DIFFERENT LEARNING STYLES IN ACQUISITION OF DECLARATIVE AND PROCEDURAL KNOWLEDGE

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ABSTRACT

Conducting Visual Basic 6.0 training in Tenaga Nasional Berhad creates problems due to differences in cognitive skill among the executives and the non-executives as the target participants. This skill varies among them in the modes of learning style, types of knowledge and problem-solving method. Thus we propose a web-based training prototype as an aid for learning. The prototype is meant to teach simple concepts of Visual Basic 6.0. It consists of two different learning modules: the declarative knowledge module and procedural knowledge module. It directs the learners to their respective learning modules based on their learning styles. The prototype contains instructional design methodologies that are derived from behaviorism, cognitivism and constructivism learning theories. Evaluations done on the prototype show that it manages to identify individuals according to the target audiences and accommodates training needs of both groups.

TABLE OF CONTENT

Chapter 1.0 Introduction *1*

1.1 Project Overview **1**

1.2 Project Objectives **1**

1.3 Limitations **1**

1.4 Dissertation Organisation **2**

Chapter 2.0 Learning Styles and Instructional Design *3*

2.1 Chapter Introduction **3**

2.2 Cognitive Skill **3**

2.2.1 Learning Style 4
2.2.2 Knowledge 8
2.2.3 Problem-solving method 12

2.3 Instructional Design **20**

2.3.1 Learning Theories 20
2.3.1.1 Behaviorism Principles 21
2.3.1.2 Cognitivism Principles 21
2.3.1.3 Constructivism Principles 25
2.3.2 Is There One Best Learning Theory for Instructional Design? 28
2.3.3 Instructional Design Theory 29
2.3.4 Instructional Design Methodologies 31
2.3.4.1 Tutorials 32
2.3.4.2 Drills and Practices 33
2.3.4.3 Hypermedia 34
2.3.4.4 Simulations 37
2.3.4.5 Open-ended learning environment 38
2.3.4.6 Tests 39
2.3.4.7 Web-based learning 40

2.4 Learning Styles and Instructional Design **42**

2.5 Chapter Summary **46**

Chapter 3.0 Learning Styles of Tenaga Nasional Executives and Non-executives *47*

3.1 Chapter Introduction **47**

3.2 Background of Training in Tenaga Nasional Berhad **47**

3.3 Learning Differences **48**

3.4 Problems **52**

3.5 Proposed Solution **53**

3.6 Chapter Summary **55**

Chapter 4.0 Design and Implementation *56*

4.1 Chapter Introduction **56**

4.2 Description of 'Learn Visual Basic 6.0 Now' **56**

4.2.1 Development Process 57
4.2.2 Prototype Design 57

4.2.2.1 Site Planning 58
4.2.2.2 User Interface Design 61
4.2.2.3 Site Design 63
4.2.2.4 Database Design 67
4.2.3 Prototype Implementation 72
4.2.3.1 Development Environment 72
4.2.3.2 Hardware Tools 72
4.2.3.3 Software Tools 73
4.2.3 Gagne's Nine Events of Instruction 74

4.3 Chapter Summary 81

Chapter 5.0 Evaluations 82

5.1 Chapter Introduction 82

5.2 Types of evaluations 82
5.2.1 Online survey 82
5.2.1.1 Survey Samples 83
5.2.1.2 Survey Results 84
5.2.2 Observation 85
5.2.2.1 Direct Observation 86

5.3 Data analysis 88
5.3.1 Discrepancy 90

5.4 Strengths of LeVB6 92
5.4.1 Strengths 92

5.5 Chapter Summary 94

Chapter 6.0 Conclusion 95

6.1 Chapter Introduction 95

6.2 Project Objectives 95

6.3 Differences in Cognitive Skill 95

6.4 Web-based Training Prototype 97

6.5 Effectiveness of Learn Visual Basic 6.0 Now 98

6.6 System Weaknesses and Future Enhancement 101

6.7 Chapter Summary 102

References 103

Bibliography 111

Appendix 113

TABLE OF FIGURES

Figure 2.1	Heuristics Technics	16
Figure 2.2	Three-Stage Information Processing Model	22
Figure 2.3	Anchor	36
Figure 4.1	Main Framework of LeVb6	58
Figure 4.2	About the course Framework of LeVb6	58
Figure 4.3	Login Framework of LeVb6	59
Figure 4.4	Declarative Knowledge Framework of LeVb6	59
Figure 4.5	Procedural Knowledge Framework of LeVb6	60
Figure 4.6	Other Learning Material Framework of LeVb6	60
Figure 4.7	Sample Screen Design	62
Figure 4.8	Homepage of Learn Visual Basic 6.0 Now	64
Figure 4.9	An e-mail link	66
Figure 4.10	Message Board	67
Figure 4.11	Relationships between the tables	71
Figure 4.12	Glossary	77
Figure 4.13	List of Commands	78
Figure 4.14	Feedback of test performance	80
Figure 5.1	Histogram showing results of online survey	85

LIST OF TABLES

Table 2.1	Summary of Deep and Surface Processing Approaches	6
Table 2.2	Kinds of Knowledge	12
Table 2.3	Associations between the factors influencing cognitive skill, the 3 learning theories and the appropriate instructional design methodologies	45
Table 4.1	Database General Profile	67
Table 4.2	Database Structure of the User Table	68
Table 4.3	Database Structure of the Survey Table	69
Table 4.4	Database Structure of the Answer Table	70
Table 4.5	Database Structure of the Board Table	71
Table 5.1	Results of Online Survey	84

Chapter 1.0 Introduction

1.1 Project Overview

This dissertation explores the area of cognitive ability of target audiences in Visual Basic training conducted in Tenaga Nasional. Comparison is made in terms of learning style, knowledge acquisition and problem-solving skills between the executives and non-executives who are the target audience. An instructional system which is web-based is utilized to accommodate both groups' training needs.

1.2 Project Objectives

The objectives of this dissertation are to:

- categorize type of learners among the executive group and the non-executive group in Visual Basic training in Tenaga Nasional.
- develop an instructional system which is web-based as a training tool.
- justify how the instructional system can accommodate the training needs of the two groups.

1.3 Limitations

This study is done involving cases in Tenaga Nasional Berhad training. The prototype was not tested outside the company. Hence, the evaluation was done with small number of course participants. Different work culture may produce different results.

1.4 Dissertation Organisation

This introduction chapter is followed by a literature review of learning styles and knowledge acquisition as well as the exciting field of Instructional Design in Chapter 2. A general overview of Instructional Design is given along with its relation to training. Chapter 3 concentrates on the actual problem statement and issues involved during the training of Visual Basic programming language in Tenaga Nasional. Chapter 4 discusses the prototype developed for this study. Also highlighted is the development process which involves designing and implementing the prototype. Chapter 5 analyses the evaluations done on the prototype and its solution in relation to problems stated in Chapter 3. The final chapter presents the conclusion and future enhancement for the prototype.

Chapter 2.0 Learning Styles and Instructional Design

2.1 Chapter Introduction

A summarized overview of the dissertation was given in the previous chapter. This chapter discusses the literature review that provides the background knowledge and context of the research carried out. It begins with an in-depth look at cognitive skill among individuals. The differences are discussed from the view of cognitive abilities. Three categories were chosen due to their relevance with regards to training. The following section provides a brief description on learning theories as well as their implications on instructional design. The last section explores various methodologies for facilitating learning. This chapter concludes with a brief summary of its contents.

2.2 Cognitive Skill

There are three levels of skill in every human: psychomotor skill; cognitive skill and attitudinal skill. The psychomotor skills are composed of physical knowledge of procedural tasks including the use of any tool. This skill requires a complex combination of physical movement and thought such as operating a crane or driving a golf ball.

Cognitive skills are concerned with the cognitive processes of analysis, interpretation and decision making required for "carrying out" procedural tasks. This skill includes solving problems, applying rules and distinguishing among items. Although both physical and cognitive skills require a fair amount of learning, physical skills are relatively easier to acquire due to their external visibility. The development of cognitive skill refers to changes in thinking and demands a more sophisticated learning process as much of its process runs inside a human mind [Patel et al, 2000].

Less obvious, though extremely important, is the attitudinal skills, which we recognize perhaps more for instance in sporting skills: in playing soccer you need not only to know how to play, but also to have the right kinds of attitude towards the sport; and in reading and writing too you need the right kinds of attitude towards those skills in order to perform well. The evaluative aspect means you have to be able to evaluate your own performance, to know whether you are performing well or not [Downing, 2000].

Developments of skills happen at different rates. In the classroom, there will always be a whole range of examples of different developmental rates. Some students will be larger, better coordinated or more mature in their thinking and social relationships. Others will be much slower to mature in these areas [Woolfolk, 2001]. The variance in skill development can be attributed to personality and cognitive ability or intelligent skills. In a web-based learning environment, cognitive skill differs among the learners in the mode of learning style, mechanism of knowledge acquisition and problem-solving method.

2.2.1 Learning Style

Learning can be understood as a change in an organism's capacities or behavior. Human beings learn in different ways, have different styles and build on very different backgrounds of experience. Learning means different things to different people. Säljö (1979) classified this conception into five categories:

1. Learning as a quantitative increase in knowledge. Learning is acquiring information or "knowing a lot".
2. Learning as memorising. Learning is storing information that can be reproduced.
3. Learning as acquiring facts, skills and methods that can be retained and used as necessary.
4. Learning as making sense or abstracting meaning. Learning involves relating parts of the subject matter to each other and to the real world.
5. Learning as interpreting and understanding reality in a different way. Learning involves comprehending the world by re-interpreting knowledge [Atherton, 2002].

Learning styles are individual differences that have very little to do with intelligence but can influence students' learning. Learning styles are approaches to learning and studying. Deep-processing and surface-processing are two common approaches to learning, derived from original empirical research by Marton and Säljö (1976) and since elaborated by Biggs (1987, 1993) and Entwistle (1981) among others. Individuals who have a deep-processing approach see the learning materials or activities as a means for understanding some underlying concepts or meanings. These students tend to learn for the sake of learning and less concerned about how their performance is evaluated, so motivation plays a role as well. Students who take a surface-processing approach focus on memorizing the learning materials and not understanding them. These students tend to be motivated by rewards, grades, external standards and the desire to be evaluated positively by others.

The features of deep and surface processing approaches are summarized in Table 2.1 below:

Table 2.1 : Summary of Deep and Surface Processing Approaches [Atherton, 2002].

Deep	Surface
• Focus is on "what is signified"	• Focus is on the "signs" (or on the learning as a signifier of something else)
• Relates previous knowledge to new knowledge	• Focus on unrelated parts of tasks
• Relates knowledge from different courses	• Information for assessment is simply memorized
• Relates theoretical ideas to everyday experience	• Facts and concepts are associated unreflectively
• Relates and distinguishes evidence and argument	• Principles are not distinguished from examples
• Organises and structures content into coherent whole	• Task is treated as an external imposition
• Emphasis is internal, from within the student	• Emphasis is external, from demands of assessment

Of course, situation can encourage deep or surface processing but there is evidence that individuals have tendencies to approach learning situations in characteristics ways.

Pask(1967) has described a learning style called serialist versus holist. Serialists prefer to learn in a sequential fashion sequences in which the elements are related at a low level of generality. They prefer a narrower focus in learning, concentrating on simple hypotheses and step-by-step learning, paying attention to details and processes but neglecting the broader perspective and links with other topics. Due to this, they gain depth view of knowledge. Serialists are unlikely to make use of personal experience.

Using a holistic approach, an individual tends to overview the situation, attempting to gain a broad outline of the problem before fitting in the details later. This type of learner prefer to learn in a hierarchical manner (i.e., top-down). The holist tends to make more elaborate hypotheses, looks further ahead, builds up a picture of the whole task, looks for links with other topics and even relies on his or her own analogies and descriptions. They tend to view knowledge in broader perspectives.

The essential characteristics of the two learning styles have been listed as:

1. Serialist - Immediately breaking a problem or task into its component parts, and studying them step by step, as discrete entities, in isolation from each other and their surroundings.
2. Holisitic - An overall view or seeing the task as a whole, integrating and relating its various subcomponents, and seeing them in the context of their surroundings [Brumby, 1982].

2.2.2 Knowledge

Knowledge is the outcome of learning. When we learn a name, the history of cognitive psychology or the rules of tennis, we know something. However, knowledge is more than the end product of previous learning; it also guides new learning. The cognitive approach suggests that one of the most important elements in the learning process is what the individual brings to the learning situation. What we already know is a scaffold that supports the construction of all future learning [Alexander, 1996].

Knowledge acquisition is a phase in the building of knowledge. Knowledge acquisition involves identifying the relevant knowledge, comprehending and recording it, so it can be applied for problem-solving. Knowledge acquisition or learning is usually characterized as going through three stages: a cognitive stage, an associative stage and an autonomous stage [Fitts, 1964]. The three stages can be characterized by moving from conscious, slow and error-prone to unconscious, fast and error-free. Anderson (1982) explains these three stages in terms of a transition from declarative knowledge to procedural knowledge.

- In the cognitive stage knowledge is declarative and needs to be interpreted. Interpreting knowledge is slow and may lead to errors if the relevant knowledge cannot be retrieved at the right time.
- Procedural knowledge is compiled and therefore fast and free of errors and can be associated with the autonomous stage.

- The associate stage is an in-between stage, during which part of the knowledge is declarative and another part compiled [Anderson, 1982].

A problem in the study of complex problem solving, especially in a learning context, is the vastness of individual differences. In order to study the acquisition of complex skills, it is a good research strategy to have a theory of individual differences. From the perspective of the cognitive architecture, there are two sources of individual differences: architectural differences and knowledge differences [Taatgen, 2000].

Knowledge differences are based on the idea that people have different problem solving strategies. Ackerman(1990) identified three sources on architectural differences:

- general intelligence
- perceptual speed
- psychomotor abilities

Each of these three abilities correlates with a different stage of skill acquisition. In the cognitive stage, general intelligence is the most important aspect, as an adequate representation of the task needs to be formed. In the associative stage, the knowledge compilation process (which Ackerman associates with perceptual speed) will dominate performance, so individual differences in that aspect will become important. In the final autonomous stage, all knowledge is proceduralized and differences in psychomotor abilities will be the most important [Ackerman, 1990].

The cognitive perspective on knowledge emphasizes understanding of concepts and theories in different subject matter domain and general cognitive abilities, such as reasoning, planning, solving problems and comprehending language [Greeno et al.,1996]. So, there are different kinds of knowledge. Some are domain-specific knowledge that pertains to a particular task or subject. For an instance, knowledge about ace, double-fault and back-hand is specific to the domain of tennis. Some knowledge, on the other hand, is general – it applies to many different situations such as taking a bus to work. Of course, there is no absolute dividing line between general and domain-specific knowledge. When we first learned to read, we may have studied specific facts about the sound of the letters. At that time, knowledge about letter sounds was specific to the domain of reading. But now we can use both knowledge about sounds and the ability to read in more general ways [Schunk, 2000].

Another way of categorizing knowledge is as declarative, procedural or conditional [Paris et al., 1996]. Declarative knowledge is knowledge that can be declared, usually in words, through lectures, books, writing, verbal exchange, Braille, sign language, mathematical notation and so on [Farnaham-Diggory, 1994]. Architectures with declarative representations have knowledge in a format that may be manipulated, decomposed and analyzed by the reasoning engine independent of its content. Declarative knowledge is “knowing that” something is the case. The range of declarative knowledge is tremendous. We can know very specific facts (atomic weight of gold is 196.967), generalities (leaves of some trees change colour in autumn), personal preferences (I don’t like assam laksa) or rules (to divide fractions, invert the divisor and multiply). Small units of declarative knowledge can be organized into larger units; for example, principles of reinforcement and punishment can be organized in our thinking into a theory of behavioural learning [Gagne et al.,1993].

Procedural knowledge is about knowing how to do something such as tying shoe laces or clean a refrigerator. Architectures with procedural representations encode how to do some task. In other words, procedural knowledge is skill knowledge. Another simple example of human procedural knowledge is the ability to ride a bike. The specifics of bicycle-riding may be difficult to articulate but one can perform the task. Notice the rule “to divide fractions, invert the divisor and multiply” shows declarative knowledge-the student can state the rule. But to show procedural knowledge, the student must act. When faced with a fraction to divide, the student must divide correctly. Students demonstrate procedural knowledge when they translate a passage into Malay language or correctly categorize a geometric shape. One advantage of procedural representations is possibly faster usage in a performance system. Productions are a common means of representing procedural knowledge [Woolfolk, 2001].

Conditional knowledge is knowing when and why to apply your declarative and procedural knowledge. Given many kinds of mathematics problems, it takes conditional knowledge to know when to apply one procedure and when to apply another to solve each. It takes conditional knowledge to know when to read every word in a text and when to skim. For many students, conditional knowledge is a stumbling block. They have the facts and can do the procedures, but they do not seem to apply what they know at the appropriate time [Woolfolk, 2001]. Table 2.2 shows that we can combine our two systems for describing knowledge. Declarative, procedural and conditional knowledge can be either general or domain-specific.

