CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The main purpose of this chapter is to conduct theoretical analysis on two areas of concern for this study, which is, e-learning and theory of multiple intelligences. This chapter outlines the areas of concern that precipitated the decision to conduct a review of the literature on learning styles based on the theory of multiple intelligences and how they may be considered in the design of e-learning applications. In order to relate this two areas together, a review of literature was conducted on compound learning theories.

2.2 Learning Styles

The theoretical foundation for the research lies in the areas of learning styles in general and the theory of multiple intelligences in specific from the aspect of educational psychology.

A search of the literature on the WWW revealed that documents relating to learning styles are prolific. Refining the search by including ‘online learning’ in the search criteria did not successfully elicit sites that discussed issues concerning the use of learning styles in the design of e-learning environments. However, careful examination of the ‘hits’ produced by the search engines did reveal some relevant sites, though these were few and far between. Searching online databases such as ProQuest, ACM, IEEE, ScienceDirect and examination of online journals proved more successful.

The literature relating to learning styles is vast and can be categorised as follows:

1. Description of learning styles and Test instruments.
2. Arguments relating to the validity and reliability of learning styles instruments.
3. Discussions about the relationship between learning styles and gender or race.

4. Results of search into how learning styles may affect outcomes at different phases of education including primary, secondary, tertiary and higher learning levels.

5. Articles describing how learning styles may be integrated into the design of courses.

Although many of the papers included in category (5) ‘how learning styles may be integrated into the design of courses’ do not relate to online courses, many of them include information which is pertinent to the area under investigation. Comparatively few papers or research reports address the question of how an e-learning environment can effectively accommodate students with differing learning styles. Therefore, as the literature in learning styles theory which describes how to incorporate learning styles into course design is applicable to both traditional and electronic learning, this review of the literature draws on information from a variety of papers. These include those that discuss learning styles and the design of traditional courses, and those that specifically discuss the relationship between learning styles and electronic learning. The following section presents the review of the literature.

2.2.1 Introduction to Learning Styles

We are all aware that different people learn in different ways. Many of us have been in a group learning situation in which everyone is supposedly exposed to the same learning experience. However, upon leaving the classroom it is not uncommon for two people who shared that experience to find that they have very opposing interpretations of the session and different levels of understanding. While one person may find a session enjoyable and learn new skills, another may find it boring and inappropriate (Honey and
Mumford, 2000). The reason for these different experiences is that people learn in a variety of ways and are stimulated by different learning activities. For example, some people learn best by reading, whilst others prefer to listen or communicate. These differing ways of learning have become known as ‘learning styles’. Therefore, the term ‘learning styles’ is used to describe individuals’ attitudes and behaviours towards learning.

Although no two people will learn in the same way, it is possible to identify certain groups of learners who display similar preferences in the way they learn. Most of us are aware that we prefer certain learning activities to others, but few people are aware of their learning styles. An awareness of learning styles can help learners to learn more effectively. More importantly, it can help instructors and designers to design learning environments that accommodate a variety of learning styles. This is especially important in an e-learning environment where the instructor cannot directly observe the learners and how they use the resources provided.

The question of whether or not learning styles actually exist has been a long running debate in education; research on the subject is considered ongoing. However, many educationalists are aware of the opinion that an understanding of learning styles can help learners to realise their full potential and assist instructors in the design of course materials. Learning styles theory suggests that as learners are individuals they bring different skills to the learning situation and learn in different ways. Matching resources with learning styles can help learners to make the most of a learning situation.

Kolb’s learning theory sets out four distinct learning styles, which are based on a four-stage learning cycle. In this respect, Kolb’s model is particularly elegant, since it offers both a way to understand individual people’s different learning styles, and also an explanation of a cycle of experiential learning that applies to all. Kolb includes this ‘cycle of learning’ as a central principle in his experiential learning theory, typically
expressed as four-stage cycle of learning, in which ‘immediate or concrete experiences’ provide a basis for ‘observations and reflections’. These ‘observations and reflections’ are assimilated and distilled into ‘abstract concepts’ producing new implications for action which can be ‘actively tested’, in turn creating new experiences.

