. She tries to find the right sub menu three times and succeeds.
6	The subject chooses the table menu straight away without searching from other menus.
7	The subject searches from menus and then searches from tool bars. She recognizes the table tool bar.
8	The subject searches from menus to find the table menu. She says she used to use this function before but she forgets where the menu is. She repeats searching several times and succeeds.
9	The subject chooses the table menu straight away without searching from other menus. But he has a little problem with the table because it comes up overlapping a border he has created before. Then he tries to figure it out and do it again. He searches for some option in the table menu but he cannot change it. He gives up and leaves it like that.
10	The subject chooses the table tool bar straight away but it does not have enough columns and rows she wants, then she tries to find the table menu by searching from menus and succeeds to create the table.

Table 4.4: Graph Creation Task

Subject	Observation
1	The subject searches from several menus and finds sub menu "chart". However, he does not know how to change the graph and how to fill in the data to the data sheet because he overlooks the data sheet window. He keeps trying and he can finish it.
2	The subject searches from menus and tool bar. He tries to find a menu to create a graph. He repeats searching for several times and still cannot find it. Then he asks the system for help. He takes time to read it but still cannot get it. Then he gives up and asks the observer if we can create a graph from MS word and do not need to import from excel. He tries again by searching from menus and finds the menu. He does not know how to change the graph and data because he overlooks the data sheet and closes it. He deletes the graph and creates it three times. There is a sound from the Office Assistant and it gives him a suggestion. He reads it. He finishes creating the graph.
3	The subject explores every menu but she cannot find it. Then she clicks on the help menu but still does not know which sub-menu should be chosen to get System Help because of hesitating to click on any sub menu. Then System Help comes up with many options and space for typing the question. She does not know how to ask for help. When the question is asked, System Help gives her many options about graph. She takes time to read and choose one and follows the instruction but she does not understand the instruction clearly about 'insert menu' and 'Object'. She follows the steps in the instruction but still cannot find sub menu 'Object' and keeps searching till she can find it. She creates the graph. However, she still has a problem with filling the data into the data sheet. So she keeps trying and finds the data sheet to put the data in.
4	The subject chooses the tool bar to create a graph straight away but he has a problem with the graph that it does not come up the same as in the given sheet. He tries to do exactly the same as the graph in the given sheet. It takes time and he still cannot do it. The Office Assistant gives him a suggestion but he ignores it. He keeps trying to fix the problem with the graph. A bulb appears but he still ignores it. The observer tells him that it is all right for the graph just a little thing that is different from the graph in the given sheet. Then he stops fixing it and does another task.

5	The subject explores every menu several times but still cannot find it. Then she clicks on the help menu but still does not know how to use it. She uses the word "diagram" to search for graph. System Help gives the wrong instruction to her. She takes time to read the instruction and gets the wrong one. Then she stops following the instruction and tries to search from menus again but still cannot find it. The Office Assistant gives her a suggestion but she ignores it. Then she gives up. She says, " I hate to use this one (System Help). I never use it. I still need to read it and it wastes my time and I think it is difficult."
6	The subject asks System Help for a graph straight away without searching from menus. Then he follows the steps in the instruction and can create graph. But he has a problem to fill in the data into the data sheet. There is a sound from the Office Assistant and it gives him a suggestion while he is trying to fill the data into the data sheet. However, he closes the suggestion window.
7	The subject stops doing anything for a while and then asks System Help straight away without searching from menus. She has a problem with a legend because she does not delete it when she is filling in the data into the data sheet.
8	The subject explores every menu several times. She finds the menu but she does not know how to fill in the data because she closes a data sheet window. She tries to search for a way to put the data in. No response from the Office Assistant. She says she does not know how to do it. The observer keeps encouraging her to figure it out. She tries again by deleting the graph. She tries to create the graph again but she forgets where the menu is then she searches for the graph menu. She finds it and knows where she can put the data in.
9	The subject is searching from menus but does not take long time to find it. He says he used this function before.
10	When starting to do this task, the subject pauses her action and looks at the sheet. She highlights the data in the table and searches for the graph menu. She finds the menu. She has a little problem with moving the graph to a proper place.

Table 4.5: Creating a text border

Subject	Observation
1	The subject starts by searching from menus. He uses text box to create text border. It looks similar to the given sheet. While he is searching from menus, the Office Assistant gives him a suggestion but he ignores it.
2	The subject knows this menu. He chooses this menu and creates a border for text.
3	Does not do this task.
4	The subject searches from menus and he uses text box to create the text border but it does not look similar to the given sheet then he asks System Help for border. He can create the text border, follows the steps in the instruction.
5	The subject searches from menus and she uses text box to create the text border.
6	The subject creates the text border from the text box.
7	The subject is confident to create the text border because she knows the menu. She chooses the menu straight away.
8	The subject chooses the menu straight away without searching but the subject hesitates to click on the ok button when she chooses the menu because she has failed creating the page border before. She does not get it right then she keeps trying again and can create it.
9	The subject chooses the text box to create the text border. He does not use the border menu to create this task.
10	The subject chooses the border menu straight away without searching.

Table 4.6: Creating a page border

1	The subject uses the text box for the page border but cannot do it. Then he tries again and still cannot do it. He clicks undo button and searches from menus. He tries again using text box but this time he draws the box first on the space and copies the document and pastes on the box but the software does not allow him to do that. There is a sound from the Office Assistant and it comes up with the warning twice to tell him that he cannot do that. He reads it and he stops doing it. He sets up the page and starts to search from menus again. This time he uses table '1x1' table. He copies the document and paste into the table.
2	The subject knows this menu. He clicks on the menu straight away without searching from other menus.
3	The subject explores every menu. Then she uses the text box to create the page border but it covers the whole document and cannot see the document. She tries to get rid of the text box and tries again from the menus. She finds the menu "borders and shading". She clicks on it but she does not know how to use it. A bulb appears but she ignores it. While she is trying to create the page border, The Office Assistant gives her a suggestion but she ignores it. Then she gives up and asks for help from System Help. She uses a wrong word " frame" for border then System Help gives her a wrong instruction. She cannot create a page border. The Observer asks her to stop because it takes more than 30 minutes.
4	The subject creates the page border quickly after he asks System Help for the text border. He chooses the menu straight away and creates the page border. A bulb appears but he ignores it.
5	The subject starts searching from menus. There is a sound from the Office Assistant and it offers her help but she closes it. She knows that this one is called 'border' and she tries to find this menu and she finds it. She does not know how to use it. She tries for several times. A bulb appears but she ignores it. She can create page border.

6	The subject tries to use text box again but it covers whole document and cannot see the document. He deletes it and tries again but it appears the same as the first time. Then he stops and starts searching from the menus. He finds menu "borders and shadings". He clicks on it and tries to create the page border but he overlooks the page border field so he does not get it correctly. He tries several times but it still appears the same as the first time. Then he stops and does other thing for table. After that he tries again but he still cannot do it. Then he asks System Help. He chooses the wrong option from the help options so he gets the wrong instruction. Then he chooses another option and he gets the answer but it is the same menu that he searched by himself. He tries again and he can create the page border.
7	The subject knows how to create the page border. She chooses the menu without searching and tries to create the page border exactly the same as in the given sheet.
8	The subject searches for the border menu and finds it but she does not choose the page border field and it comes up not correct. Then she tries to search for the menu again and comes back to the same menu. The Office Assistant offers her the help but she ignores it. Then she changes to do other sub tasks and then comes back to do the page border again. She chooses the right menu but still overlooks the page border field. She tries for several times. A bulb appears but she ignores it. She can create the page border.
9	The subject chooses the text box to create the page border.
10	The subject chooses the border menu straight away without searching. She has a little problem with the border because she does not choose the page border field. She tries several times and she can create it.

4.2.3 Automated messages from the system

From the observation of the usability testing, there are 4 types of messages from the system that appear when it infers that users are frustrated using the software as shown in the table 4.7. They are:

- Small window showing a suggestion or warning message.
- Small window showing a suggestion or warning message with sound.
- Small window offering the help.
- A picture of a bulb to provide a tip for using the software functions.

Table 4.7: The number of automated messages of the system offered to subjects for each sub task.

Subject	Typing	Table	Graph	Text border	Page border
1	-	1 (suggestion) Ignored	-	1 (suggestion) Ignored	2 (suggestion with sound) Read it
2	-	-	1 (suggestion with sound) Read it	-	
3	1 (a bulb) Ignored	1 (a bulb) Ignored	-	-	1 (a bulb) 1 (suggestion) Ignored
4	-	-	1 (a bulb) Ignored	-	1 (a bulb) Ignored
5	-	-	1 (suggestion) Ignored	-	1 (sound and offer help) 1 (a bulb) Ignored
6	-	-	1 (suggestion with sound) Ignored	-	-
7	-	-	-	-	-
8	-	-	-	-	1 (offer help) 1 (a bulb) Ignored
9	-	-	-	-	-
10	-	-	-	-	-

4.3 Data display

The analysis of the data uses vignettes as the display vehicle. The data consisted of the data collected from pre-test questionnaires, post-test questionnaires, interviews, and the video recording of the experiment. Data was analysed interpretively to detect patterns of user behaviours relating to the research questions. The results of this analysis are displayed as a series of vignettes. These vignettes were drawn from different episodes from the tests and the numbers do not correspond to particular subjects. The vignettes can be used to address several issues. The several vignettes can be extracted from a single user session to address separate issues. The vignettes are as follows:

Vignette 1

A female non-English speaking subject is obviously a novice user and has very little experience using the software. She is at the state in the test where she has to create a page border. She is having a problem with this. After exploring the menus several times, and also asking the observer how to do this task, she does not complete this task. She pauses her action for a while and starts searching the menus again. She finds the menu " Borders and shading" but she still cannot create the page border because she overlooks page border field. After trying several times, she gives up. She queries System Help using the word " Frame", as she believes that it is the right word to explain this function to System Help. However, System Help gives her help topics that do not relate to her task. She reads these topics and tries to find the right one for her task and she picks one but it is not the one she wants. She reads the 'help' contents

for a while and then gives up. She feels a bit nervous because she cannot find the answer from System Help. She cannot complete this task.

