Universiti Teknologi MARA

User Interface for Elaboration Theory
Based on Adept Model

Jamilah Binti Adam

Thesis submitted in fulfillment of the requirements for
Bachelor of Science (Hons) Information Technology
Faculty of Information Technology And
Quantitative Science

April 2005
ACKNOWLEDGMENT

Alhamdullillah, praise is to Allah The Almighty and The must Gracious where with His utmost blessings, I am able to finish this thesis. Firstly, I would like to give my appreciation to my lecturer Pn. Zaidah Bt Ibrahim and my supervisor, Mr Mohd. Faisal bin Ibrahim for their effort and assistance provided throughout the preparation until completion of this thesis.

Secondly, I am also would like to convey my sincere thanks to my husband, his family and my own family, for all the sacrifices, moral supports and encouragements given to me that allow me to finish my thesis beyond the limited time.

And finally, to all my friends, especially to my classmate group 6B, semester Nov-April 2005, thank you for your support, cooperations and motivations. Only Almighty Allah s.w.t can reciprocate your contributions to successful completion this thesis.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>ii</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>viii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>ix</td>
</tr>
</tbody>
</table>

## CHAPTER ONE : Introduction

1.1 Background of the project                      | 1    |
1.2 Project Description                            | 2    |
1.3 Project Scope                                  | 3    |
1.4 Project Objective                              | 3    |
1.5 Problem Significance                           | 4    |

## CHAPTER TWO : Theoretical Consideration

2.1 Introduction                                   | 5    |
2.2 Elaboration theory                             | 6    |
   2.2.1 Elaborative sequences                      | 6    |
   2.2.2 Learning Prerequisite sequences            | 8    |
   2.2.3 Summary                                    | 8    |
   2.2.4 Synthesis                                  | 8    |
   2.2.5 Analogies                                  | 9    |
   2.2.6 Cognitive strategies                       | 9    |
   2.2.7 Learner control                            | 9    |
2.3 User Interface Model                           | 9    |
   2.3.1 Adept Model                                | 9    |
      2.3.1.1 The Task Model.                       | 12   |
      2.3.1.2 The User Model.                       | 17   |

COPYRIGHT © UiTM
2.3.1.3 The Abstract Interface Model 17
2.3.1.4 The Concrete Interface Model 18

2.4 User Interface Design
2.4.1 Tools and Model 19
2.4.2 Interaction design 19

CHAPTER THREE : Literature Review
3.1 Higher Education 20
3.2 Capabilities of the World Wide Web
3.2.1 Global Reach 22
3.2.2 Interactivity 23
3.2.3 Support for multiple content types 23
3.2.4 Support for transactions 24
3.2.5 Online computing functions 24
3.2.6 Support for active social spaces 24
3.2.7 Support for system Adaptivity, User, Customization, and Site-Wide Modification 25
3.3 E-learning 26
3.4 Computer Aided Design 27
3.5 Adept model 28
3.6 Summary 28

CHAPTER FOUR : Research Methods and Development
4.1 Introduction UI Development 29
4.2 Analysis
4.3.1 User Group Analysis 31
4.3.2 Task Analysis 33
4.3 Design
4.3.1 Abstract Interface Model 41
4.3.2 Concrete Interface Model 44
### CHAPTER FIVE : Results and Findings

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Data Analysis</td>
<td>50</td>
</tr>
<tr>
<td>5.2 Design</td>
<td></td>
</tr>
<tr>
<td>5.2.1 Design Strategies</td>
<td>50</td>
</tr>
<tr>
<td>5.2.2 Tools in Interface</td>
<td>55</td>
</tr>
<tr>
<td>5.3 Interface-Flow Diagram</td>
<td>59</td>
</tr>
<tr>
<td>5.4 Output of User Interface</td>
<td>60</td>
</tr>
</tbody>
</table>

### CHAPTER SIX : Summary, Conclusion and Recommendation

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Summary</td>
<td>62</td>
</tr>
<tr>
<td>6.2 Conclusion</td>
<td></td>
</tr>
<tr>
<td>6.2.1 Difficulties encountered</td>
<td>63</td>
</tr>
<tr>
<td>6.3 Recommendation</td>
<td>64</td>
</tr>
</tbody>
</table>

### REFERENCES

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix A</td>
<td>Javascript coding for Question page</td>
</tr>
<tr>
<td>Appendix B</td>
<td>Interface-flow diagram for Data Transmission Screen</td>
</tr>
<tr>
<td>Appendix C</td>
<td>A Sample for normal page</td>
</tr>
<tr>
<td>Appendix D</td>
<td>A Sample for animated page</td>
</tr>
<tr>
<td>Appendix E</td>
<td>A Sample for question page</td>
</tr>
<tr>
<td>Appendix F</td>
<td>A Sample for movie page</td>
</tr>
</tbody>
</table>
Appendix G: A Sample for animated text and mouse roll-on effect page 79