The Gregorc model is a cognitive model designed to reveal two types of abilities, perception and ordering. Perceptual abilities, the means through which information is grasped, translated into two qualities: abstractness and concreteness. Ordering abilities are the ways the learner organises information, either sequentially or randomly. Gregorc couples these qualities to form four learning categories: concrete/sequential (CS), abstract/sequential (AS), abstract/random (AR), and concrete/random (CR).

2.2.2 Overview of Learning Styles’ Instruments

A wide variety of instruments are available for the measurement of learning styles. These include:

- Rezler’s Learning Preference Inventory (LPI) – measures the learner’s preference for instructional environments (Aragon, 2002)
- Canfield Learning Style Inventory (CLSI) – a thirty item instrument, where each item need to be ranked 1 to 4, which measures as number of variables including preferences for: listening, reading, iconics and hands-on-experience (Tecweb, 2002)
- Honey and Mumfords’s Learning Style Questionnaire – building on Direktor’s LSI, Honey & Mumford defined four learning styles: activist, reflector, theorist and pragmatist (Swinton, 2004)
• Gardner’s Multiple Intelligences – 90-question test on multiple intelligences (McKenzie, 2005)
• 4Mat Learning Styles (McCarthy, 2005)
• Ridings Cognitive Styles Analysis (Riding, 2002)
• Felder’s Index of Learning Styles – a 44-item questionnaire (Soloman & Felder, 2002)
• Solomon’s Inventory of Learning Styles – a 28-question inventory (Montgomery and Linda, 2000)
• Gregorc Style Delineator (Clougherty and Smith, 2002)

2.2.3 Review on Studies Incorporating Learning Styles into Learning

Educationalist is not the only discipline interested in the interaction between learning styles and computers, the field of human-computer interaction (HCI) is also active in this area of research. Elsayed-Elkhouly, (1995) examined how information can be presented in ways which conform to users’ learning styles in order to ‘improve the quality and usability of human-computer interface mechanisms’. The paper recommends presenting information in ways in which people most naturally learn about new information – the learning style of the user. The study used sensory modalities – sight, hearing, and touch, relating to computer learning. Although Elsayed-Elkhouly’s paper is more about computer-human interface, it provides an interesting view on presenting information.

Addressing different learning styles through hypermedia courseware has been found to enhance student learning. Carver et al., (1999) developed a selection of WWW based tools designed to enhance learning and to address a variety of learning styles. Felder’s model of learning styles was incorporated into a hypermedia course. The study
concluded that every learning style could be addressed by hypermedia courseware. Furthermore, it was found more than one tool was appropriate to each learning style and allowed students to make choices rather than having to accept the information as presented.

One of the most important issues surrounding the question of learning styles theory in relation to e-learning is whether learning styles significantly affect learning outcomes. Leuthold, (1999) in her studies has tested the hypothesis that a person’s underlying learning style is a useful predictor of his/her attitude towards computer-based instruction and learning. According to the results, students with sequential learning styles use computer-based instructional techniques more frequently and prefer them to traditional instructional techniques when compared with students whose learning styles are random. Computer-based instruction demonstrates logical flow of individual course topic.

Perniu (1999) investigated how instructional materials in a chemical course could be tailored for different learning styles. The study focused on students’ learning preferences for perception, presentation, organization, processing and assimilation of information. The paper concludes that using computers tailored to different learning styles enhances the learning process. The paper does not appear to make connections between the learning styles and the pedagogical process nor does it discuss the ways in which learning was enhanced.

In contrast to Perniu (1999) paper, Pimentel, (1999) explored the relationship between a virtual learning environment and learning styles. The paper details an approach for the design of a virtual learning environment known as LeProf. The virtual learning environment was used for a course, which taught electrical circuits. Once again the research incorporated Direktor’s LSI. The paper concludes that experiential learning, which forms the basis of Direktor’s LSI provides an ideal framework for the
design of virtual learning environments. The paper highlights the fact that in designing virtual learning environments, account should be taken of potential learners and that the design of the web should identify features appropriate for subject-specific materials.