When the observer asks her about which part of the system was the most difficult for her. She says, "Create frame (border)". And when asked about System Help, she replies that " The help is too long. I am too lazy to read it. It is better if you write down something shorter. I find it difficult because I did not understand about it." "It might be a good answer but for me I do not understand. I could not catch the word because there is too much detail and I am lazy to read it all. Help is too lengthy. You do not get to the point. Some people like me do not know how to use it even whenI read it I do not understand what they said."

Vignette 2

A female non-English speaking subject is a novice user of this software. She has a problem creating a graph. She explores the menus for a while and then she gives up. She hesitates to use System Help. Finally, she clicks on the help menu. She types the word "diagram" in her query. System Help, however, gives her help topics that do not relate to her task. She tries to pick one choice from the help topics and reads the instruction but she does not understand it and then she gives up.

She says during the interview that graph is the most difficult part for her, saying that " Graph because I could not do it." When asked about System Help, she says, " I think I can. But sometimes I misunderstand what they are talking about. A chart and diagram is one example that I misunderstand."

Vignette 3

A male non-English speaking subject is an experienced user for this software. He does not use System Help during the test even when he has a problem with using the system. However, he has a little problem with the table. It overlaps the page border he has created before. Then he tries to fix it but he cannot fix it. He prefers to explore menus by himself.

He expresses during the interview that "I think I am not in the position to criticise System Help because I do not have experience using it when I use this software. Normally, I just ignore it." and "If I try to use System Help I may not find the information what I want."

He also says after the interview "I feel uncomfortable to use System Help because I found it is not very useful and it is not informative when we are using it. From my experience, if I do not know how to do it I just guess and use trial and error or ask someone else. I found that it is better than using system help."

Vignette 4

A female English-speaking subject is an experienced user of this software. She does not use System Help when she is frustrated using the software for some functions. She prefers to try by herself. She is having a problem with graph and page border. She cannot move the graph to the place she wants and she overlooks the page border field when she creates the page border. However, she manages to fix the problem.

During the interview she says, " I did not use it because I always find the way on my own. I never like to use System Help even though I know it is easier." And also says "I know it does already have something in the system. But I am the type of person that always likes to do thing on my own. So that is why I do it like this. If I do need help, I would actually rather ask someone or talk to someone rather than use System Help. I do not even know what the help does. I never use it, may be it could help. I am sure it does not know exactly what I want to do but when I ask someone, I can tell him/ her exactly what I want to do. If I cannot find someone else at that time I guess I can work it out on my own. I do not use System Help but usually I am just typing up like assignments or something. I do not need help. It is just straight forward."

Vignette 5

A female, English-speaking subject is a novice user. When she creates a graph, she does not know where she can put the data because she closes the window for filling in the data. She tries to find a way to enter the data to create the graph but she cannot find it. She says, " I do not know how to do it". Then the observer asked her what she knows about the function to ask for help from the system. She said, "yes but I have never used it before. I just ask someone to help me. It is better because I do not know what to ask and do not know the right word to ask." She pauses her action for a while and then she tries to create graph again. She now sees the data sheet and she enters the data into the data sheet.

She comments during the interview "The help, I do not know how to ask the right question, maybe if I knew what to ask it would be better. But you do not know what

to ask then you cannot get an answer. When you know the right word to ask it will be better. It is so confusing."

Vignette 6

A male, non-English speaking subject is obviously an experienced user. He uses System Help straight away when he is creating a text border. At first he uses 'text box' but it does not look similar to the given sheet so he asks System Help how to create a border. He creates the text border following the steps in the instructions. When he creates a page border, he clicks on the Borders and Shading menu straight away. He knew this menu from System Help when he was creating the text border. He also says during the interview when the observer asks him about System Help that "Yes, when I was looking for border when I typed "border" it just showed me where it is. It is easy."

Vignette 7

A male non-English speaking subject is an experienced user. He starts doing the test by asking System Help about creating a graph. He does not search any menus. He clicks on the help menu straight away. He creates a graph by following the steps in the instructions from System Help. During the interview, the observer asks him if, when he used System Help, it responded to him properly or not. He replies, "Yes, because it showed the information that related to the topic and related to the keyword that I wanted to search."

Vignette 8

A female, English-speaking subject is an experienced user. She asks System Help straight away when she is creating a graph. She does not search any menus. During the interview, the observer asks her about System Help she says, "Yes, it was good. I typed my question and it came up straight away what I wanted to know."

Vignette 9

A male, non-English speaking subject is an experienced user. He receives the messages from the Office Assistant while he is creating a table, a text border, and a page border. The Office Assistant appears to give a suggestion while he sets the table. However, he ignores it. Another time while he is searching for the text border task from menus, the Office Assistant gives him a suggestion but he ignores it. The last time occurs while he is creating page border by using text box. He is drawing the box first on the space and copying the document and pasting on the box but the software does not allow him to do that. There is a sound from the Office Assistant and it comes up with the warning twice to tell him that he cannot do that. He reads it and he stops doing it.

He says during the interview "For this task, it was ok for me because once it told me that I could not do it like this when I tried to copy the whole document and paste on the text box. But at other times I ignored it."

Vignette 10

A male, non-English speaking subject is an experienced user. He receives the messages from the Office Assistant while he is creating a graph. He does not know

how to change the graph and data because he overlooks the data sheet window and closes it. He deletes the graph and creates it three times. There is a sound from the Office Assistant and it gives him a suggestion. He reads it but does not carry out the action suggested by the message.

Vignette 11

A female, non-English speaking subject is a novice user. She receives the messages from the Office Assistant while she is typing and creating a table and a page border. She does not know too much about menus and how to use them properly, like changing the size of font or where the cursor should be. While she is setting a format before typing, a bulb appears, but she ignores it. When creating the table, she explores every menu but hesitates to click on any menu. She repeats doing this several times. She finds the table menu but does not know which sub menu she should click on. She tries twice to find the right sub menu. A light bulb appears while she is filling in the data into a table however she ignores it. And the last time when she is creating page border, she explores every menu. Then she uses 'text box' to create a page border but it covers the whole document and she cannot see the document. She gets rid of the text box and tries again from the menus. She finds the menu "borders and shading". She clicks on it but she does not know how to use it. A bulb appears but she ignores it. While she is creating the page border, the Office Assistant gives her a suggestion but she ignores it. Then she gives up and asks for help from System Help. She is using a wrong word " frame" instead of border so System Help gives her a wrong instruction. She cannot create a page border.

Vignette 12

A male, non-English speaking subject is an experienced user. He receives messages from the Office Assistant while he is creating a graph and page border. He is having a problem with a graph. It does not come up the same as in the given sheet. He tries to do exactly the same as the graph in the given sheet. It takes time and he still cannot do it. A light bulb appears but he ignores it. He keeps trying to fix the problem with the graph. A bulb appears but he still ignores it.

Vignette 13

A female, non-English speaking subject is a novice user. She receives the messages from the automated assistance of the software (the Office Assistant) while she is creating graph and page border. This happens several times as she explores every menu but she ignores it. Then she clicks on the help menu however she still does not know how to use it. She uses the word "diagram" to search for graph. The Office Assistant now gives her the wrong instruction. She takes time to read the instruction. However, it is not the right instruction. She eventually realises this and stops following the instruction and tries to search from menus again but still cannot find it. The Office Assistant then gives her another suggestion but she ignores it. Then she gives up. Later on when she is creating a page border she again starts searching from menus. There is a sound from the Office Assistant and it offers her help but she closes it. She knows that this one is called border and she tries to find this menu and she finds it. She does not know how to use it. She tries several times. The bulb appears and she ignores it.

Vignette 14

A male, non-English speaking subject is an experienced user. He receives the message from the Office Assistant while he is creating a graph. He is having a problem to fill in the data into the data sheet. There is a sound from the Office Assistant and it gives him a suggestion while he tries to fill the data into the data sheet. However, he closes it ignoring the suggestion.

Vignette 15

A female, English-speaking subject is a novice user. She receives the message from the Office Assistant while she is creating a page border. She searches for the border menu and finds the item. However, she does not choose the correct page border field. Then she tries to search for the menu again and comes back to choose the same menu. The Office Assistant offers her help but she ignores it. Then she changes to do other sub tasks and comes back to create the page border again. She chooses the right menu but still does not choose the page border field. She tries several times. The light bulb appears, however, she ignores it. She says in the interview about the appearance of System Help "No, I did not get it."

Vignette 16

A female, non-English speaking subject is an obvious novice user for this software. She is having a problem creating a graph. She explores every menu and she cannot find it. Then she clicks on the Help menu and asks how to create a graph. Then System Help gives her many options about graph. She takes time to read and choose one and follows the instruction but she does not understand the instruction clearly about 'insert menu' and 'Object'. She follows the steps in the instruction but still

cannot find sub menu 'Object' and keeps searching till she can find it. She can then create the graph. However, she still has a problem with filling the data into the data sheet. So she keeps trying and finds the data sheet to put the data in.

Vignette 17

A male, non-English speaking subject is an experienced user. He is having a problem creating a graph. He searches from menus and tool bar. He tries to find a menu to create a graph. He repeats searching several times and still cannot find it. Then he asks System Help. He takes time to read it but still cannot get it. Then he gives up and asks the observer if we can create graph from MS Word and do not need to import from Excel. He tries again by searching from menus and finds the menu. He can create the graph.

He says the following during the interview about System Help "It gave too many options and too much text to read. Normally, most of the time I do not use help. I try to find it myself or ask someone else if I really cannot find it. I was looking for the chart and looking from the tool bar to find anything that looked like the chart but I could not find it then I asked for help. I think the help has too many options to go through."

Vignette 18

A male, non-English speaking subject is an experienced user. He makes a comment about System Help during the interview "When I did this task it was easy to find the help. But usually when I use it, it gives too many answers like when I typed something and it gave some options then I needed to click on it. If I know it, I can find

it. If I have no idea about this, it is hard to find the answer. It just keeps giving many options when typing the question. It shows 4-5 options when I click on one option it will show another 4-5 options and so on."

Vignette 19

A female, non-English speaking subject is a novice user. She says during the interview about System Help "I think it is too boring for me. That's why I just want to try. I do not want to read all of the instructions because sometimes we can still make mistakes. That's why it would take longer time than when you just try it by yourself."