Table 2.2 : Kinds of Knowledge

	General Knowledge	Domain-Specific Knowledge
Declarative	Hours the library is open	The definition of "hypotenuse"
	Rules of grammar	The lines of the poem " The Raven"
Procedural	How to use your word processor	How to solve an oxidation-reduction equation
	How to drive	How to throw a pot on a potter's wheel
Conditional	When to give up and try another approach	When to use the formula for calculating volume
	When to skim and when to read carefully	When to rush the net in tennis

2.2.3 Problem-solving method

A problem is a situation which is experienced by an agent as different from the situation which the agent ideally would like to be in. A problem is solved by a sequence of actions that reduce the difference between the initial situation and the goal [Hewette, 1995]. In simple well-defined problems, the solution is trivial. The situations we usually call problems have a more complex structure. The most general approach to tackle such processes is generate and test: apply an action to generate a new state, then test whether the state is the goal state; if it is not, then repeat the procedure. This principle is equivalent to trial-and-error or to evolution's variation and selection. The repeated application of generating and testing determines a search process, exploring different possibilities until the goal is found. Searches can be short or long depending on the complexity of the problem and the efficiency of the agent's problem-solving strategy or heuristic [Heylighen, 1998].

Defining a problem as reaching a desired goal without the benefit of specific prior experience distinguishes problem-solving from learning and memory and also identifies problem-solving research with the study of abstract thought. The emphasis on abstract thought ties research on problem to research on thinking [Hunt & Ellis, 1999].

Thinking is notoriously difficult to formally define, but whatever else we may mean, thinking is assumed to be an abstract psychological process that manipulates knowledge. Thinking involves processing information using mental representations such as creating and organizing mental images and critically analysing their meaning. There are various kinds of thinking, wherein we consciously direct our mental processes toward goals such as reasoning, solving problems and making judgments. Several types of thinking include analysis, synthesis, divergent and convergent thinking. Analysis refers to breaking large complex concepts into smaller and simpler forms; breaking down wholes to parts. Synthesis is combining and integrating two or more processes or concepts into a more complex form; put parts together into wholes. Divergent thinking is about generating a number of diverse ideas or alternative solutions to a problem whereas convergent thinking is taking many ideas and uniting them into a single idea or answer to a problem.

Often the goal in thinking is problem-solving, in which mental processes are used to overcome obstacles to arrive at a solution. This usually involves reasoning, drawing conclusions from evidence and judgment and decision-making wherein we evaluate various possibilities and choose the most suitable option.

When we face a mental challenge in which there is a goal to overcome obstacles, we are engaging in problem-solving. Generally we use a common method of problem-solving. We

1. identify the problem
2. define the problem
3. explore possible plans or strategies
4. choose a strategy
5. utilize resources to act on the chosen plan
6. monitor the problem-solving process
7. evaluate the solution.

If it is a well-structured problem, there is usually a clear path to find a solution. With ill-structured problems, often called insight problems, no easy solution arises and we generally have to think a lot about the problem until we have a sudden insight also known as the aha experience and the solution becomes clear to us [Heylighen, 1998].

In well-structured problem-solving, generally some of the strategies that can be utilised will be problem space, heuristics, algorithms and isomorphic problems. Problem space refers to subject's mental representation of the problem, as well as the various solutions that may be attempted. Problem spaces are the various ideas or hypotheses, which a person might develop about a problem. The mental representation of the problem is a central feature of effective problem-solving and this mental representation is assumed to change with progress toward a solution [Hunt & Ellis, 1999]. Heuristics are informal, speculative, intuitive mental shortcuts such as trial and error or using strategies that worked on similar problems; one selectively tests solutions most likely to be correct – can be helpful and are quicker, but do not guarantee they will lead to a solution. This strategy may involve techniques such as working forward, working backward, means-ends analysis and generate-test (see Figure 2.1). Algorithms are formal, step by step strategies to lead to a solution, such as repeating a series of steps to balance a checkbook or solve a mathematics problem; however many problems do not have algorithms that generate solutions. Isomorphic problems are problems that differ in content but not in structure. Therefore, the solver can apply the solution for one isomorphic problem in another problem.

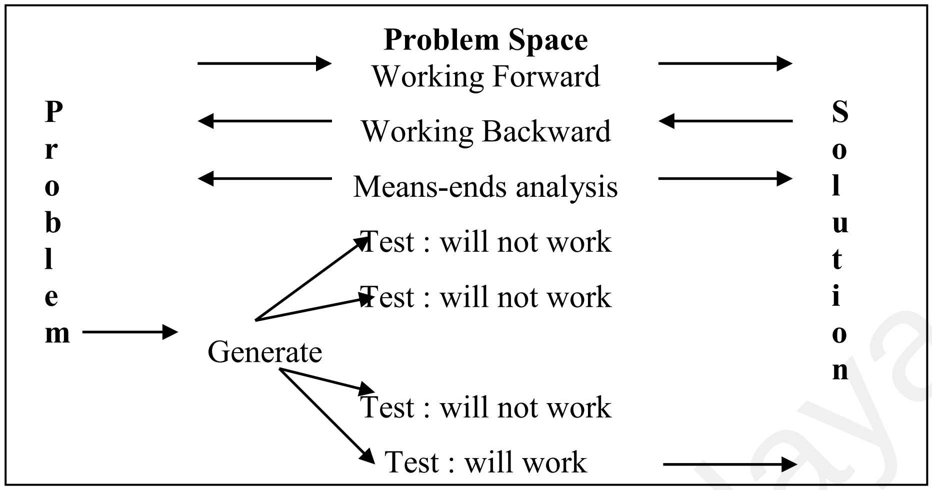

Figure 2.1 : Heuristics Technics

Ill-structured problems require insight to see the problem in a new way. It is not solved with clever algorithms but need a whole new strategy. Some take the "nothing special view" of insight, believing it is merely an extension of ordinary perceiving, recognizing, learning and conceiving. The three-process view contends that insight occurs when people selectively encode relevant information, compare relationships between old and new information and selectively combine old and new relevant information to solve problems.

Productive thinking, typical of creative people, involves novel combinations of ideas and insights. Insight is the result of productive thinking that has successfully arranged the parts of the problem in a new way, representing the solution to the problem. Reproductive thinking uses existing ideas and associations between those ideas. Creative people generate new ideas and insights that do not rely on simply making use of what already exists.

Efficient problem-solving results from learning a cognitive skill. Within Anderson(1982) theory, learning a cognitive skill is a matter of converting declarative knowledge into procedural knowledge. For example, one may have declarative knowledge that a car which will not start and whose radio does not work probably has a dead battery. To solve the problem, however, requires that one knows how to do something about the battery and this is procedural knowledge. Proceduralization of knowledge makes problem-solving more efficient by reducing the working memory capacity demands [Hunt & Ellis, 1999].

Expertise in an area also adds to problem-solving capabilities as experts know more and can organize the information more efficiently. They rely on large amounts of information that are stored in memory and that are retrievable whenever the solver recognizes cues signaling its relevance [Heylighen, 1998]. An important point to keep in mind is that experts do not excel because of superior native intelligence. Mayer (1982) identified four major aspects of problem-solving that separate the expert from the novice. First, the expert seems to store factual knowledge relevant to the problem in larger units than does the novice and can access those units more quickly. Experts also show a difference on what Mayer calls semantic knowledge. By this, he means the expert is more capable of relating a particular problem to general underlying concepts. Expert performance is guided by superior schematic knowledge, which Mayer defines as an ability to discriminate between types of problems, that is when confronted by a problem the expert is capable of categorizing the problem on the basis solution strategy. Finally, the expert develops a global strategy for solving the problem but works forward by considering alternatives to the global strategy as progress is made towards the solution [Hunt&Ellis, 1999].

Every person has some problem-solving capability and it varies from person to person. For a small child, tying shoelaces will indeed require problem-solving, just as cooking an omelet entails problem solving for many adults. Thus problem-solving involves an interaction of a person's experience and the demands of the task. People of all ages can and must be solvers of problems. Perhaps young children are the most natural problem solvers. They must adapt because they continually face circumstances that are novel. It is their job and they are amazingly good at it [What, 2001].

An expert in a certain domain may solve problems in a nearly automatic manner than a novice. The experts:

1. have a better memory for relevant problem details,
2. classify problem types according to their underlying principles, rather than their surface structure,
3. work forward towards a goal, rather than backwards from it, and
4. use well-established procedures or rule automation.

The first three of these can be viewed in terms of schemas, which suggest the category to which a problem might belong, as well as appropriate solutions strategies. Both schemas and rule automation reduce memory load, allowing an expert to handle familiar aspects of a problem routinely, while freeing cognitive capacity for novel aspects of a problem [Selden, 1998].

In addition to this, creativity, psychometric ability, personality, motivation as well as society are among contributing factors towards influencing individual's skill in problem-solving. Creative problem-solving is not always approached the same way by all people. People have brain dominance or thinking preference [Hart, 1997].

Creative problem-solving depends on using the right tools, procedures or methods of analysis. Some individuals are capable of using these tools, procedures or methods when solving problems. In some cases, they will develop new tools and methods from scratch before a problem can be solved. This produces productive thinking [Sylvan, 1997].

Some individuals have higher psychometric ability than others whereby they possess abstract problem-solving skill and manage stress and difficulties bestowed by problems brilliantly. There are people out there who thrive on solving problems and resolving chaos. They are master problem solvers and have little or no fear of change. They have a distinct personality structure and think just slightly different from the average people [McAllister, 1994]. Conversely, certain people are unable to work out problems due to lack of motivation and persistence.

2.3 Instructional Design

Instructional design is a systematic approach to designing instruction and instructional materials to achieve specified learning objectives. Developing a complete instructional material project involves design, development and delivery. These processes for developing instruction are ingredients of instructional design. Many instructional design models exist, ranging from simple to complex. Reigeluth (1997) stated that instruction is anything that is done to help someone learn and instructional design model is anything that offers guidance for improving the quality of that help. He distinguishes between descriptive sciences, which describe the way things function in the natural world and design sciences which offer ways to do certain human-defined tasks. Clearly instructional design model is a design science, as it provides guidance on the task of designing learning experiences. But, it also provides a bridge to the descriptive science of Learning Theory. The following section describes the primary principles of these learning theories. Understanding these principles is essential to understand the best instructional approaches.

2.3.1 Learning Theories

The three fundamentals of learning theories are behaviorism, cognitivism and constructivism. In the middle of the 20th century, learning theory was dominated by the principles of behaviorism which maintains that learning should be described as changes in the observable behavior of a learner made as a function of events in the environment. In the 1970s, the behavioral paradigm began to be expanded by the ideas of cognitivism which maintains that a complete explanation of human learning also requires recourse to nonobservable constructs such as perception, memory and comprehension. In the 1980s, a new learning paradigm, constructivism, began to influence education and instructional design. This theory views learners as active creators of knowledge, who learn by observing, manipulating and interpreting the world around them.

2.3.1.1 Behaviorism Principles

The theory of behaviorism concentrates on the study of overt behaviors that can be observed and measured. It views the mind as a black box in the sense that response to stimulus can be observed quantitatively, totally ignoring the possibility of thought processes occurring in the mind. Some key players in the development of the behaviorist theory were Pavlov, Watson, Thorndike and Skinner [Good et al.,1990].

Instructional design procedures are largely based on behaviorism principles. Their emphasis is on specifying behavioral objectives (statements of things the learner will be able to do at the end of instruction), analyzing learning tasks and activities and teaching to specific levels of learner performance.

2.3.1.2 Cognitivism Principles

Cognitivism arose from a reaction to behaviorism because it was felt that behaviorism's emphasis on the link between a stimulus and a response was not sufficient to account for all human activity. This theory focuses on:

1. mental processes that operate on stimuli presented to the perceptual and cognitive systems which usually contribute significantly to whether or not a response is made, when it is made and what it is.
2. behaviorists claim that such processes cannot be studied because they are not directly observable and measurable. Cognitive psychologists claim that they must be studied because they alone can explain how people think and act the way they do [Winn&Snyder, 1996].

Cognitivism can be traced back to the ancient Greeks, Plato and Aristotle. One of the major players in the development of cognitivism is Jean Piaget, who developed the major aspects of his theory as early as the 1920's. Figure 2.2 below illustrates one of the key concepts of cognitive theory which is Three-Stage Information Processing Model developed by cognitive psychologists Atkinson R. and Shiffrin R.

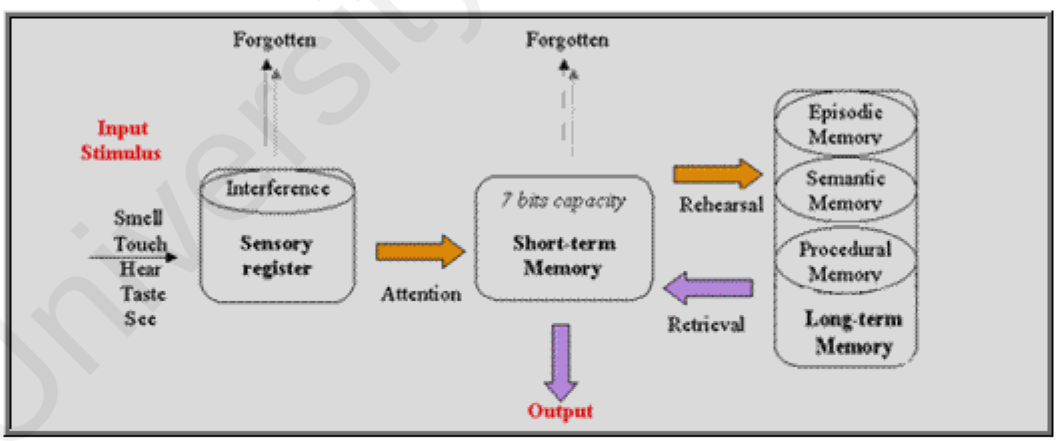

Figure 2.2 : Three-Stage Information Processing Model

The areas of cognitive theory that are most important to multimedia design are those relating to:

1. Perception and Attention – Learning begins with attention to and perception of information in the learner's environment. Perception is constantly strained by many competing stimuli. Attention may falter or be attracted to different stimuli than the desired ones.
2. Encoding – Once the learner attends to and perceives stimuli, it must be encoded. This means it must be transformed into a format that can be stored in the brain.
3. Memory – Having perceived and encoded information, it must be retrievable for later use. Although the information storage and retrieval capacity of humans is immense, ensuring that the important information can be recalled is not trivial.
4. Comprehension – Information perceived must be interpreted and integrated into current knowledge of the world. It should be able to be classified, applied, evaluated, discussed, manipulated and taught to other people.
5. Active Learning – People learn not only by observing but also by doing. One of the essential features of computer-based instruction, in contrast to more traditional media, is its capacity to require learner actions and act on them.
6. Motivation – Is essential to learning but enhancing it in a computer-based instruction is not an easy task.
7. Locus of Control – This means whether control of sequence, content, methodology and other instructional factors are determined by the learner, the program or some combination of the two.

8. Mental Models – Refers to a representation in working memory that can be used by the learner to understand a system, solve problems or predict events. One may have a mental model of long division, of how a computer executes loops or of how electricity flows.
9. Metacognition – Refers to one's awareness of one's own cognition. It has been suggested that designers need to pay as much attention to learners' metacognition as to their cognition. However, helping learners with metacognition has proved to be elusive.
10. Transfer of learning – Refers to the extent to which performance in one situation is reflected in another situation. It is perhaps more commonly means applying what is learned in an instructional environment to real-world activities.
11. Individual Differences – Not all people learn alike or at the same rate. Better instructional software adapts to individual learners, capitalizing on their talents, giving extra help where needed and providing motivators learners can respond to [Atkinson and Shiffrin, 1968].

In 1980s, most instructional designers began to take cognitive principles into consideration. In computer-based instruction and interactive multimedia, screen design and presentation strategies increasingly reflected theories of attention and perception as well as motivation principles. Whereas the earlier version of computer-based instruction was very program controlled, modern interactive multimedia programs provide a better mixture of learner and program control. Additionally, instructional strategies and user control are increasingly based on individual needs and differences. Interactions are more frequently designed to foster comprehension and metacognition. The cognitive approach has put increasing emphasis on active learning and on learners' activities being designed and selected to enhance transfer of learning.

2.3.1.3 Constructivism Principles

Constructivism is now challenging the currently dominant cognitive approach. According to Jerome Bruner the theme is that learning is an active process in which learners construct new ideas or concepts based upon their current or past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so. Cognitive structure (i.e., schema, mental models) provides meaning and organization to experiences and allows the individual to "go beyond the information given" [Bruner, 1960].

The work of Piaget and Bruner among others provides historical precedents for constructivist learning theory. Constructivism represents a paradigm shift from education based on behaviorism to education based on cognitive theory. Constructivist experts assume that learners construct their own knowledge on the basis of interaction with their environment. Four assumptions referred to as constructivist learning is as listed below:

1. Knowledge is physically constructed by learners who are involved in active learning.
2. Knowledge is symbolically constructed by learners who are making their own representations of action.