Montgomery and Linda (2000) assert that multimedia can be used to address learning styles more effectively than traditional teaching methods. Solomon’s Inventory of Learning Styles, which measures the four dimensions; processing (active/reflective), perception (sensing/intuitive), input (visual/verbal) and understanding (sequential/global), was used to assess students using three multimedia programs. The study revealed that students with different learning styles had preferences for different types of multimedia. For example, movies and interaction were enjoyed by both ‘visual’ and ‘active’ learners; ‘sensors’ learners preferred abstract materials and demonstrations; whilst ‘global’ learners benefited from placing materials in the wider concept.

Zywno & Waalen, (2002) conducted a quasi-experimental study to examine the influences of learning styles based on Felder-Solomon Index on academic performance in two types of learning environments: hypermedia assisted and conventional. The paper highlights that largest increases in achievement were found among students with active, sensing and global learning preferences. These students also expressed the highest rate of approval for the hypermedia instruction and supplemental web materials.

When designing instructional material, it is important to accommodate elements that reflect individuals’ differences in learning. One such element addressed in this study is the learning style based on the theory of multiple intelligences as it has been widely embraced by educators and enjoyed numerous adaptations in a variety of educational settings.
2.2.4 Gardner’s Theory of Multiple Intelligences (MI)

In 1983, Howard Gardner, a Harvard University professor, introduced his theory of “multiple intelligences.” Over fifteen years later, his original book, Frames of Mind: The Theory of Multiple Intelligences (Gardner, 1983) has been translated into twenty languages and countless “Multiple Intelligences (MI) schools” have been established throughout the United States. Since that time, Gardner’s original list of seven distinct forms of intelligence has grown to nine. Today, Gardner’s theory serves as one of the most effective curricular and instructional frameworks for classroom teachers to use in designing their lesson plans.

Gardner asked if intelligence is a single thing or, instead, various independent intellectual facilities (Gilman, 2001). He suggests that different intelligences may be independent abilities; a person can be low in one domain area but high in another. All of us possess the intelligences but in varying degrees of strength and skill.

Intelligence Quotient (IQ) theory (based solely on the verbal-linguistic and logical-mathematical intelligences) assumes that a person’s intellectual potential is a fixed, genetically determined trait, which can be measured early in life and will determine an individual’s potential. Gardner’s definition above suggests a broad view of cognitive functioning and is in sharp contrast to intelligence as defined by IQ. In other words, Gardner’s MI model broadens our perceptions of what is meant to be intelligent. Until Gardner’s arrival, this model of intelligence was perceived as the norm throughout most of the world. The MI theory continues to open the minds of educators, psychologists, learners and parents as to how learning and education can be changed so that all persons may be guided to achieve their maximum potential.

In this study, intelligences are referred to as learning styles, as there are similarities. Below are the explanations on each of the intelligences:
Verbal-linguistic intelligence – use words effectively. These learners have highly developed verbal skills. They like reading, playing word games, making up poetry or stories. They can be taught by encouraging them to say and see words or to read books together. Tools include computers, games, multimedia, books, tape recorders, and lecture.

Logical-Mathematical intelligence – reasoning, calculating, thinking conceptually, abstractly and is able to see and explore patterns and relationships. They like to experiment, solve puzzles, and ask cosmic questions. They can be taught through logic games, investigations, and mysteries. They need to learn and form concepts before they can deal with details.

Visual-Spatial intelligence – think in terms of physical space, as do architects and sailors. They are very aware of their environment. They like to draw, do jigsaw puzzles, read maps, and daydream. They can be taught through drawings, verbal and physical imagery. Tools include models, graphics, charts, photographs, drawings, 3-D modeling, video, videoconferencing, television, multimedia, texts with pictures/charts/graphs.

Musical-rhythmic intelligence – show sensitivity to rhythm and sound. They love music, but they are also sensitive to sounds in their environments. They may study better with music in the background. They can be taught by turning lessons into lyrics, speaking rhythmically, and tapping out time. Tools include musical instruments, music, radio, stereo, CD-ROM, multimedia.

Bodily-kinesthetic intelligence – use the body effectively, like a dancer or surgeon. They like movement, making things, touching. They communicate well through body language and can be taught through physical activity, hands-on learning, role playing, and acting out. Tools include equipment and real objects.