Appendix H: Text link page 80

Appendix I: In-progress assessment 81
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>The roles of lecturer and student</td>
<td>35</td>
</tr>
<tr>
<td>4.2</td>
<td>List of software</td>
<td>48</td>
</tr>
<tr>
<td>5.1</td>
<td>Menu Button and its function are used in webpage.</td>
<td>56</td>
</tr>
<tr>
<td>5.2</td>
<td>Navigation Button element in webpage.</td>
<td>57</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 2.1</td>
<td>Framework of user interface for Elaboration Theory</td>
<td>5</td>
</tr>
<tr>
<td>Figure 2.2</td>
<td>Summary of models and process in Adept</td>
<td>11</td>
</tr>
<tr>
<td>Figure 2.3</td>
<td>Role performed by users.</td>
<td>14</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>Screen design form</td>
<td>46</td>
</tr>
<tr>
<td>Figure 5.1</td>
<td>Learning content with text and graphic for simple concept screen display</td>
<td>51</td>
</tr>
<tr>
<td>Figure 5.2</td>
<td>Learning content text and graphic for more complex concept screen.</td>
<td>52</td>
</tr>
<tr>
<td>Figure 5.3</td>
<td>Sample of Question screen</td>
<td>54</td>
</tr>
<tr>
<td>Figure 5.4</td>
<td>Sample of user interface use in page full duplex</td>
<td>55</td>
</tr>
<tr>
<td>Figure 5.5</td>
<td>Mouse roll-on effect and bullet with red color</td>
<td>54</td>
</tr>
<tr>
<td>Figure 5.6</td>
<td>Link using click and show element</td>
<td>58</td>
</tr>
<tr>
<td>Figure 5.7</td>
<td>An example of interface-flow diagram for Data Transmission e-learning system</td>
<td>59</td>
</tr>
</tbody>
</table>
ABSTRACT

The emergence of World Wide Web in 1992 as a telecommunication tool has revolutionized how to teach and learn. It makes e-learning increasingly accessible and many learning institutes have adapted to e-learning. Experiences with development of user interface (UI) projects for e-learning indicated a need for additional flexibility and speed applying new technologies to future products. Learner satisfaction is most important criteria to imply in design and developing UI. The paper discusses of UI that can influence learning and teaching process in e-learning medium for high education. More features are including to UI towards hypermedia era.

This study to develop prototype user interface (UI) for Data Communication subjects offered in Faculty of Information technology and Quantitative Science (FITQS). The Elaboration Theory and the Advanced Design Environments for Prototyping with Tasks Models (ADEPT) are used to develop this UI. The method used in this studies by conduct observation on 20 students which consist 16 females and 4 males of 18 to 25 years old in FITQS. This observation is conduct during their laboratory session that takes two hours. Second method is interviews two of lecturers are involved teaching Data Communication in the same faculty. Last method, we study five of existing web course. Through this gathered information, researcher indicates that when using more UI tools, its can influence student learning and make them enjoy this activity.
Chapter One
Introduction

1.1 Background of the project

The information and communication technologies (ICT) are one of project government known as Multimedia Super Corridor (MSC) to support educational activities. An education is an important element in developing country and stabilizes the economic. ICT is a catalyst for innovations in teaching and learning process. Therefore, use of e-learning can be the alternative way of teaching and learning in the information era.

According from The Common Front Group, Cornell University (1995), the term "User Interface" refers to interface between the user and the devices. User interfaces can take on many forms; it's always with two fundamental tasks: communicated information from the device to the user, and communicated information from the user to the device. In this research the device refers to a computer.

The very first computers had user interfaces that were as rudimentary as the computers themselves. The computer communicated information to the user through flashing lights, and the user communicated information to the computer by setting mechanical switches. The next stage of evolution had computers communicating to users through printing devices, and the users communicating to the computer through punch cards. This was an improvement, but still cumbersome and inefficient (Cornell University, 1995).
Nowadays, user interfaces are toward to object oriented that the paradigm change on it.

1.2 Project Description

This project involved with multimedia product development such as Macromedia Dreamweaver, Macromedia Flash MX which combined with Human Computer Interaction concept. The outcome of this user interface e-learning is also can be browse with web based applications such as Internet Explorer and Netscape Communicator.

With development of this prototype, teaching and learning process is made more interesting. Therefore, lecturers and students will have more choices of style to conduct teaching or learning process with the suitable technique and approaches.