3. Knowledge is socially constructed by learners who convey their meaning making to others.
4. Knowledge is theoretically constructed by learners who try to explain things they do not completely understand [Fosnot, 1996].

In the early 1990s the constuctivist approach to learning spread rapidly in the instructional design and multimedia fields. Semour Papert's research with Logo was one of the early examples of applying a constructivist view of the educational use of computers.

Constructivist approach maintains that designers should be creating educational environment that facilitate the construction of knowledge. This approach emphasizes discovery learning whereby the learner explores, experiments, does research, asks questions and seeks answers. Constructivism also implies that construction is the central emphasis of the constructivist approach. The process of construction entails learners setting or negotiating a goal, making plans, doing research, creating materials, evaluating them and revising. Papert(1967) refers to this instructional approach as constructionism rather than constructivism, reflecting their emphasis on learners' actual construction of learning artifacts.

One of the more substantial aspects of constructivist thinking is a basis in situated learning and the implied use of the anchored instruction approach. Situated learning is the theory that learning always occurs in some context and the context in turn significantly affects learning. The main implication of situated learning theory is that properly designing the situation in which learning takes place enhances transfer to other settings. Anchored instruction is the notion that a learning environment should be embedded in a context that is like the real world with real world imagery, goals, problems and activities.

Another considerable aspect of constructivist thinking is an emphasis on cooperative and collaborative learning. Cooperative means learners are helping each other rather than hindering, competing or ignoring one another. Collaborative learning goes a bit further, suggesting environments in which learners work on a shared project or goal such as a group of learners working on a newspaper or rebuilding a car engine. Collaborative suggests joint goals whereas cooperative more generally implies similar goals and helping each other [Kearsley, 2004].

Constructivism has broad implications for traditional and new methods of instructional design. Constructivists believe that some traditional methodologies, such as tutorial and drill instructions are poor for developing lifelong learners. In contrast, they suggest that methodologies such as hypermedia, simulation, virtual reality and open-ended learning environments are of more benefit to learners, allowing them to explore information freely, apply their own learning styles and use software as a resource rather than a teacher.

2.3.2 Is There One Best Learning Theory for Instructional Design?

Theories are useful because they act as eye-opener to other possibilities and ways of seeing the world. The best design decisions are most certainly based on the knowledge of learning theories. Nevertheless, trying to tie instructional design to one particular theory is like school vs. the real world. What we learn in a school environment does not always match what is out there in the real world, just as the prescriptions of theory do not always apply in practice.

Behaviorism, cognitivism and constructivism - what works where and how do we knit everything together to at least give some focus in approach to instructional design. Circumstances surrounding the learning situation must be allowed to help in deciding which approach to learning is most appropriate. It is necessary to realize that some learning problems require highly prescriptive solutions, whereas others are more suited to learner control of the environment [Schwier, 1995].

Jonassen(1991) identified the following types of learning and matched them with what he believes to be appropriate learning theory approaches.

1. Introductory Learning - learners have very little directly transferable prior knowledge about a skill or content area. They are at the initial stages of schema assembly and integration. At this stage classical instructional design is most suitable because it is predetermined, constrained, sequential and criterion-referenced. The learner can develop some anchors for further exploration.

2. Advanced Knowledge Acquisition - follows introductory knowledge and precedes expert knowledge. At this point constructivist approaches may be introduced.
3. Expertise is the final stage of knowledge acquisition. In this stage the learner is able to make intelligent decisions within the learning environment. A constructivist approach would work well in this case [Jonassen, 1991].

Ultimately, it is believed that a successful designer of instructional materials must adapt to the needs of different learners, subject areas and situations and also based on instructional design theory.

2.3.3 Instructional Design Theory

Robert Gagne's Event's of Instruction theory stipulates that there are several different types of levels of learning. The significance of these classifications is that different types of learning require different types of instruction. Gagne(1985) suggests that learning task for intellectual skills can be organized in a hierarchy according to complexity:

- stimulus recognition
- response generation
- procedure following
- use of terminology
- discriminations
- concept formation

- rule application
- problem solving.

The significance of the hierarchy is to identify prerequisites that should be completed to facilitate learning at each level and to provide a basis for the sequencing of instruction. In addition, the theory outlines nine instructional events and corresponding cognitive processes:

1. gaining attention (reception);
2. informing learners of the objective (expectancy);
3. stimulating recall of prior learning (retrieval);
4. presenting the stimulus (selective perception);
5. providing learning guidance (semantic encoding);
6. eliciting performance (responding);
7. providing feedback (reinforcement);
8. assessing performance (retrieval);
9. enhancing retention and transfer (generalization) [Gagne, 1985].

These events should satisfy or provide the necessary conditions for learning and serve as the basis for designing instruction and selecting appropriate media.

As a rule of thumb, the beginning multimedia designer should start with the simpler and more directed methodologies, such as tutorial, drill and tests before tackling more complex and methods such as hypermedia, simulations or open-ended learning environments. Tutorial, drill and tests are more grounded in behaviorism and cognitivism principles whereas constructivism includes approaches such as hypermedia and open-ended learning environments. Instructional design methodologies such as games, simulations and web-based learning make use of all the learning theories. Accordingly, the next section will elaborate on some of these instructional design methodologies.

2.3.4 Instructional Design Methodologies

The process of instruction includes the presentation of information to learners, guidance of learners' first interaction with the material, practicing the material to enhance fluency and retention and finally, assessment of learners to determine how well they have learned the material and what they should do next. Seven methodologies of instructional design methodologies for the facilitation of learning would be:

1. tutorials
2. drills and practices
3. hypermedia
4. simulations
5. tools and open-ended learning environment
6. tests
7. web-based learning

2.3.4.1 Tutorials

Tutorial software usually assumes no previous knowledge of the content being taught and attempts to present the material in a logical sequence which fosters understanding. One problem with much tutorial software is that it is too passive; that is, it requires too little interaction of the student with the computer. Tutorial software must be written in such a way that it engages the student actively. Animations, sound effects and other deviations from the monotonous stream of text help eliminate the passive approach of much music software.

Another problem with tutorial software is that frequently little or no attempt is made to assess the student's understanding of the material presented. The best tutorial software presents the material and then utilizes some type of evaluative format to test for understanding. Tutorial software is capable of teaching higher level cognitive skills but unless it incorporates some type of evaluative techniques, it is usually seen by students as boring. As such, it loses much of its advantage over low-technology printed materials.

Tutorial software, because of its capability for animation and sound effect illustration, does have many advantages over books. One area, however, in which books, in the past, have surpassed tutorial software, is in the accessibility of the information. In a book, students may begin on any page and may turn either forward or backward through the pages. Early tutorial software frequently required that the student start at the beginning and proceed sequentially to the end. Forward progress was allowed but moving backward to review material was not. The proper use of menu and overview screens and of links can help bring this accessibility to tutorial software as well. Another advantage of books is that they usually have an index through which students may look up a given topic for quick access. This capability is easy to implement on the computer but is often overlooked in tutorial software.

To create the best tutorial software, the developer must make the content active and accessible. This includes the inclusion of animations, sound effect, evaluative techniques, indexes and overview pages, the capacity for forward and backward movement, and the ability to search for specific text [Alessi et al., 2001].

2.3.4.2 Drills and Practices

Drill-and-practice software usually gives the student repeated practice on lower level cognitive skills. Note-reading programs are good examples. Drill-and-practice programs usually assume that the student has some prior knowledge of the content and is seeking primarily to refine existing skills. Drill-and-practice software is strongly based on behaviorist models of learning which include stimulus, response, and reinforcement. Most drill-and-practice software uses the following design.

1. The computer selects and presents a problem.
2. The student responds.
3. The computer evaluates the student's response and provides positive or negative feedback based on the student's response.

4. Steps one through three are repeated until the student is ready to stop.

Drill-and-practice models are especially appropriate for lower level cognitive skills. They may be adapted to teach higher level cognitive skills as well but this requires more effort on the part of the lesson author. Many skills in music, however, must be mastered through lower level cognitive processes. For those skills, drill-and-practice is completely appropriate.

It is not intended for providing new information. Problem arises when instructors assume drill-and-practice is capable of teaching new information. It should generally be preceded by instructional methodologies that present information and guide the learner through initial acquisition. This means preceding it with an appropriate tutorial, reading the text book or a classroom lesson [Alessi et al., 2001].

2.3.4.3 Hypermedia

Hypermedia is becoming a common technology delivered on the Web, on CD-ROMS and on other digital media. Although it is a good methodology for constructivist learning environments, its utility is much more general. Hypermedia represents the integration, extension and improvements of books and other media including photographs, video and audio recording in the electronic domain. Hypermedia on CD-ROMs and on the Web contains the knowledge of textbooks, encyclopedias and works of literature and adds to them audio, video and many forms of pictorial information. Hypermedia improves on books and other media by providing better search and navigation capabilities, being user modifiable, easily updated and most important easily duplicated and distributed.

Hypertext is text with links or pointers, showing relationships between parts of the information. Hypermedia extends the concept of information with links to collections including text, audio, video, photographs or any multimedia combination. When hypertext documents include not only text but pictorial and audio information, they are referred to as hypermedia.

Shneiderman (1990) defines hypermedia as a database that has active cross-references and allows the reader to "jump" to other parts of the database as desired. This definition clarifies some interesting points about hypermedia:

- A hypertext is a database. The information is not simply a bucket full of bytes, but is structured, and also large, much like the information stored in most databases. Although the structure of the information is different from that of the more common administrative databases, most current-generation database systems are capable of storing the information used in hypermedia systems.
- The typical user action is a jump or goto between parts of the database. This is different from typical database use, which consists of asking queries that gather information elements from different parts of the database and present them together.

- Apart from textual or other pieces of information, the database contains connections between related pieces of information, so as to guide the user when jumping around through the database.

The pieces of information, or parts of the database, are called nodes, the connections or cross-references between nodes are called links. Together they form a hyperdocument. The nodes and links can be viewed as forming a graph, which may be arbitrarily complex. Below is a simplified view of an extremely small hyperdocument, having only five nodes and seven links. Figure 2.3 also shows that links are tied to a specific point or word or region within a node, called an anchor.

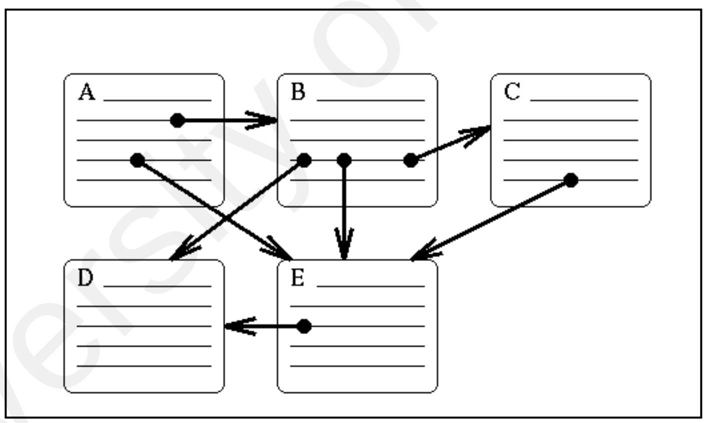

Figure 2.3 Anchor

Although it is a good methodology for constructivist learning environments, its utility is believed is much more general and still in its infancy [Alessi et al., 2001].

2.3.4.4 Simulations

Simulation software attempts to set up an environment in which the student may manipulate the various elements on the computer screen, thereby discovering the content which the lesson designer desired to teach. Simulations may be free as in the Holt, Rinehart, and Winston software or controlled as in a flight simulator.

Multimedia simulation is an increasingly popular method for learning. It is perceived as more interesting and motivating than other methodologies, a better use of computer technology and more like learning in the real world. A simulation does not just replicate a phenomenon; it also simplifies it by omitting, changing or adding details. Using simplified models, learners may solve problems, learn procedures, come to understand the characteristics of phenomena and how to control them or learn what actions to take in different situations.

Simulation enhances motivation, transfer of learning and learner control. Research has shown, however, that imposed control increases learning significantly over programs in which the learner controls the instructional scope and sequence. Other research, however, indicates that students vary according to their personality as to the amount of self direction that is appropriate. Naturally, one would assume that students who are highly self-motivated, detail oriented and adept at self-evaluation would benefit the most from software over which they exercise a great degree of control [Alessi et al., 2001].

2.3.4.5 Open-ended learning environment

Michael Hannafin(1995) uses the term open-ended learning environments to mean environments that allow learners to set goals and pursue them using methods they deem appropriate and desirable. They contrast open-ended learning environments to directed learning environments. Open-ended learning environments emphasize solving meaningful problems, experimenting, interpreting, analyzing the whole rather than parts, taking multiple perspectives on problems, learning from errors, testing and revising knowledge and usually working collaboratively with other learners. Directed learning environments emphasize analysis of content and teaching it systematically, careful sequencing of instruction to elicit correct learner actions, explicit teaching and practicing and mastery of content. This model of instruction is well grounded in behaviorism theory.

Good open-ended learning environments include motivating scenarios, natural and easy to operate interfaces, tools for manipulating and communicating ideas (searching, collecting, processing, organizing and reporting them) and resources such as databases, multimedia libraries and encyclopedias. They also include support for learning through pedagogical techniques such as authentic contexts, cognitive and metacognitive scaffolding and analyzing errors. Most important, open-ended learning environments can be used by teachers as part of a classroom or curriculum that includes a combination of directed learning and open-ended learning.

Technology provides powerful engines that enable flexible search strategies, and tools with which to connect, link, record, capture, manipulate. Technology embeds various kinds of advice and/or support (e.g., scaffolding, strategic guidance, etc.) to aid learners in constructing understanding. Open-ended learning environments use is typically informed by problems, needs and other devices that induce perspectives to be strengthened, refined, or refuted.

Open-ended learning environments are expected to incorporate multiple methodologies such as case studies, simulations, games and web-based learning and combine the use of materials on CD-ROMs, in books and on the web [Choi and Hannafin, 1995].

2.3.4.6 Tests

Assessment is an essential aspect of learning and good instruction. It serves a variety of purposes: determining what a person knows and does not know; rank ordering people in terms of performance; deciding who should be employed; assigning grades; admitting to college and diagnosing mental problems. Assessment can take the form of an informal quiz, a strictly monitored examination for which admission is by reservation only, a portfolio or rubric of learner-developed materials or an evaluation of how the learner performs a given task.

Tests are one of the primary methods of assessment. It is always important to analyze the requirements of both examinees and instructors when designing a testing program or when evaluating one for purchase. People should regard testing as a three-phase process: the phase before the examinee takes the test, the phase during testing and the phase after the test. Both instructor and examinee play different roles in each of these phases and require different information from each. The program must not only meet these needs but also prevent accidents disruptive to them.

From the examinee's perspective the most important phases are before the test and during the test. Before the test the examinee needs to become comfortable with all aspects of testing program in a way that does not heighten test anxiety. During the test the examinee should be able to concentrate on answering items and not on the procedures of the test administration software.

Finally, using computers to administer tests not only can provide relief to instructors but also can improve the overall quality of traditional tests. Computer-delivered tests are becoming well established and widely accepted. Even though still in its infancy it has exciting possibilities that continue to be worth exploring [Alessi et al., 2001].

2.3.4.7 Web-based learning

Web is a methodology for course delivery or a methodology for developing a learning environment. The standards of the web are based on hypermedia and the underlying programming language of the web, hypertext markup language (HTML). Nevertheless, it is possible for a web site to include multimedia programs that are tutorials, drills, simulations and any other methodologies.

Using the web and its various technologies, we can deliver traditional software methodologies such as drill of simulation, can foster learning through person-to-person communication and collaborative work and can provide learners with a vast library of textual, visual and auditory material for their own self-directed research and learning activities. Web can be used to deliver material, manage learning environments and provide assessment of learning.

One of the main uses of the Web and currently the more common one is to support traditional on-site learning. On-site learning is learning in which people come to a classroom or other central location where learning and instruction take place, as well as learning that involves independent work at home, in libraries and other locations relatively nearby the main site for learning. The Web is rapidly becoming the common tool to support on-site learning in the following ways:

- Delivery of learning material – this may include text material equivalent to traditional textbooks
- Facilitating communication – this can add to the existing communication of the regular classroom in many ways
- Providing an additional vehicle for learners doing research – the great volume of knowledge on the web makes it very useful medium for locating information
- Integrating learning activities and managing them – web can provide a central place at which all resources for a course or other learning environment can be stored or organized and managed
- Facilitating collaboration among learners and instructors – the web can foster collaborative activities in which several learners work together on a common product.

- Providing an alternative method for assessment of learning – tests delivered via the web can have all the advantages of computer-based testing, including adaptive testing, automatic scoring, data storage and analysis, time savings for instructors and convenience for both learners and instructors.
- Supporting people after formal learning is finished – web may permit learners to have continued access to course materials which might be periodically updated and resources that would be useful beyond the course.

Web has the ability to be an integrating environment that unites different educational methodologies, distance learners with on-site learners and people of different ages and abilities as well as enables designers and instructors to mange learning activities well and easily.