Table 4.8: A summary of the vignettes explained above

Vignette No.	Language	Gender	Expertise	Activity
1	NE	Female	N	Using common words explain in the query.
2	NE	Female	N	Using common words explain in the query.
3	NE	Male	Ex	Does not use System Help
4	E	Female	Ex	Does not use System Help
5	E	Female	N	Does not use System Help
6	NE	Male	Ex	Using System Help
7	NE	Male	Ex	Using System Help
8	E	Female	Ex	Using System Help
9	NE	Male	Ex	Read the message from OA
10	NE	Male	Ex	Read the message from OA
11	NE	Female	N	Ignore the message from OA
12	NE	Male	Ex	Ignore the message from OA
13	NE	Female	N	Ignore the message from OA
14	NE	Male	Ex	Ignore the message from OA
15	E	Female	N	Ignore the message from OA
16	NE	Female	N	Using System Help
17	NE	Male	Ex	Comment about the contents in System Help
18	NE	Male	Ex	Comment about the contents in System Help
19	NE	Female	N	Comment about the contents in System Help

(NE = Non-English speaking, E = English speaking, N = Novice, Ex = Experienced)

4.4 Interpretation of the data analysis

The qualitative analysis of data resulted in the identification of some typical or illustrative cases, which were presented above as a series of vignettes. Subsets of these vignettes can be selected to provide answer to the questions addressed in this research, as shown in the following section.

Following the literature review of the Lumiere project, the User Model implemented in the Microsoft Office products, involved both direct intervention with offers of help from the Office Assistant when a need was detected and also a natural language facility for querying the systems online help. The findings of these two aspects of the adaptive system are now addressed.

4.4.1 Direct Intervention from the Office Assistant

Eight vignettes (9-16) concern the use of the Office Assistant. Five vignettes (11 – 15) provide evidence that the messages from the Office Assistant are ignored or the Office Assistant is even turned off by users even when they are frustrated using the software. Subjects in vignette 11 and 13 are female, non-English speaking subjects and the subject in vignette 15 is female, English-speaking subject. They are all novice users. They all ignore the messages from the Office Assistant at all times. They do not pay attention to the messages even when it offers help. Subjects in vignettes 12 and 14 are male, non-English speaking subjects. They are both experienced users. They both ignore the messages from the Office Assistant all the time even when they are having problems with some system functions.

In vignette 16 the subject, who is female non-English speaking and obviously is a novice user, pays attention to the Office Assistant and System Help. However, she misunderstands the content in System Help offered.

Vignettes 9 and 10 strongly suggest that experienced users ignore the messages from the Office Assistant most of the time. However, they eventually read the messages and respond to the messages in different ways. Subjects in vignettes 9 and 10 are male, non-English speaking subjects. They are both experienced users. The subject in vignette 9 does eventually read the message from the Office Assistant when it appears with sound to warn him that he could not do that action. Then he responds to the warning by stopping his action. The subject in vignette 10 reads the message when it appears with sound to give him a suggestion, but he does not respond to the suggestion. He keeps doing his task.

This evidence supports the notion that the Office Assistant can sometimes correctly infer users' goals and needs and provide some suggestions to users at the right time. It can occasionally be useful for some users in some situations and can also succeed in offering useful suggestions and assistance. However, users generally ignore its suggestions or assistance. The test subjects do not pay attention to the Office Assistant while they are using the system to complete the given tasks, even when they have problems using the system. They ignore the Office Assistant when it tries to offer help or give a suggestion. There are only 3 subjects who pay attention to the Office Assistant when it appears with the sound. However, they still ignore the Office Assistant at other times.

4.4.2 Natural Language Querying of the online Help

Vignettes 1 and 2 provide substantial evidence that System Help does not understand common words particularly those that novice users used in their queries to describe unfamiliar software functions. Subjects in vignettes 1 and 2 are both female, novice users and both of them are non-English speaking subjects. The subject in vignette 1 uses the word "frame" instead of " border" in her query and the subject in vignette 2 uses the word "diagram" instead of "graph or chart" in her query. They do not understand the instruction of the help topic they pick, in fact, System Help misinterpret their queries and offers the wrong help topics to them.

Vignettes 6, 7, 8 and 16 are evidence that System Help can sometimes be useful for users. It can provide the help topics that relate to subjects' tasks and help them to complete their tasks. Subjects in vignettes 6 and 7 are male, non-English speaking subjects and the subject in vignette 8 is a female, English-speaking subject. They are all experienced users, however, they are all considered as novices for particular functions with which they are unfamiliar (Nielsen, 1993, p. 45). System Help can help them to learn about a new function quickly. The subject in vignette 16 is a female, non-English speaking subject. She is a novice user. System Help is also useful for her even when she faces some difficulty in understanding and following the steps in the instruction.

Vignettes 1, 17, 18, and 19 are substantial evidence that the content of System Help is rich in text. Furthermore, it provides many help topics for users to choose. Subjects in vignettes 1 and 19 are female non-English speaking subjects and they are obviously novice users. They comment about System Help, that it gives too much information

and they do not clearly understand the content in the instructions. They have to spend time to read the instructions. Subjects in vignettes 17 and 18 are male, non-English speaking subjects. They are experienced users. They also comment that the content of System Help contains too much information and there are many options to choose from the help topics. Therefore, they prefer to do the task on their own rather than use System Help. They are too impatient to go through all the information in the help topics and in the instructions.

This evidence leads to the conclusion that there are two problems, particularly for novice users, with Natural Language querying. Firstly, users use terms in the queries that the system misunderstands. Secondly, the content of System Help contains a wealth of text as well as offers many alternatives to users that are confusing.

4.4.3 Emerging Characteristics of Users

Vignettes 3 to 8 and 17 are evidence that learning style, attitude, and expertise of users influence the way users use or do not use System Help. The subject in vignette 3 is a male non-English subject and subject in vignette 4 is a female English-speaking subject. They are both experienced users. They believe that System Help cannot help them to complete their tasks because System Help cannot understand and know exactly what they want or detect the problem they are facing at that time to help them to solve the problem. Therefore, they prefer to do their tasks by themselves although they do really need help they still prefer to ask other people to help them rather than ask System Help. The subject in vignette 5 is female English-speaking subject. She is a novice user. She prefers to ask people to help her rather than ask System Help. She does not know how to ask the system or what is the right question to ask the system.

The subject in vignette 17 is male non-English speaking subject. He is an experienced user. He prefers to do the task on his own or ask people to help him rather than ask System Help.

In contrast, the subjects in vignette 6 and 7 are male non-English speaking subjects and the subject in vignette 8 is a female English-speaking subject. They are all experienced users. They have much more experience than subjects in vignette 3,4 and 5. They choose to use System Help to solve their problem with the function of the software that they never used before or not familiar with that function. They are confident to use System Help as described in the vignettes that they ask System Help without searching any menus.

4.5 Chapter conclusion

This chapter presented the data analysis and the interpretation of the data analysis to identify elements of interest of the research objectives. The data collected from pre-test questionnaire, post-test questionnaire, observation, and interview were summarised and integrated to create a series of vignettes, which were then interpreted and discussed.

The next chapter presents a discussion of these in light of the research questions and objectives as well as recommending an issue for further research.

Chapter 5

Discussion and Conclusion

5.1 Introduction

This thesis is an exploratory study. It has described experiments and analysed their data to meet the research objectives as described in the introduction chapter. A literature review presented a discussion of adaptive systems, summarized the background study, described of Usability Tests technique used in the experiment, and characteristics of users. Chapter 3 explained the methodologies and the procedure for this research. Finally, the analysis of the data and the interpretation of the data analysis were presented in chapter 4.

This chapter contains a discussion about the research findings in terms of the research questions and the research objectives. It also describes the limitation of the research and a suggestion for future research in this area.

5.2 Discussion of the research objectives and the research questions

As mentioned in chapter 1, the aim of the research is to explore the effectiveness of computer systems that are sensitive to the users' context. In this research the users' context is take to include their language, gender, user's expertise, and user's personality. In general it would appear that these contexts are too complex for the

adaptive system that is being used in the research, particularly for effective direct intervention by the system in the form of the Office Assistant.

In more detail the interpretation of vignettes from chapter 4 addresses the research objectives and the research questions as stated in chapter 1 as follows:

5.2.1 The effectiveness of the chosen adaptive system in helping the user

As described in the literature review the implementation of the Lumiere User Model in the Microsoft Office products included both direct intervention, with offers of help when the systems detected a need, and also a natural language facility for querying the systems online help.

5.2.1.1 Direct Intervention from the Office Assistant

The most unambiguous result of this research was the failure of the Office Assistant to provide acceptable and useful unsolicited help to users. This facility would no doubt be the most exciting outcome for the Lumiere project researchers from their point of view but was the least interesting in the current research.

The system claims to infer users' goals and needs by observing users' activities with the system and automatically offers suggestion or assistance to users when it detects that users need help. However, when the system interrupts the user with a suggestion or offering the assistance, users have a tendency to ignore any assistance and suggestion from the automated assistance. It was clear from the observations of the Usability tests, the post-test questionnaires and the interviews that the tendency from all subjects ignored any assistance or suggestion from the automated assistance the

"Office Assistant". In the overwhelming number of cases, the subjects kept searching for the right functions from menus, and if the Office Assistant tries to offer help or suggestion to the subjects, they ignore it. They concentrated on searching or doing the given task and do not pay attention to the automated assistance (the Office Assistant). When asking about the Office Assistant in the interview, one of novice subjects does not understand what the Office Assistant is and she is not aware that the Office Assistant is offering her the assistance or suggestions while she is searching through menus.

Of the three subjects who paid attention to the automated assistance (the Office Assistant) only one subject responded to a warning from the Office Assistant reporting that the system did not allow him to do an activity while he is doing the given task. This made him aware of the problem and he found another way to complete the task. Another subject did read the message provided, but he did not respond to the suggestion from the Office Assistant. A third subject read but misunderstood the Office Assistant message.

The design of the Office Assistant and its interaction with the user is based on Bayesian user modelling, developed in the Lumiere project. Horvitz, et al. (1998) explain the Bayesian user modelling is employed to observe and understand a user's needs from user's activity while using the software and then to provide intelligent assistance. Although the users' goals are under uncertainty, Bayesian user model claims to capture the uncertain relationship of users' goals and needs from users' actions and to consider the likelihood those users need assistance. Automated assistance is then offered to guide and give suggestions. This model is used to classify

evidence from users' activities and then assess the time when the user needs assistance.