The main challenge faced by teaching and learning based on Elaboration Theory user interface is to develop a design that is acceptable to all users and harmoniously across the wide spectrum of application. In this research, e assume that all users are not disability.
1.5 Project Scope

Project will focus on Elaboration Theory and applying Adept model. The user interface of e-learning also used an audio and visualization to make it to be more innovative and interactive. This project scope focused on Data Communications for first year student in higher education.

This project will only focus on one sub topic which data transmission.

1.4 Project Objective

The objectives of this research are:-

1. to develop a user interface for Data Communications subjects offered in Faculty of Information Technology and Quantitative Science (FITQS).
2. to provide the alternative learning concept using pedagogy (Elaboration theory) with ADEPT model.
1.5 Project Significance

The significance of this research is that it takes into consideration an account-personalized approach towards e-learning that will significantly improve the overall teaching and learning process.

This user interface will deepen the learner understanding and encourage them to seek knowledge in a more interactive way. Lecturers and students will find it easy to access this user interface because of its web-based application, so that the users can do session learning at any time and any where.

This system is hoped to benefit all the lecturers and students or learners who use the system. Below are benefits from the system:

1. The creation of model through the implementation of hypermedia helps a complex and dynamic learning community.
2. A student’s skill and understanding in Data Communication can be improved in future.
3. The lecturers do not have to prepare a lot of notes for their teaching session.
4. Students are free to complete their learning or research at any time and everywhere by internet access available.
5. Users can get to know their competency or weakness on the spot when they answer the questions in the module.
6. The learner is easy to memorize the learning content because it is planned in a coherent way.
Chapter Two
Theoretical Consideration

2.1 Introduction

Developing of creative interactive systems within a design space constrained by requirements originate from widely varying perspectives.

Figure 2.1 Framework of user interface for elaboration theory based on Adept model.

Figure 2.1 shows the framework of user interface for elaboration theory based on Adept model. Factors taken into consideration can encompass various online elaboration learning issues including: components of elaboration theory, user interface model and user interface design. The following are the detail description three dimensions of the framework.
2.2 Elaboration theory

Elaboration Theory has seven strategy components:

- a. Elaborative sequences
- b. Learning prerequisite sequences
- c. Summary
- d. Synthesis
- e. Analogies
- f. Cognitive strategies
- g. Learner control

2.2.1 Elaborative sequences

An elaborative sequence can start from simple to complex sequence in which the lesson epitomizes the ideas and skills that follow.

| Conceptual Elaboration Sequence is used for teaching many related concepts |
|-----------------------------|-------------------------------------------------|
| Concepts are groupings, classes, objects, events, or ideas |
| Concepts can be broken down into narrower concepts |

People tend to store a new concept under a broader, more inclusive concept in their cognitive structures (Reigeluth, 1999).

<table>
<thead>
<tr>
<th>Theoretical Elaboration Sequence is used to teach related principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles are either causal relationship or natural process relationships among changes in concept</td>
</tr>
<tr>
<td>Principles, like concepts, exist on a continuum from broader, more general, and more inclusive ones to narrower, more specific and less inclusive ones</td>
</tr>
<tr>
<td>People tend to store a new concept under a broader, more inclusive concept in their cognitive structures (Reigeluth, 1999).</td>
</tr>
</tbody>
</table>
principles under a broader, more inclusive concept in their cognitive structures

- Principals can be combined into casual models that reflect the complex, systemic and often seemingly chaotic nature of phenomena in the world (Reigeluth, 1999).

Simplifying Content Method (SCM) provides practical guidelines to make a very different kind of simple to complex sequence from hierarchical sequence one that is holistic rather than fragmented (Reigeluth, 1999).

There are two kinds of tasks. One is procedural tasks, the other one is heuristic tasks.

**Procedural tasks** focus on the steps (mental/physical) that expert use to decide what to do and when.

**Heuristic tasks** focus on the principles, guidelines, or casual models that experts use to do what to do when (Reigeluth, 1999). SCM is composed of two parts for both of the tasks. They are epitomizing and elaborating. Epitomizing is a process of the identifying the simplest version of a task, representative of a whole task. Elaborating is the process of identifying more complex part of a task (Reigeluth, 1999).
How to design an SCM Sequence

Phase I - Prepare for analysis and design

Phase II - Identify the first learning episode

Phase III - Identify the next learning episode
- Whole task
- Simplest Version of the task
- Real world version of the task
- Representation of the task

2.2.2 Learning Prerequisite Sequences

Topical sequencing: A topic is taught in depth before moving to the next one, such as learning adding numbers, subtracting numbers, dividing numbers and etc.

Spiral Sequencing: learners learn basics of one topic then another and another then they return to learn about more each topic such as first learning about different triangles, then learning about how to calculate right triangles area.

2.2.3 Summary

Summarizers are content reviews. The learning content are summarize at the end of the topic discuss.
2.2.4 Synthesis

Synthesizer is a presentation device such as concept hierarchy, procedural flowcharts, decision table, and cause-effect models.