Many lessons combine methodologies, such as a lesson that begins with a tutorial and then follows a drill or a drill is practiced in the context of a simulation to make it more enjoyable. It is rare for an instructional material to use only one methodology [Driscoll, 1998].

2.4 Learning Styles and Instructional Design

There are three levels of skill in every human: psychomotor skill, cognitive skill and attitudinal skill. Training that involves programming languages such as Visual Basic and Access involves cognitive skill. This skill varies among the learners in the mode of learning style, mechanism of knowledge acquisition and problem-solving method.

Learning styles are individual differences in approaching learning. Two styles that have been described in 2.2.1 are

- Deep-processing and surface-processing
- Holist and serialist

Knowledge is the outcome of learning. Knowledge acquisition is characterized as going through three stages: cognitive, associative and autonomous. Individual differences in terms of general intelligence, perceptual speed and psychomotor abilities too contribute towards knowledge acquisition. Individual differences and the three stages that are involved in knowledge acquisition influence transition from declarative knowledge to procedural knowledge.

Converting the types of knowledge may need problem-solving skill. This usually involves reasoning, drawing conclusions from evidence and judgment as well as decision-making wherein learners evaluate various possibilities. Every person has some problem-solving capability and it varies from person to person. Creative ones are able to generate new ideas rather than using the existing ideas.

Due to all the factors influencing cognitive skill, instructional materials must be developed to achieve specified learning objectives. Ideally, these materials should be based on instructional design methodologies which are derived from 3 learning theories of behaviourism, cognitivism and constructivism. Table 2.3 shows the associations between the factors influencing cognitive skill, the 3 learning theories and the appropriate instructional design methodologies.

Table 2.3 Associations between the factors influencing cognitive skill, the 3 learning theories and the appropriate instructional design methodologies.

Factors influencing cognitive skill	Approaches	Learning theories	Instructional design methodologies
Learning Styles	• Surface-Processing • Serialist	Cognitivism	• Tutorials • Drills and Practices • Hypermedia • Tests • Web-based learning
	• Deep-Processing • Holist	Constructivism	• Simulations • Tools and open-ended learning environment • Hypermedia • Tests • Web-based learning
Knowledge	Declarative Knowledge	Constructivism	• Simulations • Tools and open-ended learning environment • Hypermedia • Tests • Web-based learning
	Procedural Knowledge	Cognitivism	• Tutorials • Drills and Practices • Hypermedia • Tests • Web-based learning
Problem-solving Method	Productive Thinking	Constructivism	• Simulations • Tools and open-ended learning environment • Hypermedia • Tests • Web-based learning
	Reproductive Thinking	Cognitivism	• Tutorials • Drills and Practices • Hypermedia • Tests • Web-based learning

2.5 Chapter Summary

This chapter presented the literature review that bestowed the background knowledge of the research carried out. The earlier component of this chapter looked in-depth at cognitive skills related to learning along with the differences among learners from the view of cognitive ability. The cognitive abilities issues highlighted here were learning style, knowledge acquisition and problem solving skill. An overview of learning theories was also given. Behaviorism, cognitivism and constructivism principles were detailed out together with their insinuation for instructional design. The instructional design methodologies provided basic groundwork for understanding and developing instructional material of the behaviorist, cognitivist or constructivist varieties.

Chapter 3.0 Learning Styles of Tenaga Nasional Executives and Non-executives

3.1 Chapter Introduction

The previous chapter covers the literature review that provides the background facts of this research. Various issues and problems are identified in this chapter. The chapter begins with a brief description of the training requirement in Tenaga Nasional Berhad. Section 3.3 raises the issue of individual differences in cognitive abilities among two groups of training participants in Tenaga Nasional followed by problems encountered during the training practices in Tenaga Nasional Berhad in the next section (Section 3.4). A brief summary of its contents is given at the end of the chapter.

3.2 Background of Training in Tenaga Nasional Berhad

Tenaga Nasional Berhad conducts in-house training for its 25 000 employees. Various types of training are conducted that consist of technical, management and information technology courses. These trainings are also known as short courses because they are normally conducted between 3 to 5 days. The target audiences are the executive group and non-executive group. The non-executive group is largely comprised of technical technicians whom are also known as skill workers. The executives composed of engineers, accountants, computer system analysts, lawyers and office administrators. These two groups have different academic background. Basic university degree is needed as academic qualification for the executives whereas the non-executives possess diploma from vocational training.

These two groups have different job requirement whereby the executives have wide job responsibilities and are involved in making managerial decisions whereas the skill workers normally have specific task to be completed and would be reporting to higher authority above them in which case is an executive. The ages for both groups range between 20 to 50 years old.

Usually, the target audiences in information technology training are considered novice to the training subject especially programming such as Visual Basic and Access Module. This is due to the fact that they are trained in different background and need the programming knowledge to design and develop simple system such as leave management system in Visual Basic for internal office usage. The executive and the non-executive trainings are mostly conducted separately because of the nature of their job. A single information technology training session involves about 20 to 25 participants. However, there are times when these two groups are combined in a single session of training. This happens when there are not enough participants. This normally complicates the teaching process due to the differences in their cognitive ability.

3.3 Learning Differences

The Tenaga Nasional executives have at least undergraduate degrees from recognized universities all over the world. Their university years would have imparted them with formal and extensive training on their cognitive abilities. For an instance, the engineering degree curriculum should focus on preparing engineering students to recognize and understand common conditions, while at the same time fostering the skills of self-directed learning which will enable the student and later, the engineer, to analyze and address the unusual or novel situation. Taken together, the knowledge acquired and cognitive skills developed during undergraduate engineering education should broadly prepare the student for their future career.

Most non-executives in Tenaga Nasional have diplomas from various polytechnics or apprentice certificates obtained after 18-months in-house training in Institute Latihan Sultan Ahmad Shah, which is the training center of Tenaga Nasional. The formal training that they go through is based on vocational education. This type of training emphasizes on psychomotor skills and some cognitive skills. They have a propensity to be good in their jobs but slower in report writing, budget planning or presentation skill.

The nature of job for executives involves a lot of thinking, reasoning, problem solving and decision making. These processes increase their cognitive resources. Since, cognitive skill is taught very well using web-based training, the executives normally find it easy to adapt to the training. In contrast, the non-executives deal with tasks related to physical skills. Of course, these skills are difficult to teach in a web-based training program, as they require an environment with coaching and detailed feedback [Driscoll, 1998]. Thus, for the non-executive to harness his cognitive skill for a short period of training is proven to be difficult.

After conducting this kind of training for the past 5 years, I am of the opinion that an executive learning style is deep processing and holist approach whereas the non-executive adopts surface processing and serialist approach. The executives normally attend information technology training due to their own desire to acquire new knowledge. This knowledge is essential for planning and designing a computer system which can contribute positively towards their work environment. They have the tendency to relate theoretical ideas to different courses and everyday experience. They are inclined to overview the situation and try to gain the breadth view of the knowledge. They can also arrange as well as structure the knowledge coherently. They perceive the learning topics as of immediate value.

Most of the time, the non-executives attend information technology training because they have to substitute their superiors. Therefore their presence is out of job commitment. They treat training as a task and sometime as external imposition. The knowledge is gained by rote learning which is memorisation for the purpose of assesment. They tend to be serialists in their apporach to learning. Their focus in learning is narrow and pay a lot of attention perfecting one detail before moving to the other. In addition, they neglect the broader perspective and associate facts and concepts unreflectively.

Mentioned earlier in 2.2.2, Anderson(1982) characterized knowledge acquisition as going through 3 stages and Ackerman identified three sources on architectural differences related to the different stages. During their academic years, the executives would have gone through a number of cognitive changes which led to higher intelligence and perceptual speed. This allows them to learn the lesson being taught at much accelerated speed. The non executives lack this ability thus slowing down the overall pace of learning in the group. This creates problem in a traditional classroom because the instructor would have to wait for the slower learner to complete the exercises before moving on with the lesson. During this process, the executives would be bored and at times fidgety. They occupied themselves with other things such as browsing internet or checking the mail. If the waiting period is long, then gaining focus on learning from the faster group is tough.

The types of knowledge these two groups are interested in are also dissimilar. The executive is concerned with declarative while the non-executive is fascinated with procedural knowledge. As the executives view more breadth of content knowledge and have the ability to combine abstract information, they favour declarative knowledge. Higher level executive will delegate the job of developing the system to their subordinates whom are junior executive or non-executive. Therefore, they do not need to proceduralize the knowledge.

The kinds of jobs the non executives execute involve procedural or skill knowledge because they are skill workers. They are involved in step-by-step learning of a task and disregard the broader perspective of the topic.

In training sessions that involve writing programming codes, problem-solving exercises are given to test principally declarative and procedural knowledge. Differences in knowledge exist between these two groups because of the way and rate they acquire knowledge. Even though these differences should contribute to diversify problem solving strategies, both groups obviously utilized reproductive thinking to complete their exercises. This is due to the fact that they are all novice in this domain but there have been some effort from the executive group to use productive thinking.

Truly in my opinion, combining the non executives and executive in a single training session is setting hurdles towards a positive learning environment. Various problems are arising due to this arrangement.

3.4 Problems

- Method of learning

  Due to different approaches to learning, knowledge acquisition and problem-solving method, the executives and non-executives display dissimilar method of learning. The executives have better cognitive resources. Since learning Visual Basic programming requires cognitive skill, the executives normally find it easy to adapt to the training as opposed to the non-executives who deal with tasks related to physical skills. The executives favour self-independence and problem-based type of learning whereas the non-executives prefer hand-holding approach and step-by-step learning.

- Speed of learning

  Some people need to go at different speeds while doing the exercises to fully understand and absorb the information. While working in a group, someone is either slowed down or forced to catch up faster then they would like to. Teaching in combined groups such as this can often involve situations where the group moves too fast or too slow for a course participant. It allows lesson to be taught without knowing that every person in the training session actually understands what was taught or one does not learn as quickly and the instructor tries to slow down to explain things to this trainee. The whole group may end up falling behind.

- Uneasy in expressing ideas

  Some of the course participants may not feel comfortable expressing themselves and their ideas in a combined group. These people may be better off working alone than in a group situation. The non-executives tend to be reserved and feel awkward which may due to their pre-conceived idea that the executives in the same training session are equivalent to their superiors in the work environment. Alternatively, the executives tend to be domineering or acquire an active role in the classroom. When this happens, others do not learn how and why things are done, but only copy the information when solving the exercises.

3.5 Proposed Solution

These problems discussed above would have predominantly arrived from the differences in cognitive abilities between the non-executive and the executive groups. One of the ways to resolve this will be to place them in the different groups, however this is limiting their communications. The company benefits from higher social interaction between these two groups which can possibly be achieved in training sessions.

The other way to deal with these problems would be transferring teaching from traditional instructor-led classroom to a web-based training. Web-based training combines the best of self-paced, self-study training with the best of classroom training, given that an instructor is available and interaction with other course participants is encouraged [Steed, 1999].

The web-based training is able to solve the problems mentioned in 3.4 in the following ways:

- Delivery of learning material – this includes text material equivalent to traditional textbooks
- Providing an additional vehicle for learners doing research – the great volume of knowledge on the web makes it very useful medium for locating information
- Facilitating communication – this can add to the existing communication of the regular classroom in many ways
- Facilitating collaboration among learners and instructors – the web can foster collaborative activities in which several learners work together on a common product.

Web has the ability to be an integrating environment that unites different educational methodologies, learners and people of different ages and abilities as well as enables designers and instructors to manage learning activities well and easily. The next chapter explores the development of a web-based training program.

3.6 Chapter Summary

This chapter has identified various issues and problems of this research. A brief description of the training requirement in Tenaga Nasional Berhad has been given. The issues of individual differences in cognitive abilities among two groups of training audience in Tenaga Nasional have been high-lighted and discussed in-depth. Problems encountered during the training sessions due to the individual differences have also been raised.

Chapter 4.0 Design and Implementation

4.1 Chapter Introduction

This chapter discusses on the web-based training prototype, '*Learn Visual Basic 6.0 Now'* produced to overcome the problems mentioned in the last chapter. The development process which involves designing and implementing the prototype are highlighted. Robert Gagne's Event's of Instruction theory is described because it is adopted in the development. A lot of illustrations are given to stress the features incorporated in the prototype. A brief summary of its contents is given at the end of the chapter.

4.2 Description of 'Learn Visual Basic 6.0 Now'

'Learn Visual Basic 6.0 Now' (LeVB6) is a web-based training prototype. Web-based learning instructional design methodology was chosen because it can incorporate other instructional design methodologies such as drill and practices, tests and case studies to foster learning. The objective of LeVB6 is to teach learners simple concepts of Visual Basic 6.0 programming language. The potential users are the executives and the non-executives who attend the Visual Basic programming course conducted in the training institute of Tenaga Nasional Berhad.

The requirement of LeVB6 is to direct the executives and non-executives to their respective learning modules. For the non-executives, they will be directed to the module which contains content descriptions, drill and practice and test. Another set of module contains content descriptions, test and case study. For the executives whose learning style is holists and acquire declarative knowledge will end up with this set of module.

4.2.1 Development Process

The development strategy used is the software prototyping methodology. The emphasis is on trying out ideas and providing assumptions about the requirements, not on system completeness. A software prototype is a dynamic simulation that actually works and has the necessary functionality of the system. Therefore, users can interact with the system in real time. Development process involves designing and implementing the system.

4.2.2 Prototype Design

The instructional design adopted to build LeVB6 is Robert Gagne's Event's of Instruction theory. As LeVB6 needs to accommodate two user groups and it contains a variety of instructional design methodologies for the facilitation of learning, careful considerations have to be given in building this prototype to ensure it does not look sloppily built, with poor visual design and low editorial standards, which will not inspire confidence in learning.

This web-based prototype design process generally follows four major stages:

- Site planning
- User interface design
- Site design
- Database design

4.2.2.1 Site Planning

At this stage the web-based prototype framework has to be detailed out. The framework consists of all the routine parts of the prototype such as the web pages that describe and introduce the lesson, register learners, gather feedback and provide access to additional learning materials. Framework also aid in the actual directory structure for building this website. The process of creating framework involves defining the relationships between the web pages. Figure 4.1 is a diagram showing the complete framework of LeVB6.