Interpersonal intelligence – understand and interact with others. These students learn through interaction. They have many friends, empathy for others, street smarts. They
can be taught through group activities, seminars, and dialogues. Tools include the telephone, audio conferencing, time and attention from the instructor, video conferencing, writing, computer conferencing, e-mail.

**Intrapersonal intelligence** – understanding one’s own interests and goals. These learners tend to shy away from others. They are in tune with their inner feelings; they have wisdom, intuition and motivation, as well as strong will, confidence and own opinions. They can be taught through independent study and introspection. Tools include books, creative materials, diaries, privacy and time. They are the most independent among all the other types of learners.

**Naturalist intelligence** – demonstrate expertise in the recognition and classification of numerous species, the flora and fauna of the environment. Value is placed on these individuals who can recognise members of a species that are especially valuable or notably dangerous and can appropriately categorise new and unfamiliar organisms. These abilities come into play more probably with respect to “artificial” items. Discrimination by a teenager with regard to sneakers, cars, sound systems, or CDs also fits the intelligence.

**Existentialist intelligence** – sensitivity and capacity to tackle deep questions about human existence, such as the meaning of life, why do we die, and how did we get here.

Brief descriptions of nine intelligences are shown in Figure 2.1. The categorisation process can be summarised as follows:

- **Verbal-linguistic** : Word smart
- **Logical-mathematical** : Number smart
- **Visual-spatial** : Picture smart
- **Musical-rhythmic** : Sound smart
- **Bodily-kinesthetic** : Body smart
- **Interpersonal** : Group smart
- **Intrapersonal** : Self smart
- **Naturalist** : Nature smart
- **Existentialist** : World smart
2.2.4.1 From the Theory to Practice

Existing views of the theory of multiple intelligences appear to fall into two groups: explanations from Howard Gardner and the translation of the theory from members of the educational community. The two have offered somewhat different pictures of the multiple intelligences theory. Gardner’s position is that he defined each of the intelligences based on the results of his wide and massive survey of literature. On the other hand, the educational community has translated the multiple intelligences theory and found it significant in improving teaching and learning.

In this section, the literature is reviewed related to the MI curriculum, instruction and assessment methods.
Curriculum

Traditional methods of learning in schools heavily favor the verbal-linguistic and logical-mathematical intelligences. Gardner suggests a more balanced curriculum that incorporates the arts, self-awareness, communication, and physical education.

In 1987, the Key School in Indianapolis became the first MI school to officially apply the theory across all grade levels (Olson, 1988). With emphasis in physical education, art and music, students as young as five years old were required to play a musical instrument. Based on these diverse learning experiences, students were encouraged to draw on and explore their own intelligences through three major projects each year, such as focusing on the “connection” between people and their surroundings (Olson, 1988). They were also encouraged to learn through projects (or project-based learning) so that they could be creative, cooperative and personal in their own learning pace. In addition, they were videotaped at the beginning and the end of each year throughout their years at the Key School to create a profile (Olson, 1988).

The Fuller School MI curriculum was constructed with the Key School as a model. According to Bates (1996), the Fuller MI program was characterized by student-centered learning, authentic assessments, large-scale project learning, “less is more” in the acquisition of knowledge, and student-and-teacher learning partnerships. The difference between Key School and the Fuller School is the emphasis on “personal intelligences” in the Full School curriculum. In Seven Windows to a Child’s World: 100 ideas for the multiple intelligences classroom, O’Connor and Callahan-Youn (1994) suggested how the seven intelligences could be applied in their five example units. For instance, in the “Self” unit, one objective is to understand “why I am special and valued as an individual and a member of a group.” Based on this “Self” unit, the lesson plans would be divided into seven different intelligences. For example, in the logical-mathematical area, lesson plans were divided into “Graphing Eye Color,” “Exploration
of Math Manipulatives,” and “People Patterns.” On the other hand, in interpersonal and intrapersonal intelligences, emphases were placed on “All by myself,” “Our Unique Faces,” and “I was so Mad.” To assess these activities, the authors suggested teacher-made forms, checklists, narratives and portfolios formats such as collecting work samples, audio-tapes and/or videotapes to record students’ progress (O’Connor and Callahan-Young, 1994).