The implementation of the model in the Office Assistant does this to some extent but it is not well received by the users. One possible reason for this is that users like to be in control and feel that the Office Assistant puts the system in control. Another reason may be that, in spite of the design that animates the Office Assistant, it is not seen to have the believability of a human expert. A third reason may be that an initial bad experience with it, convinces the user that it is not worth considering.

5.2.1.2 Natural Language Querying of the online Help

This aspect of the Microsoft Help system was able to offer some assistance to users to complete their tasks by providing some help content when user requested it from the system. From the observations, some subjects, both novice and experienced users, did receive useful information from System Help when they ask for help from the system. However this was mainly for tasks which users understood reasonably well.

In one case the system provided some help in the learning of new functions in the system. One novice subject completed a task by following an instruction in System Help. She however, had considerable difficulty to clearly understand the content in the Help text. Therefore, she spends a great deal of time to read and understand it before eventually finishing the task. In general, subjects had problems using unfamiliar functions of the system. Even some experienced subjects behaved like novice users for particular functions that they never used before.

For the most experienced users, System Help can provide help topics that relate to users' tasks after users make queries. Users can choose a relevant help topic that they want and be able to follow the steps in the instructions they have chosen. They however have a good understanding of computer terminology and can quickly identify useful information. One problem that many less experienced users encountered was that they used terms in queries that were meaningful to them but not in the Help vocabulary or had a completely different use for them. A second problem was that the text in the Help was far too rich with information and it was hard to distinguish useful from irrelevant parts of the text.

5.2.2 Different user characteristic that influence the use of adaptive systems

This research looked for elements of the users' contexts that appear to influence the effectiveness of adaptive systems as mentioned in chapter 1. The possible characteristics considered were gender, language, user's experience, and user personality. From the observations, gender and language, however, did not appear to have as significant influence as did user's experience and user personality.

From the observation of the Usability test, there are three major characteristics of users that influence the use of the system, which are found. They are:

- Learning style of user
- Attitude of user
- Expertise of user

Learning style of user and attitude of user are the characteristics that relate to user personality. Expertise of user is related to user's experience.

It was found that these three characteristics of users influence the use of the system. Although the system had already adapted to sensitive to users' context, it needed to be concerned more about users' characteristics that influence the way users employ the system.

Learning style preference of users lead to the way users perform a task using the software. Users are more likely to prefer to use the trial and error method when they have frustration using the software. As shown in the tests, subjects always starts doing the tasks by searching menus for unfamiliar functions or functions that they do not use often. Two experienced subjects confirm that they prefer to do their tasks on their own. Even they have frustration using the software, they still prefer to solve it by themselves rather than using System Help. Some, particularly novice users, prefer to ask people who have experience using the software. One novice subject expresses that, normally, she prefers to ask people to help her when she has frustration using the software. She never uses System Help and she does not know how to use it.

Attitude of users toward the software also influence the way they use the software. Users do not have a good impression of the system because they believe that the computer is not as intelligent as humans. Therefore, users will not ask for help from the system if they believe that the system cannot understand their problem using the system and cannot provide the appropriate solution for them. Two experienced subjects believe that the help from the system cannot help them to complete their tasks if they have problems using functions of the system. Their reason is the system cannot understand and know exactly what they want or what problem they have while performing the tasks at that moment. Therefore, the system cannot provide useful

assistance to solve their problem straight away. This reason makes them prefer to do the tasks on their own or even if they really do need help they still prefer to ask experienced people rather than ask for help from the system.

Furthermore, users are impatient to read through all the instructions that are offered by System Help. They do not want to spend time to choose the help topics and read it through. They prefer to do their tasks on their own rather than use System Help. They believe that they can finish their tasks on their own quickly rather than use System Help as two experienced subjects commented during the interview.

Expertise of users is another users' characteristic that influence how users use the software. Experienced users may have some difficulties using the system when they use new functions of the system or functions they do not use often. They may become novice for those particular functions of the system (Nielsen, 1993, p.45). Therefore, they need help from the system. Moreover, the use of language, both technical language and spoken language, also influences the way users use the software. Experienced users understand more technical terms than novice users. Therefore, they are more confident and more successful when using System Help than novice users. In the test, there are three experienced subjects who obviously have much more experience than other subjects. They perform subtasks they have never used before by asking System Help straight away without searching any menu.

5.2.3 The limitations of adaptive systems

As is clear from the results of this research the Office Assistant did not contribute to any great understanding of effective adaptive software systems. Of more interest and promise was the natural language querying facility.

From the data analysis, it is found that the limitation of this aspect of the system is that users, particularly novice users, cannot use common words in their queries to describe unfamiliar software functions. The language of the user's queries does not match the language that is understood by System Help. Subjects have difficulties getting answers from System Help when they ask for assistance in words that are meaningful to them. System Help does not understand the common words that are used in the users' queries. Therefore, it gives the answers that are irrelevant to subjects' tasks. The data reveals that novice subjects have particular difficulties in asking for assistance from System Help when they have problems using the system to complete their tasks. One of subjects asks for assistance when she cannot find a function menu to create a graph. She types the word "diagram" in the query to search for graph instead of the words "graph" or "chart" that the system understands. System Help, therefore, gives her instructions that are not related to her task. She fails to create a graph from the instruction and then she gives up to do this task. She feels nervous after System Help offers her the wrong instructions. Another subject has a problem using System Help when she cannot find the function menu to create a page border. She types the word "frame" to search for border function menu in her query. She calls this task "frame" but this is not the same meaning as used in the system. System Help gives her help topics for creating frames but not for creating borders. Therefore, she fails to complete this sub-task. As a result, the subjects misunderstood

the instructions that are provided by System Help. In fact, System Help misinterpreted their queries and offer the irrelevant help topics to them.

Once again the natural language processor of MS Office 2000 help relied on the Bayesian user model of the Lumiere project. Heckerman and Hovitz (1998) describe how the Bayesian models focussed on integrating additional discrimination and structure about language usage and user aims. The Bayesian Information retrieval system constructs probabilistic knowledge bases for interpreting user queries. In MS Office 2000 the size of the Bayesian Information Retrieval knowledge bases was scaled up to provide more abstraction of terms to cover a large class of user problems and to decrease the number of evaluation and links. It considers key words, phrases, and sentences used in the user's query. The concept of Metanym was developed to refer to sets of words including phrases that indicate the same basic concept of user problems in order to reduce the number of links and assessments. This concept can define the common words that have the same concept and group into a word to provide appropriate help topics to users as described in chapter 2. When a user asks for assistance by typing common words describing his/her problem in the query, the key word, phrase, or sentence in the query would be analysed. System Help should provide appropriate help topics related to the words that are being used in the query after analysing and retrieving the information from the knowledge bases.

The content of System Help contains a wealth of text as well as offers many alternatives to users. Users were too impatient to read the whole instructions in System Help. System Help offers many help topics so that the relevant help users need is hard to find. As in the observation, subjects sometimes choose wrong options

from the return list of the help topics. Thus, they cannot complete their tasks or even take time to understand the contents in System Help. As a result, users prefer to explore menus and toolbars on their own rather than asking for help from the system. In the estimation of most users, this would take longer time than if they tried to search by themselves.

Even though the system is able to infer users' goals and needs as discussion earlier, users still ignore its appearance to offer suggestion or assistance. Reasons for the ignorance of users to the automated assistance could be

- The system does not provide appropriate assistance at the right time. Therefore, users do not welcome its appearance.
- The system does infer users need assistance, however, it offers completely inappropriate assistance or suggestions.

5.3 Conclusion of the research

This research aims to assess the effectiveness of an existing adaptive system based on the Bayesian user model. As a result of this research, the system is able to provide some assistance to users when users ask for help from System Help. It offers help topics that relate to users' task to users who are both novice and experienced. Furthermore, it is able to infer users' goals and needs by observing from users interacting with the system. Users will receive automatically a message from the system to offer assistance or suggestion. However, most users ignore or even resent this.

It can be concluded that the adaptive system can occasionally infer users' goals and needs by capturing users' activities and providing assistance at the right time. It is useful for some users in some situations and succeeds in offering useful suggestions and assistance because some subjects benefit from the system when it tries to offer suggestions. However, at other times subjects ignore the automated assistance while they are working on their tasks. They do not welcome the appearance of the autonomous assistance in the system.

The characteristics of users are more likely to have an influence on the effectiveness of the systems, although the system has been adapted to be more sensitive to users' context. Learning style, attitude, and expertise of users are the characteristics of users that influence the way users use the system. When users have frustration using the software functions, they usually try to find the way on their own. Furthermore, they believe that the system cannot understand and detect what they want or what problem they have at the time they use the system, users prefer to solve it by themselves or ask an experienced person rather than ask System Help.

In addition, users, particularly novice users, are not able to make queries with common words to communicate with the systems because the system cannot understand the word being used in the query. It often provides a list of help topics that do not relate to the users' tasks. Users misunderstand that they do not understand the contents of the help topics whereas the system misinterpret the queries users make and offer irrelevant help topics.

Even though the system observed users' actions and balanced the benefits and costs before offering the assistance or suggestion to users, it rarely provides assistance to users at the right time or even provides completely inappropriate assistance or suggestion.

This research shows that the adaptive system used in this project has limited ability to support users accomplish their goals. Users will ignore the support from the system if it is not at the right time. Furthermore, some of users' characteristics influence the way users employ the system. Hence, the sensitivity of the system to context should be enhanced because the system would make a wrong interpretation of users' requirements.

5.4 The limitation of the research

This research used a methodology based on laboratory experiments only. The use of this method has limitations. The same results may not be achieved in the real world. It is difficult to control context or environment in the work places as you can in the laboratory. Thus, there are many contextual factors that can affect the efficiency of computer systems outside the laboratory.

Another limitation of this research is the small amount of subjects used. There would be more varied data to analyse for the research if the number of subjects who participate in the experiment was increased. However, the period of time for doing this research was limited.

5.5 Future research

The results of this research have shown that the language used in computer systems help does not match the language that users use in performing their tasks. The competence of users, when using computers, are different. Experienced users may understand more technical terms and language, about systems' functions, than do novice users. When users have problems using a system, they may ask for help from System Help. However, the communication between users and the system may not run as smoothly as the user expects. Common words being used in users' queries to describe system functions are not understood by the system. Therefore, the system does not provide assistance to users, as it should, even though they have been developed to be user-friendly systems.