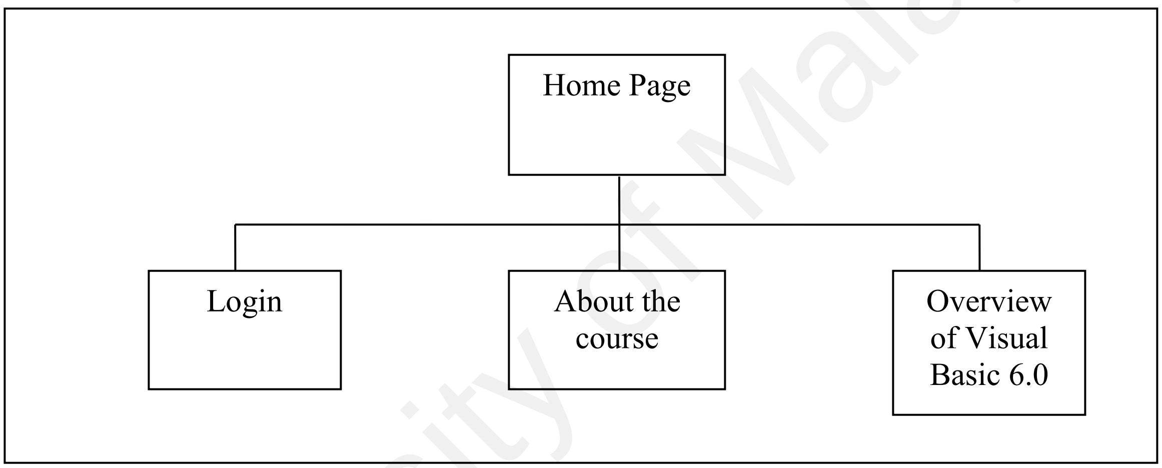

Figure 4.1 Main framework of LeVB6

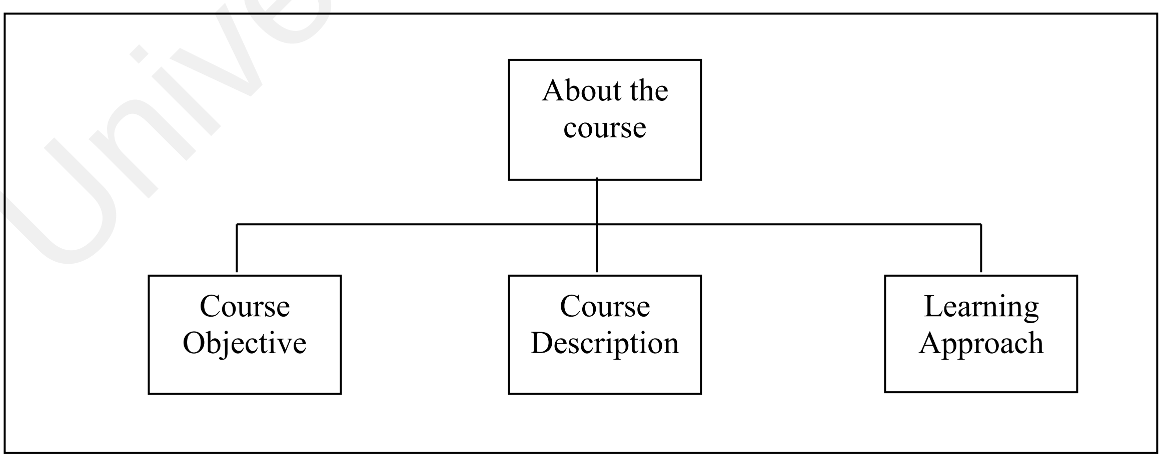

Figure 4.2 About the course framework of LeVB6

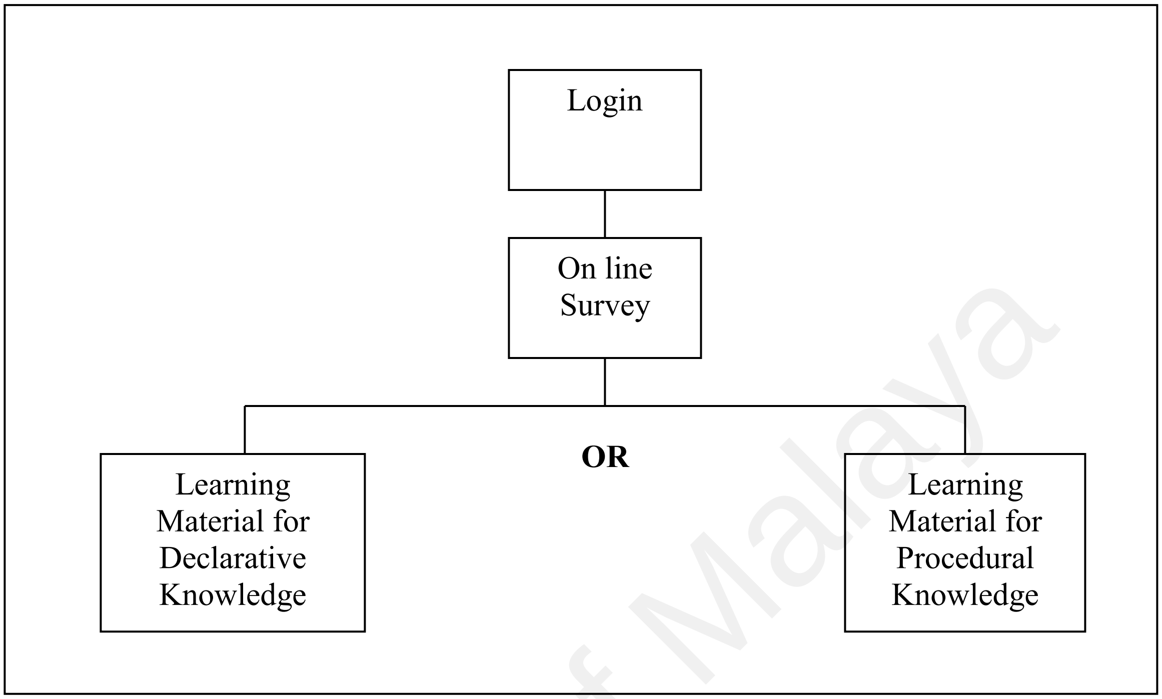

Figure 4.3 Login framework of LeVB6

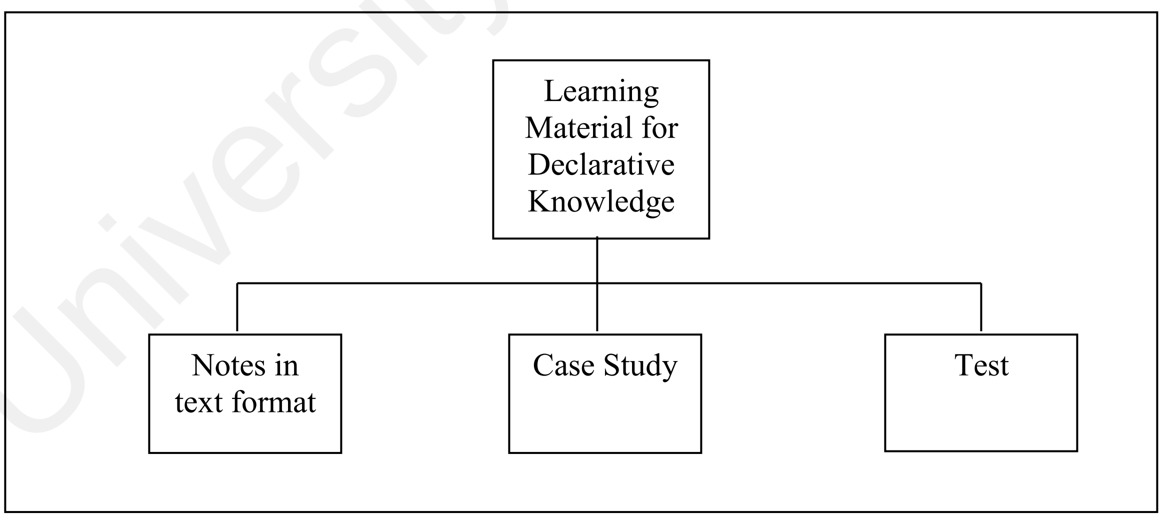

Figure 4.4 Declarative Knowledge framework of LeVB6

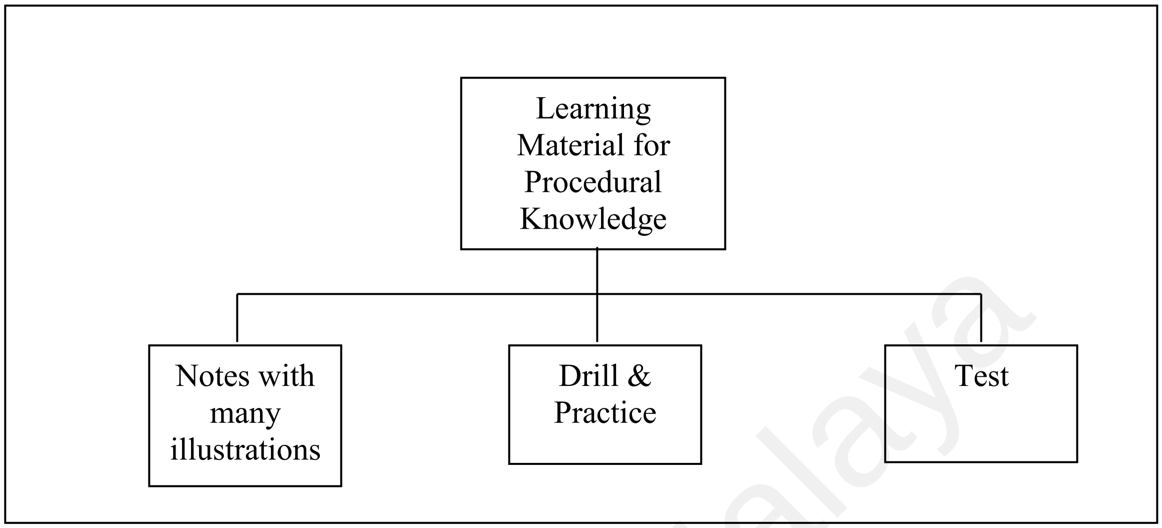

Figure 4.5 Procedural Knowledge framework of LeVB6

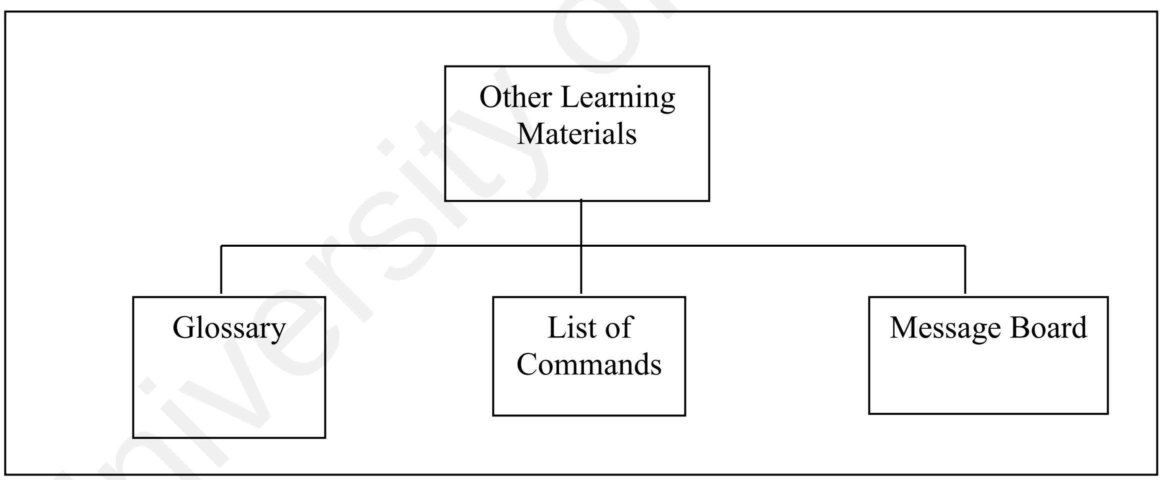

Figure 4.6 Other Learning Material framework of LeVB6

4.2.2.2 User Interface Design

The user interface design is based on the Graphical User Interface (GUI) approach. Some of the Human-Computer Interface (HCI) general principles of designing an interactive system have been considered and applied. These HCI general principles among others are simplicity, consistency, predictable, confirmation and verification message and responsiveness.

- Page Design

User's needs, skills level and preferences are a major consideration here in coming up with the page design. Data should be displayed in an organized pattern. As the prototype has many web pages, arrangement of how to present information is a major concern. Clustering a page with too many information may not be a good strategy while placing them in subsequent pages may render confusion to the users.

The screen design is divided into two parts:

1. **Navigation Area** – located on the left of the screen, this part contains the scrolling menu.
2. **Working Area** – this part occupies 80% of the screen and contains the main content.

Figure 4.7 depicts sample page design.

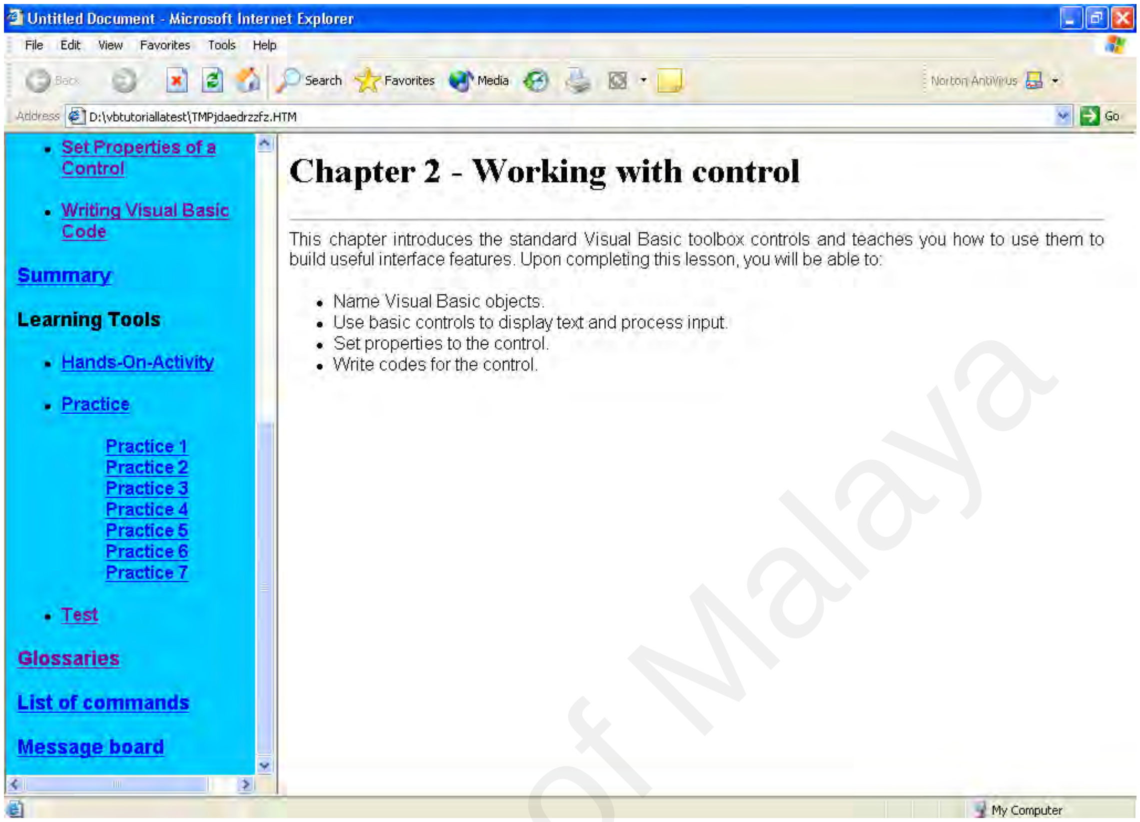

Figure 4.7 Sample Screen Design

Most of the web pages in LeVB6 have similar page layout as illustrated in Figure 4.7. This gives the prototype a consistent layout. A consistent approach to layout and navigation allows learners to adapt quickly to the screen design and to confidently predict the location of information and navigation controls across the pages of the site.

- Graphics

As LeVB6 is developed for education purpose, the graphic images and colors have been used sparingly to avoid garish effects and tune to bandwidth availability. All the graphic images used in the prototype are using JPEG format. It provides huge compression ratios that means faster download speeds and presents high resolution images. As for the background colours, white and blue have been chosen to provide some visual impacts.

4.2.2.3 Site Design

As mentioned in section 4.2, the target participants for the web-based prototype are executive group and non-executive group. It is crucial to choose a design strategy that will accommodate both the groups. LeVB6's design is linear and restricted as oppose to random access. This is because the design presents few opportunities to digress from the central flow of the presentation. It is more like reading a book. However, the design permits fast access to a wide range of topics through the menus.

This prototype requires a user log-in and presents online survey form to gauge learners' different styles in learning. Upon submitting the answers, LeVB6 will decide on which module to administer. User registration data and scores are typically stored in a database linked to the prototype. For the non-executives, the web pages contain step-by step content descriptions with many illustrations, drill and practice and form-based test questions in multiple-choice formats whereas for the executives, the web pages comprise text-based content descriptions, case study and test questions.

Various site elements have been included in LeVB6 to increase its functionality

- Home page
- Submenu and hyperlinks
- Contact information and learner feedback

- Home Page

LeVB6 is organized around a home page that acts as a logical point of entry into the system. Figure 4.8 illustrates the home page.

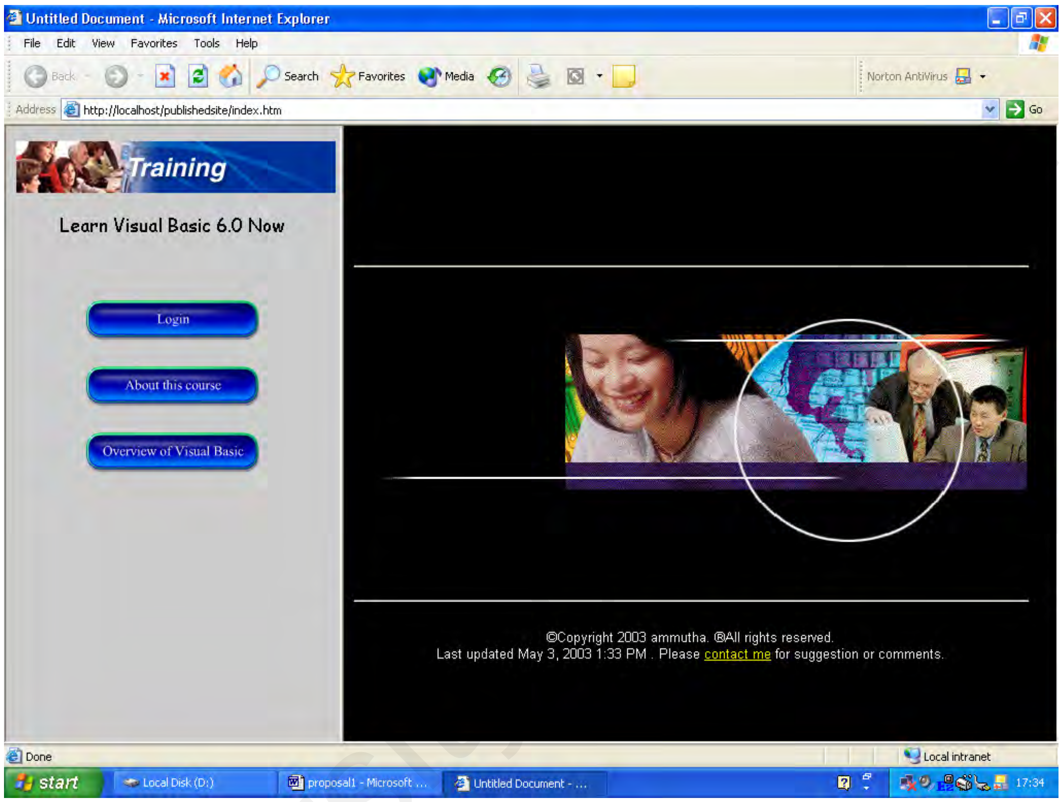

Figure 4.8 Home Page of LeVB6

As seen in Figure 4.8, the home page design strategy of LeVB6 is moderate-sized graphic images. This approach is to make a visually attractive main home page and offers a rapid access to internal pages via graphic buttons. The internal pages have well-organized set of text links as access to information. Text links offer less visual impact but are much easier to change on short notice and impose fast loading.