2.2.5 Analogies

Analogies relate the content reviews to the learners' prior knowledge or reality in life.

2.2.6 Cognitive strategies activators

Cognitive strategies activator variety of cues in the form of pictures, diagrams mnemonics and etc, that trigger cognitive strategies enabling the learner to process the instruction.

2.2.7 Learner control

Learners are encouraged to control over both content and instructional strategy.

2.3 User Interface Model

2.3.1 Adept Model

The Advanced Design Environments for Prototyping with Tasks Models (ADEPT) is a complete infrastructure for designing and implementing multi-agent systems. As such, ADEPT supplies a set of tools (i.e., models and a language) to achieve its purpose.
Adept is a novel design environment for prototyping user interfaces which addresses these issues by encouraging the designer to construct explicit models of the users and their tasks.

The Adept project aims are:-

1. to investigate how knowledge of users' tasks can inform the design of a system to support those tasks;
2. to provide an integrated, model-based environment to support user interface design and development.

The following section elaborates our work through a discussion on the role of models and tools in the design of user interfaces. A summary of models and process used in Adept is shown in figure 2.2.
A number of models are central to the Adept demonstrator: task models, user models, abstract interface models and concrete interface models. These models support different stages of the user interface design life cycle. Task models in Adept represent either the knowledge possessed by users and recruited in performing some existing task or the knowledge which will be required to perform a
designed task. User models provide a perspective on more general user characteristics which are not captured by the task models: they typically model levels of expertise and types of knowledge system of the user group. Abstract interface models (AIMs) provide a high-level description (or specification) of the interface and, finally, concrete interface models (CIMs) provide a low-level description of the interface: an instantiation of a CIM is an implementation.

Figure 2.2, modified from Johnson et al. (1993), shows these models and summarizes how they are utilized in the process of user interface design.

2.3.1.1 The Task Model

Task model are include task description and task analysis.

1. Task description

Descriptions of business tasks have been used within software development for many years. During the 1970s and 1980s, "business scenarios" were commonly used as the basis for acceptance testing, i.e., the last testing stage performed before the final fee installment paid and users accepted the system. In more recent years, due to the emphasis on involving users earlier in the development life cycle and the large number of new interaction devices are now being developed, task descriptions are used widely throughout development process i.e from early requirements activities through prototyping, evaluation, and testing. Consequently, more time and effort has been
put into understanding on how best to structure and use them.

There are different flavors of task descriptions, and we shall introduce three of them here: scenarios, use cases, and essential use cases. Each of these may be used to describe either existing tasks or envisioned tasks with a new device. They are not mutually exclusive and are often used in combination to capture different perspectives or to document different stages during the development lifecycle.

• Scenarios

A scenario is an "informal narrative description" (Carroll, 2000). It describes human activities or tasks in a story that allows exploration and discussion of contexts, needs, and requirements. It does not explicitly describe the use of software or other technological support to achieve a particular task. Using the vocabulary and phrasing of users means that the scenarios can be understood by the stakeholders, and they are able to participate fully in the development process. In fact, the construction of scenarios by stakeholders is often the first step in establishing user requirements.
Use cases

Use cases also focus on user goals, but the emphasis here is on a user-system interaction rather than the user's task itself. They were originally introduced through the object-oriented community in the book *Object-Oriented Software Engineering* (Jacobson et al., 1992). Although their focus is specifically on the interaction between the user (called an "actor") and a software system, the stress is still very much on the user's perspective, not the systems. The term "scenario" is also used in the context of use cases. In this context, it represents one path through the use case, i.e., one particular set of conditions. This meaning is consistent with the definition given above in that they both represent one specific example of behavior.

![Figure 2.3 Role performed by users.](image)
The figure above shown the roles performed by each group.

- Essential use cases

Essential use cases were developed by Constantine and Lockwood (1999) to combat what they see as the limitations of both scenarios and use cases as described above. Scenarios are concentrate stories that concentrate on realistic and specific activities. They therefore can obscure broader issues concerned with the wider organizational view. On the other hand, traditional use cases contain certain assumptions, including the fact that there is a piece of technology to interact with, and also assumption about the user interface and the kind of interaction designed.

2. Task analysis

In practice, task analysis techniques had a mixed reception. The most widely used version is Hierarchical Task Analysis (HTA). Another well-known task analysis technique called GOMS (goals, operations, methods, and selection rules) that models procedural knowledge (Card et al., 1983).

According to John Vergo et. al.(1997), task analysis is deal with eliciting goals, values, triggers, and activities and finally incorporating these into task flows, the sequence of activities leading to goal completion. The HCI notations of goals, values and triggers are closely related to the traditional marketing notions of needs and wants. A detailed