The characteristics of users affect how users use the system. Even though, the systems interface was developed to be more intelligent and friendly to users. It tries to make users feel confident and comfortable to communicate with the systems. However, the characteristics of users are different that influence the use of the system. Therefore, these 2 problems should be studied in the future. This future research should focus on aspects of user's language and user's characteristics and how these influence the effectiveness of computer systems.

Furthermore, the use of laboratory experiments for this research has not given much hindsight into the definition of context and whether context has effect on the adaptive systems. It would be interesting for future research to study this area in more depth. Research should be done both in a laboratory and in a real organization.

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Appendix A

Instruction and Task sheet

Instruction

You are to play the role of the secretary of the financial department of the local council.

As part of Annual report, use Microsoft Word to produce an executive summary document exactly as shown on the accompanying sheet.

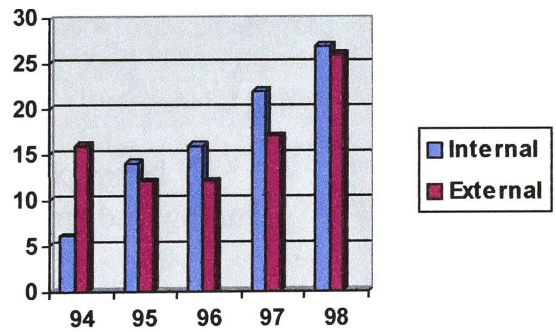
Financial Performance '98

Restricted Cash

Internal Restrictions - Council can resolve to set aside its own funds for future projects or works. Where Council resolve to do this and the funds have not been spent at the end of the financial year, these funds must be held as restricted cash.

Year	94	95	96	97	98
Internal	6	14	16	22	27
External	16	12	12	17	26

Table 1: Restricted cash



APPENDIX B

Pre – test Questionnaire

This research project concerns the use of Microsoft Office 2000.

Please answer the following questions by placing a TICK in front of the appropriate answer.

Occupational status:
- Full- time employment
- Part – time employment
- Unemployed
- Retired

Student status:
- Full – time student
- Part – time student
- Not a student

What is your age?
- 19 – 35 years
- 36 – 50 years
- 51 – 65 years
- Over 65

Your gender:
- Male
- Female

You are:
- English speaking background
- Non – English speaking background

Your highest level of education
- School certificate
- Higher school certificate
- Undergraduate degree
- Postgraduate degree
- Other _____ _

For how long, have you been using computer?

Approximately one year
Approximately 2 – 3 years
More than 5 years
Other _____

On average, how often do you use computer?

Daily
Once or twice a week
Once or twice a month
Other _____

What do you usually use computer for? (Mark more than one if applicable)

To write a document
To search Internet
☐ To check email
To play computer games
Other _____

What kind of computer do you use?

IBM PC
Macintosh
Both

What Operation system do you use? (Mark more than one if applicable)

☐ Windows 95 ☐ Window 98 ☐ Window 2000
☐ Dos
☐ Linux 2.3 ☐ Linux 2.4 ☐ Linux 2.5
☐ Unix
☐ Other (Please specify)_____

What productivity software do you use? (Mark more than one if applicable)

Word processor: ☐MS word 2000 ☐ MS word 98 ☐ MS word 97
☐ Other (please specify) _____

Spreadsheet: ☐ Excel 2000 ☐ Excel 98 ☐ Excel 97
☐ Other (please specify) _____

Database: ☐ Oracle ☐ Access ☐ SQL ☐ FoxPro

Browser: ☐ Netscape ☐ Internet Explorer
☐ Other (please specify) _____

How experienced are you in using this software?
□ I have much experience to use
□ I'm not bad at using it
□ I have a little experience
□ I don't know much about it

On average, how often do you use it?
Daily
Once or twice a week
Other _____

What do you usually use this software for? (Mark more than one if applicable)
To write a document
To calculate the data
To make a schedule
□ To find some information
□ To check email
Other _____

What kind of help do you use when you have a problem using the software? (Mark more than one if applicable)
Help menu in the software
Help Documentation (Hard copy)
Ask an experienced person
Other _____

How useful do you find the computer help system?
I can always find the answer
I can find the answer most of the time
I often have to give up and ask for somebody's help
Other _____

How confident do you feel when using the computer help system?
It is easy for me to use it
It takes a time to find the solution
I always have a problem with using the help system
Other _____

APPENDIX C

Post - test Questionnaires

Please answer the following questions after finishing the task.

The given task for me was
Difficult
Not too difficult
Easy

How do you feel about MS office 2000 in this task?
It was easy to use
□ It was easy to use most of the time
It was difficult for me
Other _____

How often did you feel that you needed help in using MS office 2000?
□ I did not need it
□ Sometimes
□ Often
□ I needed it almost all the time

How did you feel about the appearance of the MS Office Assistant?
It appeared just at the right time when I needed help
Sometimes it was helpful
It was OK but sometimes annoying
It was quite annoying
Other _____

Did you find the MS Office Assistant easy to use?
It was easy for me to use it
I had some difficulties in finding the answer
It was hard for me to find the answer most of the time
I could not find any useful information there
Other _____

Appendix D

Interview Question

Questions

1.What problem did you have when using the software for this task?

2. If you used System Help, did it respond to you in an appropriate way?

3. Which part of the system was the most difficult for you to use?

4. How did you feel when Office Assistant tried to help you to do your task?

5. In your opinion, which parts of this word processor should be adapted or changed?

6. What other help facilities would you like the system should have?

Appendix E

Interview answer sheet

Question 1: What problem did you have when using the software for this task?

Subject	Answer
1	"I never used the line around this (border). I tried to do that. But it is not really difficult."
2	"I had a problem looking for the graph, how to make the graph. I was not aware that I could make the graph from MS word. I did not know this feature."
3	"The help is too lengthy. I am too lazy to read it. It is better if you write down something shorter. I find it is difficult because I did not understand about it. I cannot say that it is easy or difficult because I cannot compare with the previous version. But it is ok. It is easy if I can do something like graph just go through the instruction put the number then clicked and it came up with graph."
4	"Yes, I had a problem about graph. I could not get rid of the number and it is different from the given sheet."
5	"Because it is the first time for me to use it. I am a little bit nervous just like exam. I think I can find the answer but it will take long time."
6	"For this task, may be it just like some option that I never knew before. That's why the first time that I'd like to do this task. I thought about how I can do that. How I can use this software to design graph."
7	"It was a little thing that I could not seem to fix like the little yellow box and one of border."

8	"I have not had enough experienced to know where everything is quickly. I am very slow. It takes my time. I could not study about it. Yes, I would eventually get there but I had to think. Next time will be better. I have to read through but I did not read just tried to find a short cut to do the task."
9	"To set up the table. It does not appear as it looks, as you want. I have no idea properly. It may relate to this frame (border) that I put it at first because I had tried and there is no option to control the size of the table."
10	"It is just a little thing. I had a problem with graph but not much. I wanted to find the menu where it was and tried to figure out and found it is easy."

Question 2: If you used System Help, did it respond to you in an appropriate way?

Subject	Answer
1	"Did not use it."
2	"It gave too many options and too much of text to read. Normally, most of the time I do not use help. I try to find it myself or ask someone else if I really cannot find it. I was looking for the chart and looking from the tool bar to find anything that looked like the chart but I could not find it then I asked for help. I think the help has too many options to go through."
3	"It might be a good answer but for me I do not understand. I could not catch the word because there is too much detail and I am lazy to read it all. Help is too lengthy. You do not get to the point. Some people like me I do not know how to use it even when I read it I do not understand what they said."
4	"Yes, when I was looking for border when I typed "border" it just showed me where it is. It is easy."
5	"I think I can. But sometimes I misunderstand what they are talking about. A chart and diagram is one example that I misunderstand."
6	"Yes, because it showed the information that related to the topic and relate to the keyword that I wanted to search."
7	"Yes, it was good. I typed my question and it came up straight away what I wanted to know."
8	"The help, I do not know how to ask the right question may be if I know what to ask it will be better. But you do not know what to ask then you cannot get an answer. When you know the right word to ask it will be better. It is so confusing."
9	" I do not know. I did not use it."
10	" I did not use it because I always find the way on my own. I never like to use System Help even though I know it is easier."

Question 3: Which part of the system was the most difficult for you to use?

Subject	Answer
1	"May be graph because I did not know that I could create graph from MS word. I thought that I had to import graph from excel. But when I tried to find from insert menu and I found it. And another thing is border but it is not too difficult."
2	"Not really difficult to work on it."
3	"Create frame" (border)
4	"Not too difficult."
5	"Graph because I could not do it."
6	"May be I think it is border because it was the last part that I have done for this task."
7	"Chart I never put the chart. I did not know that it can create chart. I use table, border but never use chart. Normally, I create it from excel."
8	"The border and the graph"
9	"Not really. Just about setting the table, I did not expect this problem happened before."
10	"The border and the graph but not much"

Question 4: How did you feel when Office Assistant tried to help you to do your task?

Subject	Answer
1	"For this task, it was ok for me because once it told me that I could not do it like this when I tried to copy the whole document and paste on the text box. But at other times I ignored it."
2	"I think sometimes it is annoying but this is not too annoying. But with some of the other option it is quite annoy. I would not prefer something or this thing when I am typing I prefer to close it and try by myself."
3	"It is ok. I like a dog. It is much better than other character. I ignored it if you put some picture that I do not like it may annoy me. For this one it is ok because it is cute. I think it depends on the picture."
4	"When I did this task it was easy to find the help. But usually when I use it, it gives too many answers like when I typed something and it gave some options then I needed to click on it. If I know it I can find it if I have no idea about this it is hard to find the answer. It just keeps giving many options when typing the question it shows 4-5 options when I click on one option it will show another 4-5 options and so on."
5	"I think it is too boring for me. That's why I just want to try. I do not want to read all of the instructions because sometimes we can still make mistakes. That's why it would take longer time than when you just try it by yourself."
6	"For this task, it was not annoying me. But actually when I use this software I prefer to close it because sometimes it is really annoying."
7	"It did not really help me you know when it came up with a bulb no I did not get it."
8	"No I did not get it."
9	"I think I am not in the position to criticise System Help. I do not have experience using it when I use this software. Normally, I just ignore it."