- Submenus and hyperlinks

LeVB6 is a prototype with three submenu pages that learners enter from the home page. See Figure 4.8 which illustrates the home page. Hyperlinks move the learners from one web page to another. Hyperlinks in this prototype are words highlighted in blue colour or graphical buttons. All the pages in this web-based prototype are connected through hyperlinks.

In the home page, the login button will direct the registered users to a survey form. The survey, as given in the Appendix is designed to gauge trainees learning style. Upon submitting the answers, the prototype will connect to web pages oriented to specific audience. These web pages have text links connecting to topics related to Visual Basic programming. An example of these web pages is shown in Figure 4.7.

As illustrated in Figure 4.7, the hyperlinks are positioned on the navigation area which is on the left side of the screen. Upon clicking the hyperlinks, the information will be displayed on the working area on the same window or a new window. The web pages also provide a basic set of links to other section of the web site such as Glossary and Message Board along with the link back to main home page. The learners can use the "Back" button of the browser to go back through a series of links that have previously been visited.

- Contact information and learner feedback

Through LeVB6 learners can send comments, questions, and suggestions. A link to the email is provided in the home page. This is shown in Figure 4.9. User information and answers submitted in the survey form, tests, drill and practice exercises as well as case studies in the prototype are stored in the database and the inputs are analyzed.

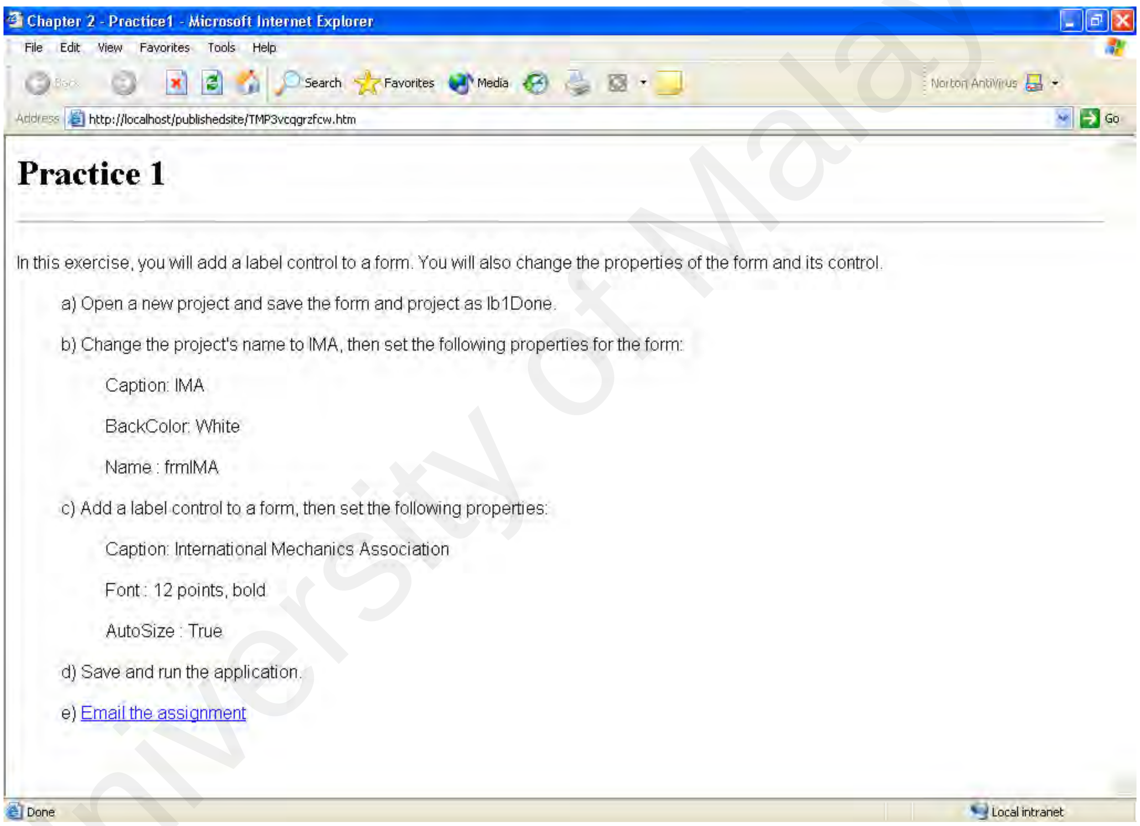

Figure 4.9 An e-mail link

LeVB6 has a message board which is a forum for learners to exchange messages. It allows people to post messages that will appear on the website and to post replies to those messages. It provides a quick and easy way for the learners to share information, ideas and opinions. Illustration of the message board is in Figure 4.10.

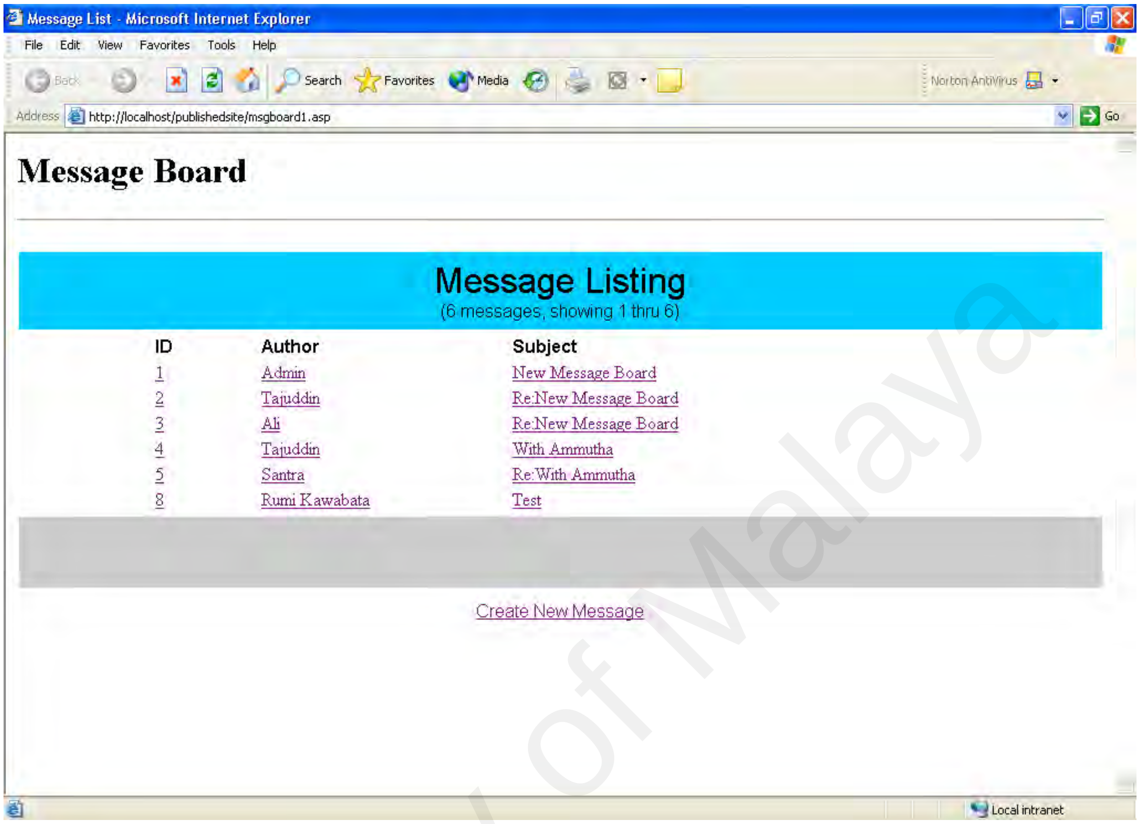

Figure 4.10 Message Board

4.2.2.4 Database Design

The database is constructed using the Microsoft Access version 6.0. Listed below are the attributes related to the database.

Table 4.1: Database General Profile

File name	Dbtutorial.MDB
Type	Microsoft Access relational database
Usage	Maintains and keeps the record related to system
Number of tables	4

The tables in LeVB6 are as listed below:

- User

  Stores user registration data.

- Survey

  Stores responses from the online survey taken by the learners at the beginning of the lesson.

- Answer

  Keeps answers of test questions.

- Board

  Keeps messages posted on the message board.

- Data Dictionary

The database structures of the tables are as shown in Tables 4.2, 4.3. 4.4 and 4.5.

Table 4.2: Database Structure of the User Table

Field Name	Data Type	Size	Description
UserID	Autonumber	Long Integer	Auto number indicating number of users
Username	Text	20	User registration name
Password	Text	20	User password

Table 4.3: Database Structure of the Survey Table

Field Name	Data Type	Size	Description
Username	Text	20	User registration name
Satu	Text	5	User response for question number 1
Dua	Text	5	User response for question number 2
Tiga	Text	5	User response for question number 3
Empat	Text	5	User response for question number 4
Lima	Text	5	User response for question number 5
Enam	Text	5	User response for question number 6
Tujuh	Text	5	User response for question number 7
Lapan	Text	5	User response for question number 8
Sembilan	Text	5	User response for question number 9
Sepuluh	Text	5	User response for question number 10
Sebelas	Text	5	User response for question number 11

Table 4.4: Database Structure of the Answer Table

Field Name	Data Type	Size	Description
Username	Text	20	User registration name
Answer1	Text	255	User's answer for test question 1
Answer2	Text	255	User's answer for test question 2
Answer3	Text	255	User's answer for test question 3
Answer4	Text	255	User's answer for test question 4
Answer5	Text	255	User's answer for test question 5
Answer6	Text	255	User's answer for test question 6
Answer7	Text	255	User's answer for test question 7
Answer8	Text	255	User's answer for test question 8
Answer9	Text	255	User's answer for test question 9
Answer10	Text	255	User's answer for test question 10
Answer11	Text	255	User's answer for test question 11
Answer12	Text	255	User's answer for test question 12
Answer13	Text	255	User's answer for test question 13
Answer14	Text	255	User's answer for test question 14
Answer15	Text	255	User's answer for test question 15
Answer16	Text	255	User's answer for test question 16
Answer17	Text	255	User's answer for test question 17
Answer18	Text	255	User's answer for test question 18
Answer19	Text	255	User's answer for test question 19
Answer20	Text	255	User's answer for test question 20
Score	Number	Integer	User's score for test. Size is between -32927 and 32927
Date_Taken	Date/Time	General Date	Date the test is attempted
Wrong_Answer	Text	255	Correct replies for wrong answers

Table 4.5: Database Structure of the Board Table

Field Name	Data Type	Size	Description
ID	Autonumber	Long Integer	Auto number indicating unique identifier of message
ParentID	Number	Long Integer	Value of the parent message
Subject	Text	255	Message Title
Author	Text	255	Message Author
Body	Text	255	Message Content

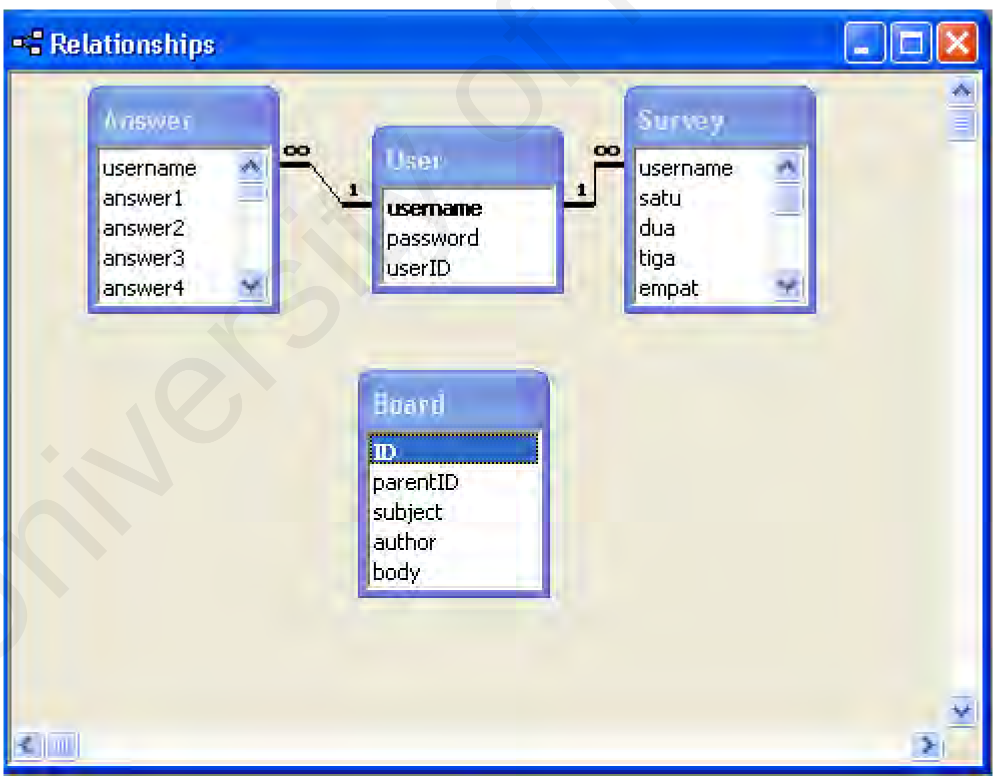

Figure 4.11 Relationships between the tables

4.2.3 Prototype Implementation

Implementation is a process that converts the system requirements and designs into program codes.

4.2.3.1 Development Environment

Development environment has certain impact on the development of a system. Using the suitable hardware and software will help to speed up system development. These tools include the entire platform, development software and programming language. Besides considering the suitability of the tools to the requirements, the tools used must be able to support each other. The following session explains all the tools used in the system.

4.2.3.2 Hardware Tools

The hardware used to develop is listed below:

- IBM-compatible Dos PC, Windows 95 or above
- CPU 133 MHz or above
- 15 MB RAM recommended
- SGVA monitor with 256 colors (640 x 480 pixels)
- CD-ROM driver with 10x or above.
- Installed with Internet Explorer or Netscape Navigator

4.2.3.3 Software Tools

The design process involves the drawing of framework and others that form the foundation of the software development. The purpose of this graphically logical design is to provide an overall view of prototype and interconnection between the web pages. The tools used here is Microsoft Word 2000 for Windows.

During the course of development, a vast array of software tools was used. Below are the lists of software tools used to develop the prototype.

- Dreamweaver Ultradev

Given the vast choices of technology available, it is decided that LeVB6 is to be built using Dreamweaver Ultradev as the main programming language. This WYSIWYG (what you see is what you get) HTML (hyper text markup language) editor creates web applications using a visual design environment that concurrently allows code editing through a logical parallel-window system. It supports Active Server Page (ASP) server technology to generate source code. The source codes are embedded directly within HTML.

Dreamweaver Ultradev will create the link for the application to the database. The type of database connection used is ADO/ODBC (ActiveX Data Objects/Open Database Connectivity). ADO/ODBC technology is Microsoft's method of connecting to data sources.

- MS Access

As for database repository, MS Access was chosen due to shorter learning curves compared to Microsoft SQL Server. As this project is not design to handle large amount of data at this stage, MS Access is sufficient to accommodate the requirements. User information and scores are typically stored in the tables.

- Operating System

LeVB6 is a web application that has to run from a web server and the clients will access it from a browser. Windows 2000 Server is chosen to be the platform for the web server. Windows 2000 Server has IIS 5.0 (Internet Information Services) which is a web service that makes it easy to publish LeVB6 on the internet.

Operating system for the clients is Windows 98. The Microsoft Windows 98 operating system is the upgrade to Windows 95 that makes the computer work better. It works better by providing better system performance along with easier system diagnostics and maintenance. It also installs Internet Explorer which is an internet browser needed to access LeVB6.

4.2.3 Gagne's Nine Events of Instruction

According to Gagne(1985), an effective instructional design should have nine events of instruction as stated in section 2.3.3. These events served as the basis for designing LeVB6 even though not all the events were satisfied.

1. Gain attention

   The homepage in Figure 4.8 has title flashed on the screen to attract the learner's attention. Graphics and background colours have been added sparingly to make the prototype attractive.

2. Informing learners of the objective

   The homepage in Figure 4.8 contains information regarding the web-based training. It explains the objectives of the web-based training, the instructional design methodologies and brief introduction of Visual Basic programming language. These descriptions are needed due to the fact that the learners do not have any or very little knowledge regarding the subject being taught.

3. Stimulating recall of prior learning

   This activity of reminding learners of prior knowledge relevant to Visual Basic 6.0 was not included as the learners are new to the subject.