10	"I just ignored it. I actually never use it."

Question 5: In your opinion, which parts of this word processor should be adapted or changed?

Subject	Answer
1	"It is ok now. Easy to use."
2	"It is ok. I think most of the thing is ok."
3	"For system help, you have to write something shorter and get to the point. Other structure is ok."
4	"It is quite ok."
5	"I think for example the word "object". I don't understand or may be I misunderstand what exactly the object in English means. That's why I couldn't figure it out. I think 98 is better you don't need to figure it out what's object. But I could find object because I use help so that means sometimes help is useful."
6	"I think it is alright. It can help users to design documents or reports. It is good."
7	"It is already changed like the chart function."
8	"It is ok."
9	"I have no idea. And I think it is ok now."
10	"May be having the tools at the top of the window. May be it has but you have to know where it is and to know how to use it."

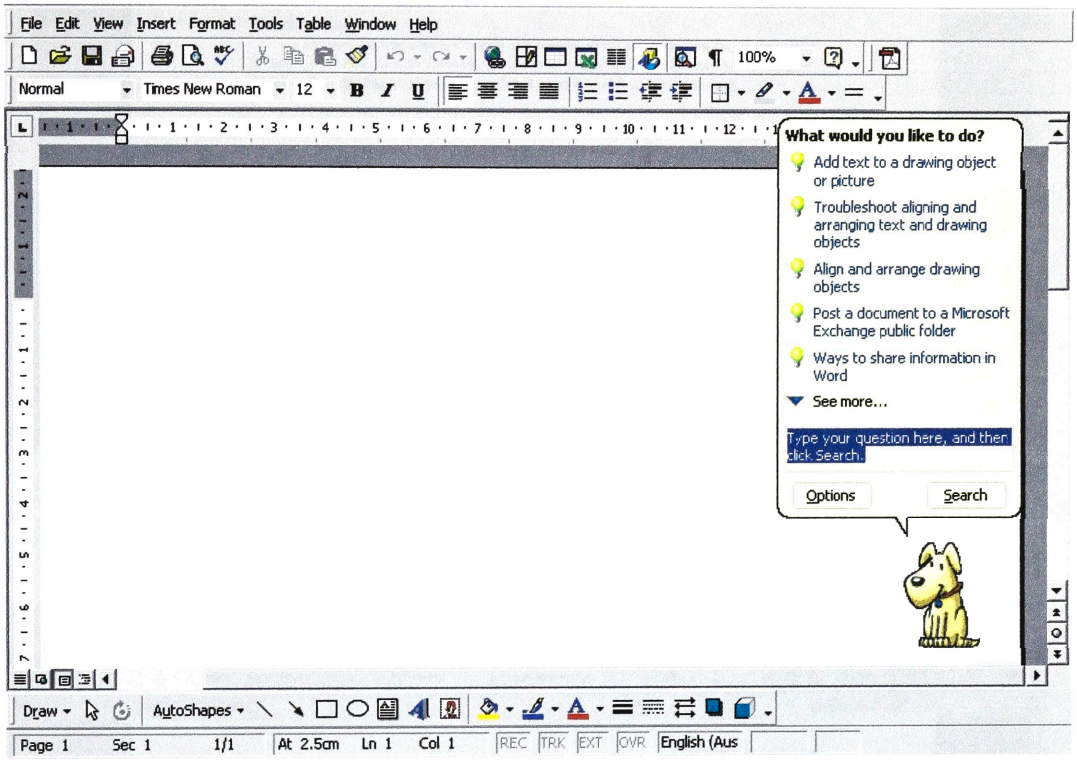
Question 6: What other help facilities would you like the system should have?

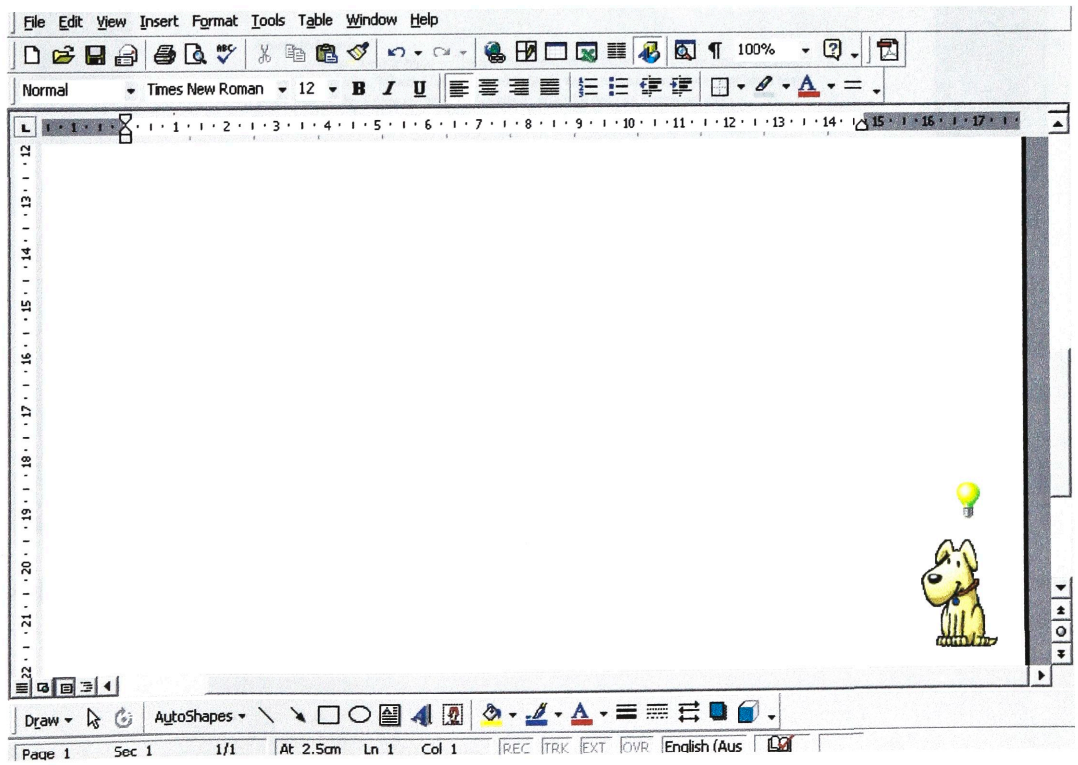
Subject	Answer
1	"System Help should be automatically done for users when they ask for something. Then they do not need to go through the instruction that is quite long to read all and sometimes cannot get any answer."
2	"When you select something and right click on it. It comes up with several options and these options should have "Help" that relate to this thing so you do not need to go to help menu."
3	"Do not know"
4	"These days they have customize help if you use website and you have personnel email address. They support personnel address book. If you have some kind of customize help. I do not need to go to this menu at all the time. May be I can make up my own help. Let say I am looking for border and it show many answers and then I just customize help and it is going to be my own help. It should be ok because I do not actually know this and it's I am looking for. And I do not need to go through the help just click on my own help and it will show 10 – 20 words. Then I choose the word that I want to know because I have some problem with this and this is I am looking for. I want to have customize help option."
5	"I do not have an idea now because it is too complicate. I think it depends on person because I used it just for document."
6	"I think it is covered all I need."
7	"It is ok now."
8	"It is ok."

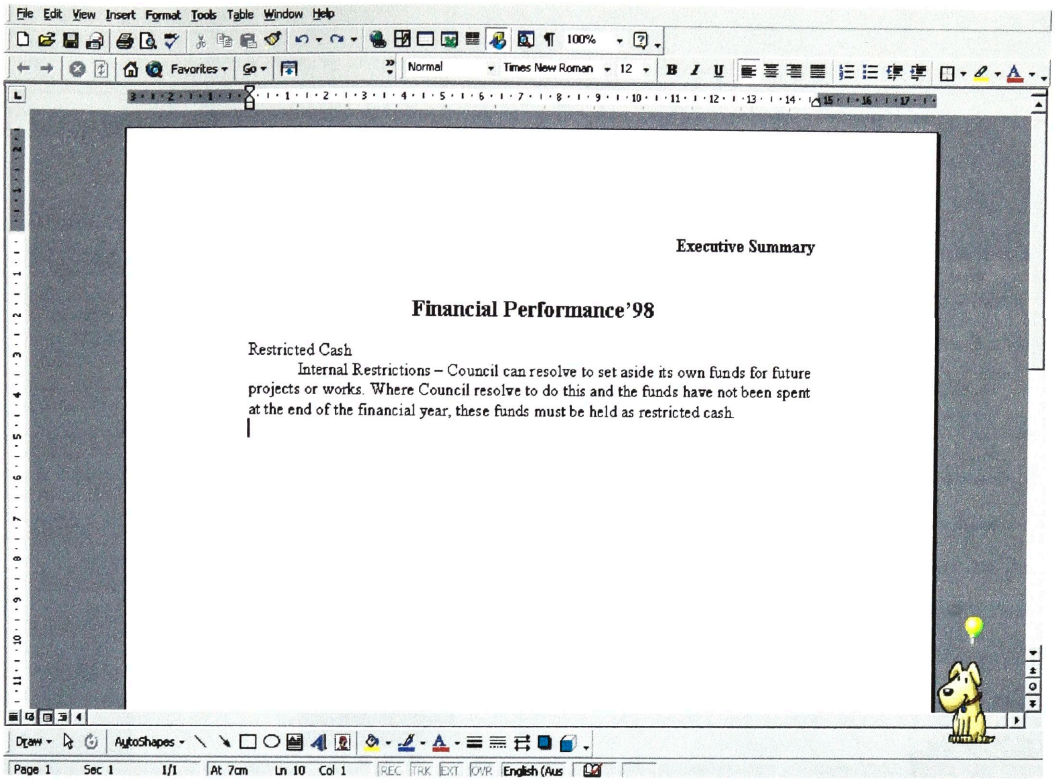
9	"I think artificial intelligent item can be include in the system. If the system can detect that I am trying to do something over and over again. This can indicate that I have some problem on this particular type of thing. There should be some notice or suggestion that appear suddenly what I should do exactly. It should detect our action automatically rather than we consult with the system. That is why I said it should have artificial intelligent item build into the system. If I try 3 – 4 times to do something, the system should know that I have some problem with this and give me a suggestion straight away without asking for help. However, if I try to use System Help I may not find the information what I want, in that case, what System Help helps me."
10	"No. I know it does already have something in the system. But I am the type of person that always likes to do thing on my own. So that is why I do it like this. If I do need help, I would actually rather ask someone or talk to someone rather than use System Help. I do not even know what the help does. I never use it may be it could help. I am sure it does not know exactly what I want to do but when I ask someone. I can tell them exactly what I want to do. If I cannot find someone else at that time I guess I can work it out on my own. I do not use System Help but usually I am just typing up like assignments or something. I do not need help. It is just straightforward."

Appendix F

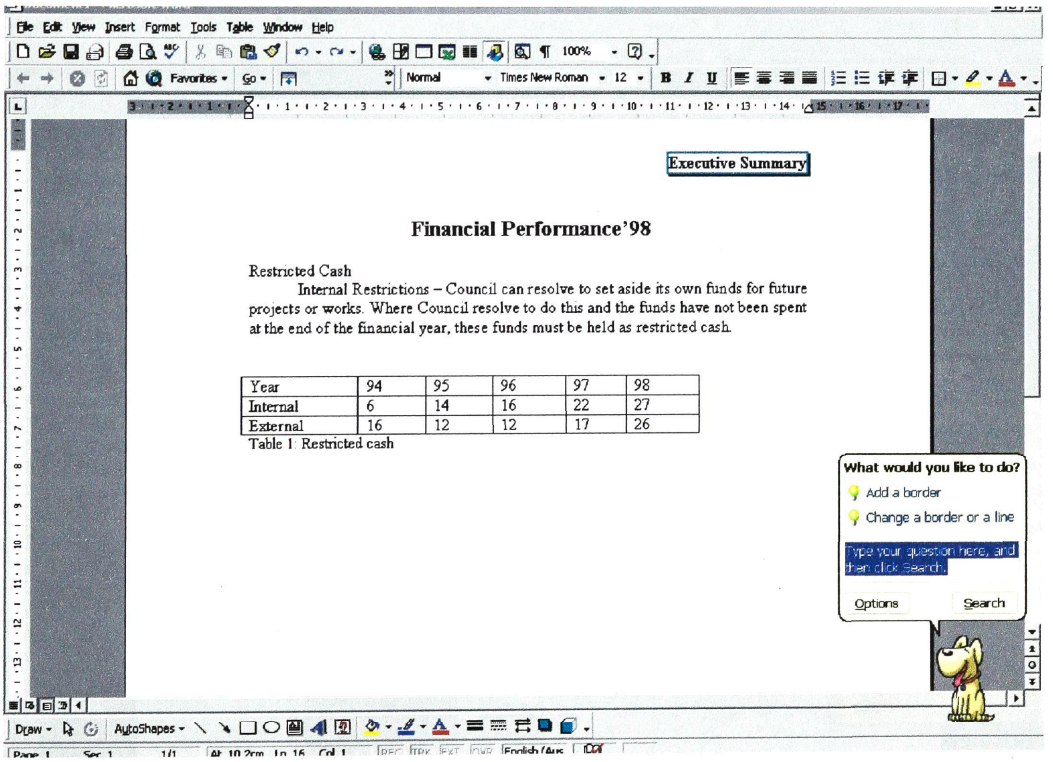
The Office Assistant



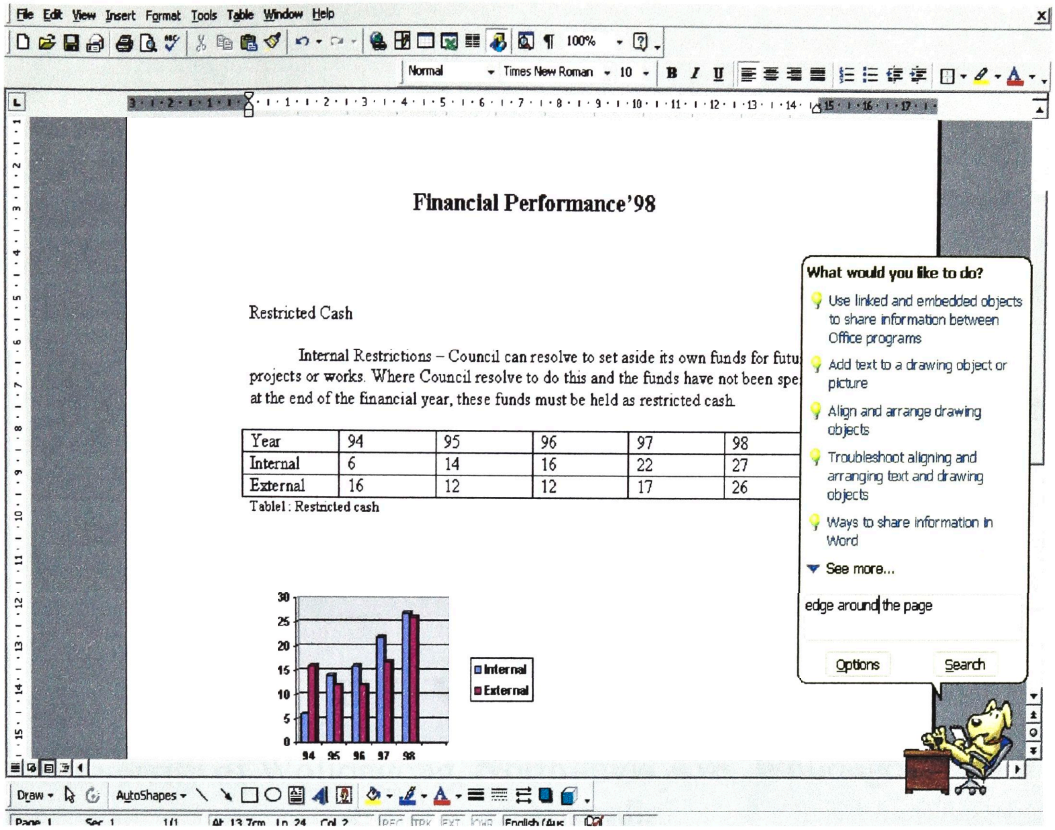




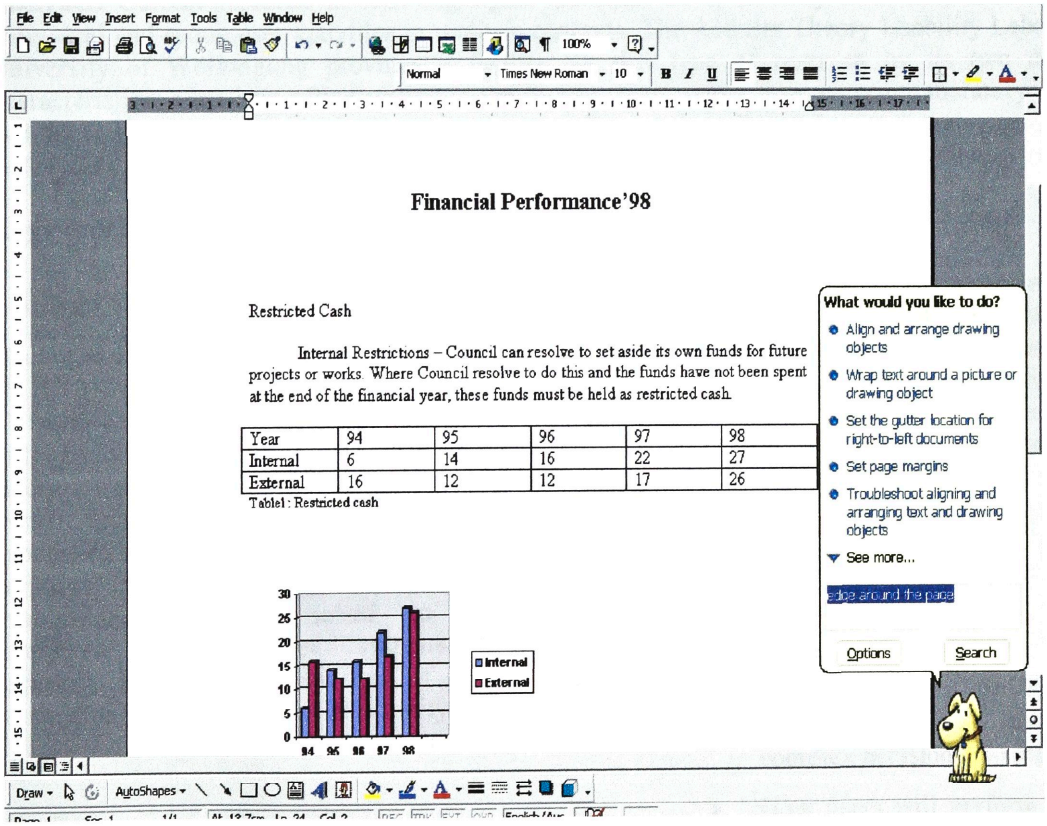
A bulb appears while a subject tries to find sub menu to insert the table.



The Office Assistant offers help to a subject while she tries to create the page border.



A subject tries to create the page border then she queries System Help using the phrase "edge around the page".



In response to the subject's query, the System Help gives irrelevant topics to her.

Appendix G

Diagram of Usability Laboratory

This appendix contains a paper presented as a Laboratory Overview at INTERACT 2001.

Activity Theory Usability Laboratory (ATUL)

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Abstract: Current research in HCI highlights the need for a usability laboratory whose focus is on individual and group user activities in realistic contexts. The Activity Theory Usability Laboratory at the University of Wollongong provides a facility for this type of research by its two distinguishing characteristics: a realistic office setting in the testing room, rather than a sterile laboratory environment; and the equipment set up which allows the capture of, not only individual users, but also group interaction as they undertake activities for which the product being tested is being used as a mediating tool.

Keywords: usability testing, Activity Theory, context

1 Overview

The Activity Theory Usability Laboratory (ATUL) was established recently at the University of Wollongong (Australia) to carry out usability testing of software and information systems that support practical human activities, either as individuals or in groups. The research conducted at ATUL employs an innovative approach to usability evaluation particularly suited to highly interactive and complex systems. This approach is the direct outcome of original research into the application of Activity Theory to information systems.