4. Presenting stimulus

   Content descriptions are arranged in a non-threatening manner so that learners are not over-whelmed by the amount of information contained in a page. They are presented in text, graphic and picture formats and follow a consistent presentation style. The format is shown in Figure 4.7.

5. Providing learning guidance

   The guides should provide suggestions to the actions that learners take and are meant to help learners make desired inferences to understand the lessons. Guides are presented in the format of Glossaries, List of Commands and Message Board. All these items as seen in Figure 4.7 are displayed in the same window as the lesson. This is to ensure visibility, reminding learners that help is available at all time and the type of guide provided. The type of help available is informational. It means help with the content. This includes accessing more detailed descriptions, additional examples or explanations worded more simply.

   The Glossaries provide additional examples to the terminologies used in Visual Basic 6.0 programming language. The terminologies are put in alphabetical order and can be assessed by clicking on the desired alphabet. Figure 4.11 gives illustration of this.

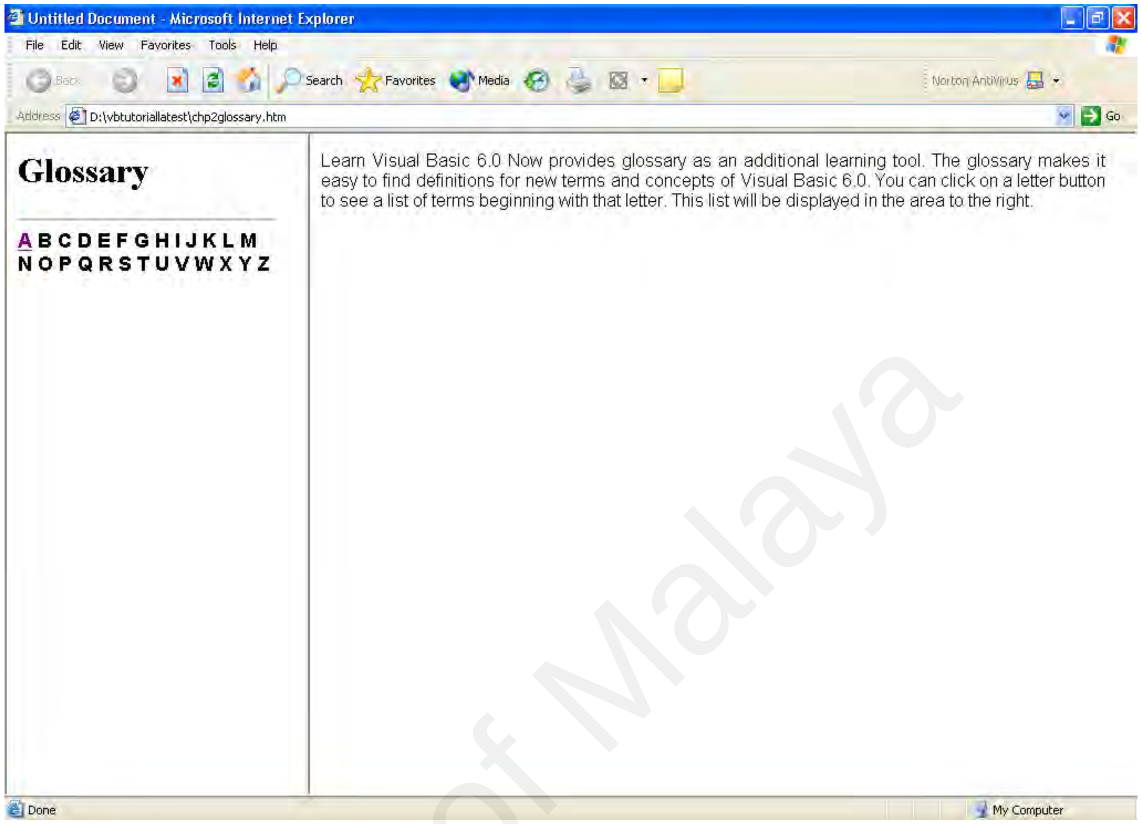

Figure 4.12 Glossary

List of commands provide the summary of all the Visual Basic commands used in the lesson. There is a simple worded explanation for each command. Learners can refer to these commands if the explanations given in the lessons are perceived complicated. Figure 4.12 illustrates this further.

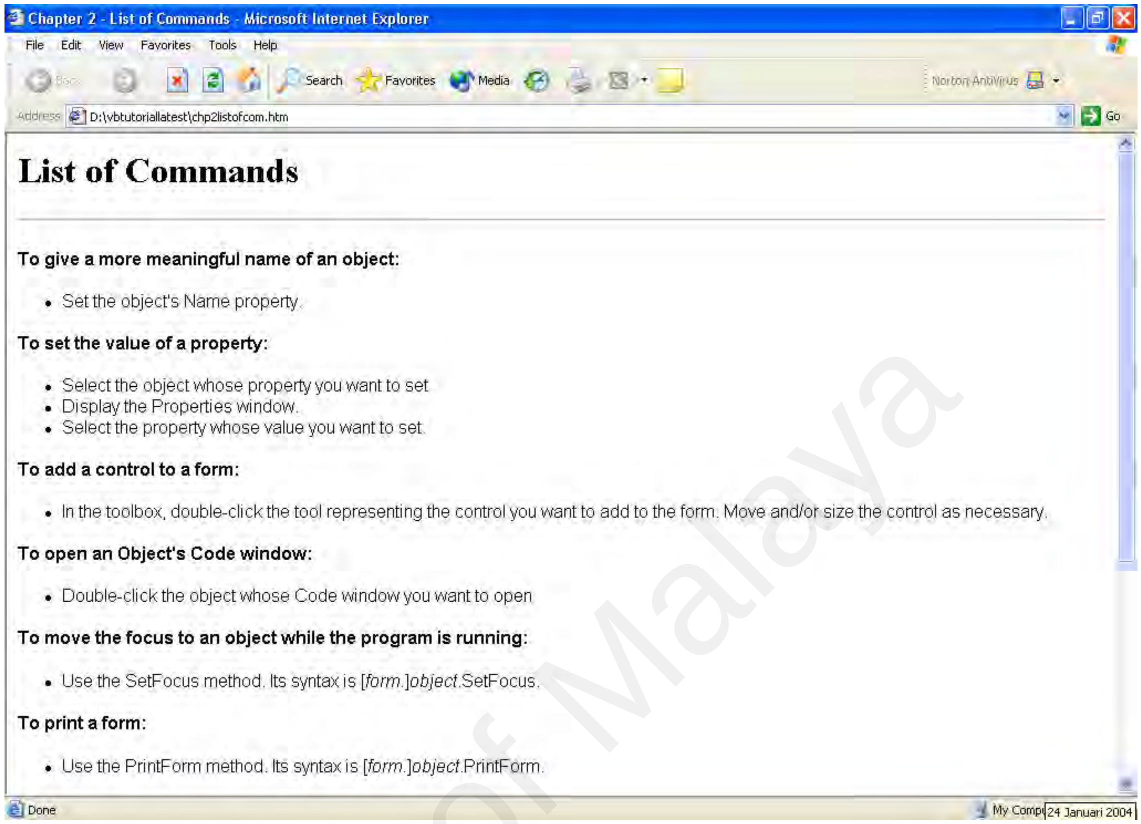

Figure 4.13 List of Commands

Visual Basic 6.0 programming language provides detail help through the Help menu. It also operates as online book. Hence the learners will be able to obtain informational help on Visual Basic.

6. Eliciting performance

The learners are given ample exercises to apply their newly acquired knowledge and practice their skills. A serialist who has the tendency to acquire procedural knowledge will be directed to the module which contains drill and practice and test. Another set of module contains test and case study. For those who are holists and inclined towards declarative knowledge will end up with this set of module.

7. Providing feedback

   Feedback is given to the learners to show correctness of the learners' response. LeVB6 does not have an online feedback facility. This is due to the nature of exercises in the prototype. The learners create simple project files using Visual Basic 6.0 program by following the instructions given in the exercises. Once completed, they will e-mail the project files to the instructor in-charge for the feedback. The instructor then will go through the project files and send them back to the learners with the comments.

8. Assessing performance

   Test is included in LeVB6 since it acts as an essential aspect of all good instruction. There are 20 questions with answers in objective form. The answers are presented as radio buttons, therefore there is only one answer for each question. Testing is individualized, allowing learners to take the test when they are ready rather than at a fixed time. The scoring is automated whereby the feedback is provided immediately. The learners will receive their individual score upon submitting their answers. Figure 4.13 shows the feedback of test performance.

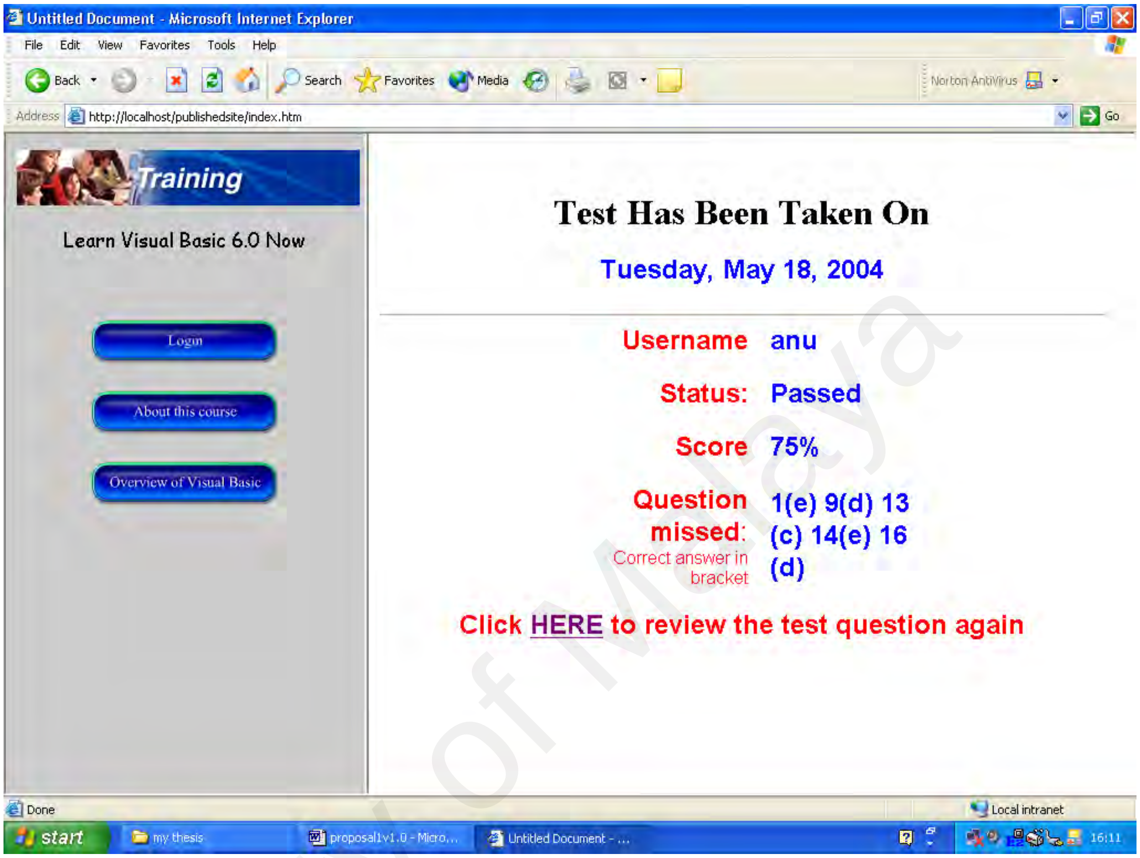

Figure 4.14 Feedback of test performance

9. Enhancing retention and transfer

   Message board allows the trainees to communicate with each other and discuss issues and problems related to Visual Basic 6.0 programming language. This encourages collaboration between them as well as informing the learners about similar problem situations and putting the learner in a transfer situation.

Figure 4.10 in page 67 depicts the message board in LeVB6. A list of all the messages that are available will be posted in the message board. When a learner finds a message he wants to view, he opens it in a viewing window. It shows the responses to a message that is being viewed. The learners can compose their messages and post them to the message board as well as reply messages posted by others.

4.3 Chapter Summary

This chapter has highlighted the components of the web-based training prototype, LeVB6 produced to overcome the problems mentioned in Chapter 3. The development process which involves designing and implementing the prototype has been discussed in depth. In addition, the Gagne's nine steps of instruction were also highlighted as they are significant to any instructional context.

Chapter 5.0 Evaluations

5.1 Chapter Introduction

This chapter discusses on how effective LeVB6 in overcoming the problems mentioned in chapter 3. Evaluations are done on the web-based prototype and data gathered about the usability of the prototype are discussed lengthily. The strengths of the prototype are highlighted at the end of the chapter.

5.2 Types of evaluations

The aim of evaluation is to find out how learners use LeVB6 and its effectiveness in accommodating the training needs of executive and the non-executive group. There are two kinds of evaluation employed. They are online survey and observation. These methods are used because they are easy to implement and data can be obtained in a short period of time.

5.2.1 Online survey

A survey is a method of collecting information from people about their ideas, feelings, beliefs and educational as well as financial background. It usually takes the form of questionnaires. It relies on directly asking people questions to get information [Preece, 1994].

LeVB6 has online survey published as new user logs at the homepage. The survey as in the Appendix contains 14 closed questions related to learning styles. The questions are to discover the learners approach to learning, problem solving and handling new or daily task. The learners are asked to select an answer from a choice of ‘a’ and ‘b’. The answers in ‘a’ are related to procedural knowledge and ‘b’ are correlated to declarative knowledge. The answers for each learner are saved in the database and analysed.

5.2.1.1 Survey Samples

20 executives and 20 non-executives in Institut Latihan Sultan Ahmad Shah that is the training center of Tenaga Nasional took the survey. The executives consist of engineers, accountants and human resource managers whom have been working for the company for more than 5 years. All of them are graduates in their respective fields with 15 of them possessing Masters degree in engineering or management along with 2 certified professional accountants. The rest are human resource professionals.

The 20 non-executives are from clerical and technical background. The clerical staff consists of personal assistants to senior managers and data entry clerk whereas the non-executives from technical background comprises of technicians who are involved in repair and maintenance work. They are generally aged between mid twenties to mid forties. Their academic backgrounds are generally certificates from polytechnics or they are Sijil Pelajaran Malaysia certificate holders.

The above groups are novice to the training subject which composes an ideal test as target participants for Visual Basic programming language training. The executive group is interested in breadth-view of the subject as tool to help in their daily tasks in the office which leads them to acquire declarative knowledge whereby the non-executives desire to use the Visual Basic in-depth and this is procedural knowledge.

5.2.1.2 Survey Results

Table 5.1 shows the findings of the survey. The survey has successfully categorized the participants according to their learning styles.

Table 5.1 Results of online survey

	Declarative knowledge of Visual Basic	Procedural knowledge of Visual Basic	Total
Executive	18	2	20
Non-executive	1	19	20

Figure 5.1 demonstrates the graphical interpretation of table 5.1.

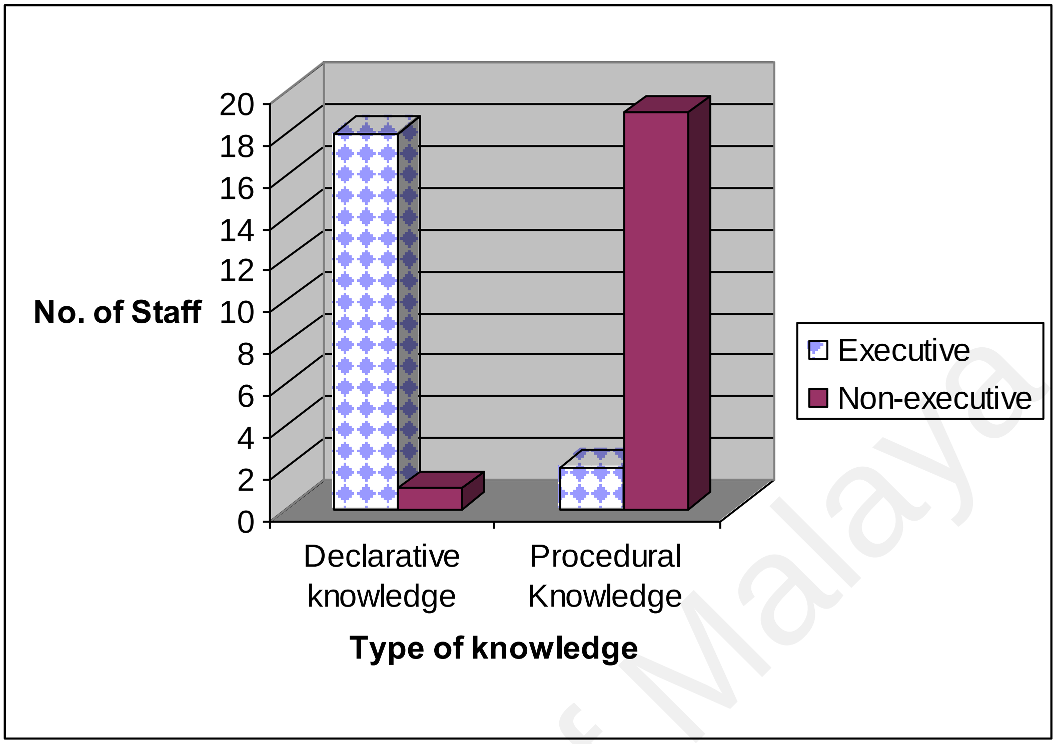

Figure 5.1 Histogram showing results of online survey

5.2.2 Observation

The Oxford Dictionary defined observation as a comment or remark. Observation solely involves the observer or observers in making the observation. The observer will observe activities, relationship, influence and message in the user environment. Observations are usually flexible and do not necessary to be structured around a hypothesis or what you expect to observe [Preece,1994]

The objective of observation in this study is to observe learners activities while using LeVB6. This categorizes observation as direct observation whereby the learners are aware that they are being watched. Data related to learning tool used, interrelationship with other learners and the complexity of exercises are gathered.