2 Background

Current usability testing methods primarily involve observations of individual computer interacting with software or information systems prototypes in especially equipped laboratories or less formal settings. The metrics employed in this traditional usability testing process relate to mainly to human cognitive abilities such as memory, perception and motor skills, while types of measurements include time taken to complete tasks, error-rates and scaled perceived ease of use. These methods are deemed suitable for transaction processing and similar operational systems, however, they fail to account for several factors critical to the success of leading edge IT. Currently there is no method or facility that effectively evaluates:

- The ability of an information system to support user tasks involving complex decision-making
- How users will perform in the future when they graduate from novice to experienced use
- How well a system supports activities involving groups of users

- How the use of a system is affected by the environment and context of use.

ATUL provides a usability evaluation facility and assessment procedure that allow researchers to capture and analyse group activities mediated by computer tools in a specific context of use by

- providing rich feedback on the usability of systems supporting complex group activities
- allowing facilitators to work with users to simulate experienced use of the system
- recording the activities and interaction of groups using the system as a mediating tool
- simulating a natural user environment and context of use.

3 Objective and Services

The principal objective of ATUL is to conduct HCI research through formal usability testing and product evaluations in a realistic context, which provides for the analysis of group activities and interaction, using an Activity Theory methodological approach.

The services offered by ATUL, in relation to existing software products, websites or prototypes, include:

- setting the product usability goals and identifying key user activities
- test planning, with or without a facilitator
- enlisting typical users to conduct tests
- conducting the usability evaluation in the laboratory
- interpreting results in terms of activities

4 Layout and Set Up

Currently, ATUL is housed in a cottage located on the university's main campus and consist of two rooms. The testing room has been set up to simulate a typical office environment, however, the layout is flexible to accommodate any type of scenario or environment. Two cameras have been unobtrusively positioned at selected points from which the activities taking place in the room can be captured. One camera is focused on the user or participant, capturing facial expressions, hand movements on the mouse, keyboard and related documents, and any sound or verbal comments made by the users, while the other camera provides a wide shot angle of the entire room in simulating group activities. The associated computer screen images and actions are captured using a scan converter to create a synchronised

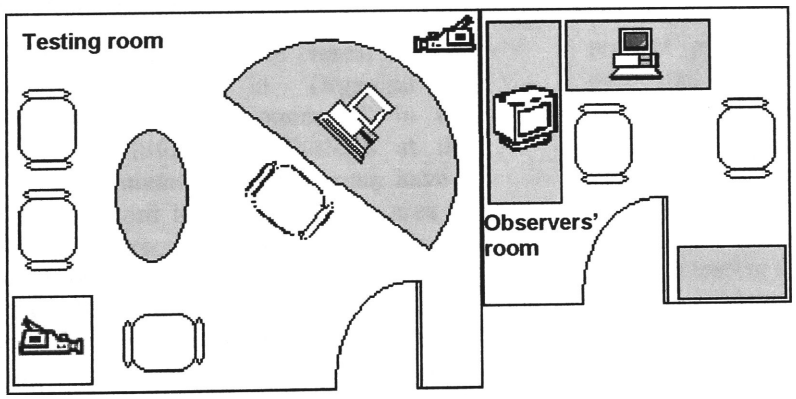


Figure 1: ATUL layout

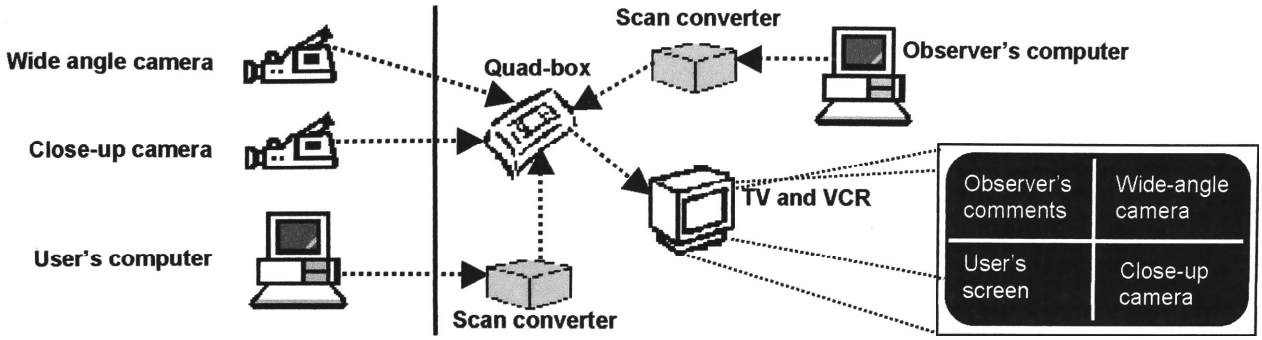


Figure 2: Equipment configuration

high-quality video image that is recorded. This set up permits either real-time viewing and discussion or delayed analysis of the recorded sessions. The video input from the scan converter is fed through a quad-box in the control room, allowing synchronised multiple views on the TV screen at once. The observer also has the ability to add his/her comments using a computer in the control room and display those on the TV screen simultaneously through a second scan converter. A diagram of the lab layout and the equipment configuration are shown in Figures 1 and 2 respectively

5 Laboratory Personnel

ATUL is operated by the research unit "Information Systems in Organisations: Activity Theory and E-Commerce" in the Department of Information Systems at the university. The members of this group have a considerable record in researching the area of HCI as well as practical expertise. Technically the group specialises in the development of interactive GUI prototypes and quick web page development, in particular those interfaces used to access database information. The research group has been invited to present workshops and tutorials on their methods at several prestigious conferences including Interact97, the DSS99, ACIS98 and OZCHI2000.

6 Current Projects and Partners

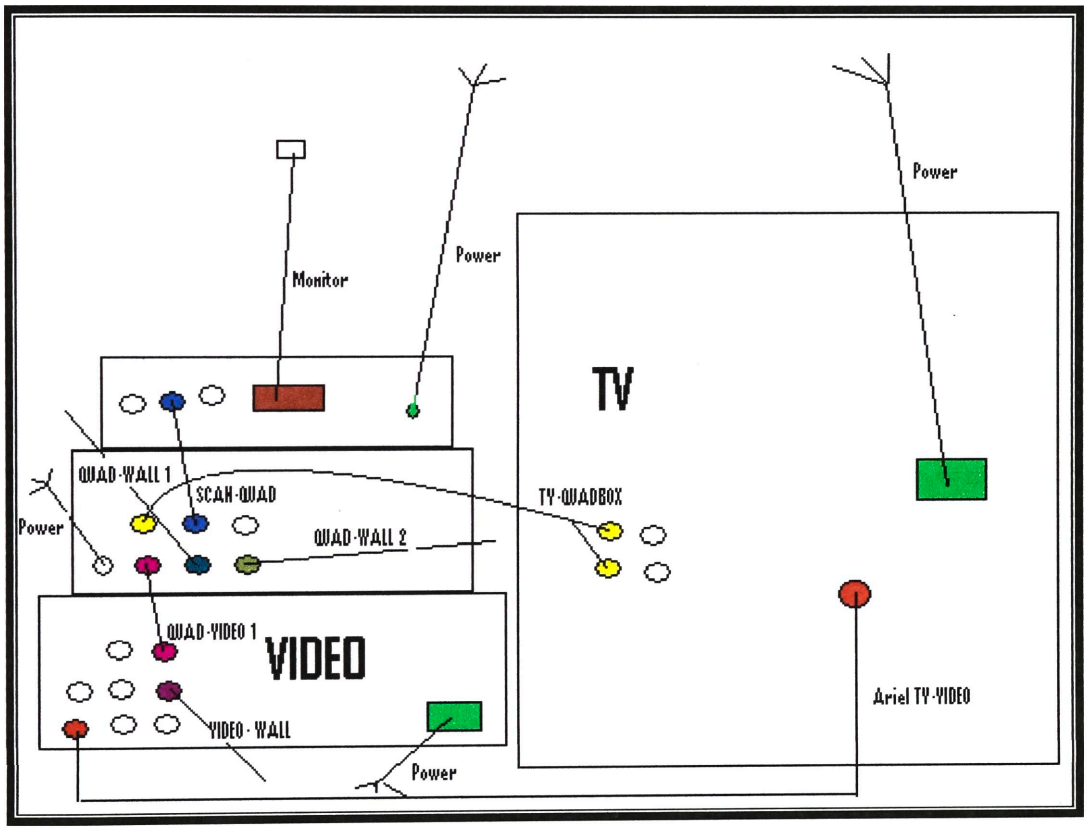
ATUL personnel are involved in developing and evaluating innovative software products in the areas of education management and training, management and executive information systems, group support systems and knowledge management tools. There is also a demand for commercial use of the facility by potential clients dissatisfied with formal reporting methods from existing usability laboratories. Interviews with these potential clients indicate their preference for interpretive analysis of users interacting with product prototypes in realistic settings. In particular, the clients have an interest in monitoring the quality of thinking and decision making supported by technology and the ways in which contextual factorsimpact on the ways people interact with the technology. ATUL is able to provide either videotaped records of usability testing sessions alone or accompanied by an expert interpretation.

ATUL also supports the work of a Cross-Institution team who study and develop innovative distributed technologies to support knowledge architectures in organisations. The collaborating partners include

- the Novae Research Group at National Innovation Centre in the Australian Technology Park
- the Enterprise Social Learning Architecture Task Group, DSTO Canberra
- The Performance Technologies Group Sydney

Appendix H

TV, Video, Scan Converter, & Quad Box Setup



TV-QUADBOX Cable

- Goes into the TV INPUT, with red on the top and black on the bottom
- On the QUAD BOX the red goes into the MONITOR OUTPUT socket

QUAD-WALL 1&2

- For the video camera, labeled A and V for audio and visual plugs into the camera

Setup to view and record

- When video is turned off, switch to channel AV to display the QUADBOX output
- When video is turned on, switch to channel 0 to display QUADBOX output
- Can only see 4 quadrants on the video

Recording

1. Switch the power on at the power point for all devices
2. Turn the VCR on
3. Put a tape in the VCR
4. Plug the camera in – A for audio, V for video
5. Turn the computer on
6. Turn the TV on, channel 0
7. Press record

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