5.2.2.1 Direct Observation

Two direct observation sessions were carried out. Each session was carried out with 20 people and it comprised of 10 executives and 10 non-executives. This arrangement was done to study whether problems as stated in Chapter 3.4 due to combining the executives and non-executives in a single training session could be solved by using LeVB6.

As mentioned in the previous chapter, the objectives of modules are similar but the approach of teaching is different. Each module contains a variety of instructional design methodologies for the facilitation of learning such as test and case study.

As the executives have the tendency in acquiring declarative knowledge, they have been presented with lessons in subjective manner and content descriptions are in essay forms without many illustrations. Exercises are in the form of case study and test as primary instructional design methodology. Appendix has the sample lesson described here.

While going through lessons in LeVB6, the executives were inclined towards attempting the test and case study questions without reading the notes. Initially they struggled while attempting the questions. However, quickly they began using the Help file in Visual Basic 6.0 program as their reference. In addition, they also tried to find solutions from the web as well as collaborating with other learners through the message board.

They managed to complete the lesson without many obstacles and many of them passed the test in their first attempt. They admitted that the questions were challenging when asked regarding the test questions but found LeVB6 very exciting method of learning. Many of them requested for the web-based training prototype to be developed fully and incorporated with the conventional classroom training.

For the non-executives, they were given drill and practices as well as test. Appendix has the sample lesson. As opposed to the executives, they were intimidated with LeVB6 at first. This reaction is due to their first exposure to different learning methodology. After explaining what to be done, they began to show interest in attempting the practices.

They diligently went through the lesson in step-by-step manner. They took time exploring Visual Basic 6.0 program interface before attempting the practices. This instructional design methodology proved to be helpful in assisting them gaining procedural knowledge of the subject.

However, they had to work hard with the test questions and many failed. When asked, they informed that the questions were difficult. This is due to lack of understanding in conceptual knowledge of Visual Basic 6.0 program. There was not much attempt made to search for more information in the web as well as collaborations with other learners using the message board. They rather asked the instructor in charge to give the solution than finding on their own. They preferred the conventional based training compared to

LeVB6 as it is a new learning tool but admitted that it will be helpful once they are familiar with it.

5.3 Data analysis

Based on the data gathered during the evaluation process, it is apparent that there are differences in learning style, knowledge acquisition and problem-solving skills among the executives and the non-executives. The executives are inclined towards acquiring declarative knowledge due to their learning styles which are deep processing and holist. The non-executives who adopt surface processing and serialist approach evidently attained procedural knowledge.

Differences in learning styles and knowledge acquisition contributed towards dissimilarity in problem-solving skills too. The executives used the Help file in Visual Basic 6.0 and information from the web to solve problems presented in the exercises. They managed to gather declarative knowledge and proceduralized them. This is a proof of productive thinking. However, this was not noticed among the non-executives.

The main factor that contributes to these differences is their academic background. The minimum paper qualification to become an executive in Tenaga Nasional is undergraduate degree. The university years would have exposed them with formal and wide training on their cognitive skill. The knowledge acquired and cognitive skills developed should prepare them for their future career.

Most non-executives in Tenaga Nasional have certificates from various polytechnics or apprentice certificates obtained after 18-months in-house training in Institute Latihan Sultan Ahmad Shah, which is the training center of Tenaga Nasional. The formal training that they go through is based on vocational education. This type of training emphasizes on psychomotor skills and not much of cognitive skills in order to provide skill workers. They have an inclination to be good in their jobs but slower in areas such as decision-making or critical thinking.

Another aspect that adds to these dissimilarities in learning styles is job characteristic. The executives have wide job responsibilities and are involved in making managerial decisions whereas the skill workers normally have specific task to be completed and would be reporting to higher authority above them in which case is an executive. The executives are involved in department administration, staff supervision and project as well as budget management. A wide degree of creativity and latitude is expected and encouraged in carrying out their daily tasks.

Therefore, they tend to overview the situation, attempting to gain a broad outline of the problem before fitting in the details later. They make more elaborate hypotheses, looks further ahead, build up a picture of the whole task, look for links with other topics and even rely on their own analogies and descriptions. These characteristics fit into holist learning style as described in Chapter 2.

Apart from that, the executives perceive the training in Visual Basic as means for assisting them in their daily tasks. They tend to relate previous knowledge to new knowledge as well as relate theoretical ideas to everyday experience. They will also attempt to organize and structure content into logical whole. These are the features of deep-processing learners.

For the non-executives in the clerical line, their duties are typing and faxing memos and inputting data into corporate systems. Those in technical background are chiefly responsible with troubleshooting problems and diagnosing as well as resolving technical problems. The tasks are given to them by their immediate supervisors. These jobs by nature require more of physical skill rather than cognitive skill.

They prefer a narrower focus in learning, concentrating on simple hypotheses and step-by-step learning, paying attention to details and processes but neglecting the broader perspectives and links with other topics. They focus on tasks and fail to associate facts and concepts reflectively. Their learning styles are known as serialists and surface-processing. Due to these learning styles, they perceive Visual Basic programming training as a complicated task and treat it as an external obligation.

5.3.1 Discrepancy

Nevertheless, based on the online survey done, there were discrepancies noted. Two executives fell on the group that acquires procedural knowledge and there was a non-executive who attains the declarative knowledge.

After having unstructured interview session with them, it was gathered that these executives were recently promoted from technician post to a junior engineer. This promotion was based on rank and file and not academic. This policy of promotion is applied to those hardworking personnel who have reached maximum salary in the current post for more than five years in Tenaga Nasional Berhad.

Based on their technical job background prior to promotion, it emphasizes on psychomotor skill. Therefore, their learning style tends to be different than the executive. New job as junior engineer involves a lot of thinking, reasoning, problem-solving and decision making. Through time these processes would increase their cognitive resources which would then change their learning style.

As in the case of the non-executive, the personnel interviewed informed that he is a management graduate from one of the local universities and currently attached with Tenaga Nasional Berhad under the scheme known as Undergraduate Competency Program which was organized by Human Resource Ministry. Through this program Tenaga Nasional Berhad employs undergraduates that could not get a job to do clerical or technician work. This case justifies that academic background contributes towards different learning styles as explained in section 5.3.

5.4 Strengths of LeVB6

The web-based training prototype is developed to direct the executives and non-executives to their respective learning modules. For the non-executive, they will be directed to the module which contains drill and practice and test. Another set of module contains test and case study. The executive whose learning style is holists and acquire declarative knowledge will have access to this set of module.

As stated in Chapter 3.4, several problems arose when combining non-executives and executives in a conventional based training. These problems are method and speed of learning as well as uneasiness in expressing ideas. Based on the data gathered during online survey, majority of the target audiences were directed to their respective learning modules based on their learning styles. LeVB6 was successful in accommodating the training needs of the target participants.

5.4.1 Strengths

- Method of learning

  LeVB6 imposed a new method of learning in a conventional based training. The executives who favour self-independence and problem-based type of learning found it stimulating. They adapt to the changes easily due to their high cognitive resources. Even though the non-executives prefer hand-holding approach and step-by-step learning, they still accepted LeVB6 as a tool to learn Visual Basic 6.0.

- Speed of learning

Teaching in combined groups can often involve situations where the group moves too fast or too slow for a learner. LeVB6 allows learners to go at different speeds while doing the exercises. The non-executives took longer time to finish their exercises compared to the executives. In a traditional classroom, this would create problem as the instructor has to wait for the slow learners to complete the exercises before moving on.

LeVB6 managed to eliminate this problem. The executives were busy exploring the web attempting to gain breadth view of the subject. They tried to relate the theoretical ideas to their everyday experience. Some were building a picture of the whole task that need to be carried out in their respective offices.

- Ease in expressing ideas

  The non-executives tend to be reserved in expressing ideas which may due to their pre-conceived idea that the executives in the same training session are equivalent to their superiors in the work environment. Alternatively, the executives tend to be domineering or acquire an active role in the classroom. The message board in LeVB6 was used as a tool to collaborate and share ideas with other trainees. All the learners took the opportunity to play around with the message board. The executives posted messages related to the lesson where as the non-executives were testing it out with more casual messages.

5.5 Chapter Summary

This chapter discussed LeVB6's effectiveness in overcoming problems that arose due to combining the non-executives and executives in a single training session. Evaluations were carried out using online survey and direct observation and data were gathered about the usability of the prototype. The strong points of the prototype are highlighted at the end of the chapter.

Chapter 6.0 Conclusion

6.1 Chapter Introduction

This chapter presents the conclusion of the study. It discusses briefly the differences in cognitive skill between the learners in Visual Basic 6.0 training and the effectiveness of the prototype developed to overcome the problems arose during the training sessions. It also highlights the weaknesses of LeVB6 and its future enhancement.

6.2 Project Objectives

On the whole the objectives of this dissertation have been achieved. LeVB6 which is a web-based training tool was developed and it managed to distinguish the cognitive ability of the executive group and the non-executive group in Visual Basic training in Tenaga Nasional. In addition, this instructional system can accommodate the training needs of the mentioned groups. Justification is given in the sections below.

6.3 Differences in Cognitive Skill

This study investigates the differences in cognitive skill between two groups of target participants in Visual Basic 6.0 program training in Tenaga Nasional Berhad. This training involves cognitive skill. This skill varies among the learners in the mode of learning style, mechanism of knowledge acquisition and problem-solving method.

The target audiences for Visual Basic 6.0 training in Tenaga Nasional are executives and the non-executives group. The executives are composed of engineers, accountants, and office administrators. The non-executive group is largely comprised of technical technicians whom are also known as skill workers.

Executives learning style is deep processing and holist approach. They have the tendency to relate theoretical ideas to different courses and everyday experience. They are inclined to overview the situation and try to gain the breadth view of knowledge. They can also arrange as well as structure the knowledge coherently. They perceive learning topics as of immediate value.

The non-executives adopt surface processing and tend to be serialists in their apporach to learning. Their focus in learning is narrow and pay a lot of attention perfecting one detail before moving to the other. In addition, they neglect the broader perspective and associate facts and concepts unreflectively.

The types of knowledge these two groups are interested in are also dissimilar. The executive is concerned with declarative while the non-executive is fascinated with procedural knowledge. As the executives view more breadth of content knowledge and have the ability to combine abstract information, they favour declarative knowledge.

Academic backgrounds and job characteristics have contributed towards differences in the cognitive skill among the executives and the non-executives. Combining them in a Visual Basic 6.0 training session sets hurdles towards a positive learning environment.

Various problems are arising due to this arrangement. Therefore, a web-based training prototype was developed to handle these problems.

6.4 Web-based Training Prototype

The objective of web-based training prototype named *Learn Visual Basic 6.0 Now* is to teach trainees learn simple concepts of Visual Basic programming language. Web-based training was chosen as the main instructional design methodology. This is because it can incorporate other instructional design methodologies such as drill and practices, tests and case studies to foster learning. Web-based trainings are also accessible anytime and anywhere and easy to be updated. Collaborative tools such as message board and e-mails can be included to make learning more interesting. The web can also extend the reach of learners to many resources when links to other websites are provided.

The prototype has been designed to direct the learners to their respective learning module. This is decided by the online survey in the homepage. For the learners whose learning style are serialists and acquire procedural knowledge, they are directed to the module which contains drill and practice and test. Drill and practice methodologies are used here to give repeated practice to the learners to guarantee fluency and retention which helps them to proceduralise knowledge. The content descriptions are presented in step by step manner. There are many illustrations and explanations which are very easy to understand.

For learners whose learning style are holists and have the tendency of acquiring declarative knowledge will end up with the module containing test and case study. Case study is a tool of open-ended learning environments. This methodology reflects a more constructivist approach to learning and teaching. They emphasize learning by discovery, exploration, creating models and solving complex problems. They are presented with content descriptions similar to text-book style whereby they are in subjective manner and elaborations are in essay forms without many illustrations.

Both set of modules contain the same test. Test is included in this prototype since it acts as an essential aspect of all good instruction. Besides learning tools, the prototype has been incorporated with Help element to assist learners. The type of help accessible is informational. It means help with the content. It is presented in the format of Glossaries, List of Commands and Message Board.

6.5 Effectiveness of Learn Visual Basic 6.0 Now

Evaluations were done to find out the effectiveness of LeVB6. Based on the data gathered during online survey, majority of the target participants were directed to their respective learning modules based on their learning styles. It is apparent that there are differences in learning style, knowledge acquisition and problem-solving skills among the executives and the non-executives. The executives are more inclined towards acquiring declarative knowledge due to their learning styles which are deep processing and holist. The non-executives who adopt surface processing and serialist approach evidently attained procedural knowledge.

Both target participants accepted LeVB6 as a new and exciting learning tool in a conventional based training. LeVB6 allows learners to go at different speeds while doing the exercises. The non-executives took longer time to finish their exercises compared to the executives. While waiting for the fellow trainees to complete the task, the executives kept themselves busy exploring the web and sending messages in the message board. All the learners took the opportunity to play around with the message board.

Thus, this proves that LeVB6 managed to achieve its task and solved the problems that arose in combining the executives and non-executives in a single training session. In addition, the prototype is considered an effective instructional design material for the reasons listed below:

- Instructional objective

  This has been incorporated in the home page of the web-based prototype. Measurable objectives improve the probability of a lesson's success and provide the basis for evaluation of the student.

- Learner's characteristics

  LeVB6 was designed for specific users. The instruction matched the characteristics of the learners that used the system.

- Individualised

The learning materials were decided based on the learning style. The information about the learning styles were gathered from the online survey and this information is personal information. This information also determines the difficulty levels in the exercises. Learners can also send personal comments via ammuthas@yahoo.com which is an e-mail address provided on the homepage.

- Learner's interest

  The executives were very excited with LeVB6. It managed to motivate them to learn Visual Basic 6.0.

- Performance evaluation

  It evaluates performance. Data on learners' performance are recorded for evaluation and positive feedbacks are given.

- Computer resources

  Multimedia is used sensibly since LeVB6 is an educational based web site. Too much multimedia elements will hinder performance because they will create larger files which will make them difficult to access over the network. Thus, making the learning process less effective.

- Instructional Design principals

  LeVB6 complies with the Gagne's instructional design theory.

6.6 System Weaknesses and Future Enhancement

Below are the weaknesses found in the prototype:

1. Lack of navigation support

   Currently there is no site map to access information and each page does not have a link to get to the previous page or home page. Also there is no search engine attached in the web site to enable users to do key word searches in the prototype. The only feature provided in the prototype is hyperlinks to go to next page. If the user wants to go to the previous page or home page he has to use the navigational button provided in the internet browser. Any key word searching will be done using search engines such as Google or Yahoo. Each page should have a link to the home page. Guided searches for specific information should be allowed.

2. Multimedia content

   A scrolling text has been put on the home page for the purpose of holding the user's attention. However, this is the only multimedia element which is animation that is included in the prototype. Other elements such as video or sound that are relevant and will make learning fun should be included in the future. This has to be done without affecting the download time and instructional quality.

3. Content expansion

   Only one chapter has been included in this prototype. For maximum usage, the other chapters need to be added to complete the prototype. Also it should be improved by adding more practices such as online tests which are scored automatically and a running total is maintained for all test scores. In addition, the glossary and list of commands require to be expanded as well. The test questions need to be scrambled as well. This is because the answers in a) are related to procedural knowledge and in b) are related to declarative knowledge.

4. Effectiveness

The system only managed to categorize type of learners among the executive group and the non-executive group in Visual Basic training in Tenaga Nasional but not the effectiveness of it. Usability of LeVB6 should be considered. The site should provide for both types of learners. LeVB6 is also an intranet system whereby it is accessible only in TNB training institute. It should be made into internet system in order to provide access to TNB trainees outside of training institute. By doing so, learning can take place any time and any where.

6.7 Chapter Summary

This chapter presented the conclusion of the study. It summarizes the issues related to dissimilarity in cognitive skill between the learners in Visual Basic 6.0 training and highlights how LeVB6 overcame the problems arose during the training sessions. It also underlined the weaknesses of LeVB6 and its future enhancement.

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