**Instruction**

Gardner advocates instructional methods that appeal to all the intelligences, including role playing, musical performance, cooperative learning, reflection, visualization, story telling and others.

<table>
<thead>
<tr>
<th>Form of Intelligence</th>
<th>Teaching Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical/Mathematical</td>
<td>Problem solving, investigation, experimentation, questioning</td>
</tr>
<tr>
<td>Verbal/Linguistic</td>
<td>Discussion, narration, advanced organizers, writing activities</td>
</tr>
<tr>
<td>Visual/Spatial</td>
<td>Imagery, map analysis, observation activities, construction or posters</td>
</tr>
<tr>
<td>Musical/Rhythmic</td>
<td>Simulations, song analysis, creative song writing, performances</td>
</tr>
<tr>
<td>Bodily Kinesthetic</td>
<td>Simulations, modeling, role playing, analysing manipulatives</td>
</tr>
<tr>
<td>Naturalist</td>
<td>Recognize and classify cultural and natural artifacts, data gathering in natural setting</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>Cooperative learning, peer teaching, brainstorming, shared inquiry</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>Decision making, journal writing, self discovery, independent learning projects</td>
</tr>
<tr>
<td>Existentialist</td>
<td>Tackle deep questions about human existence</td>
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</table>

Just as there are certain characteristics relevant to each of the nine intelligences identified by Gardner, so too are there specific teaching strategies that address each of these students’ ways of learning (refer Table 2.1).
Assessment

MI theory calls for assessment methods that take into account the diversity of intelligences, as well as self-assessment tools that help students understand their intelligences.

Although many instruments have been suggested for assessing MI (Gardner, 1993; Torff, 1997, Lazear, 2003), no particular assessment technique has been accepted as a standard tool for assessing achievement of students with multiple intelligences. The reason, Krechevsky and Gardner (1990, p. 80) argue is that, “intelligences must be assessed in ways that are “intelligence fair” that is, in ways that examine the intelligences directly.” Related to that, Project Spectrum provides a list of recommendations (not standardized assessment instruments) for teachers to observe domain-specific activities that will allow preschoolers to grow creatively and imaginatively based on each individual’s profile or strength and weakness (Giudici et al., 2005). In conjunction, the Arts PROPEL team also proposed two assessment techniques, portfolios and domain-projects, for assessing the arts domain in series (Gardner, 2006).

Since most MI supporters advocate using individual-intellectual profiles, MI assessments namely primarily teacher developed documentation has been formulated for each of the seven intelligences. For instance, the Fuller School MI program has used the “Multiple Intelligences Program Interest Inventory” and “MI Assessment Form” to assess each intelligence, along with the “Goals/Assessment Report” for each subject matter. The main assessing categories for these tools are “less interested, interested, or strongly interested.”

Armstrong (2000) explained that when a school does not rely on a particular assessment instrument or a grading system, students have more opportunities to demonstrate their competence in a specific subject matter. Therefore, Armstrong
recommended using his table of “49 MI Assessment Contexts,” in which students would have better chances to exhibit their proficiency in diverse ways for a specific subject matter. Similarly, Lazear (2003) suggested a list of possible activities and tools that he called a “Multiple Intelligences Assessment Menu.” He suggested that these tools – videotapes, photography, student journals, informal tests, student interviews, checklists, criterion-referenced assessments, classroom maps, and calendar records – can be used to create intellectual profiles. In this study, “The One and Only Surfaquarium” survey instrument (McKenzie, 2005) was used to identify students’ intelligence. The survey questions are categorized into nine sections where each section has ten questions corresponding to one of the nine intelligences.

2.2.4.2 Gardner’s Educational Suggestions

Gardner admitted that when he discussed the educational implications of the theory in his 1983 Frames of Mind, his “eyes were not beamed toward the classroom” (Gardner, 2006). However, since the book has greatly influenced the educational community, Gardner and his colleagues at Harvard Project Zero have put forth more efforts to bridge the theory to educational practices. Gardner’s educational suggestions can be reviewed in two phases: early and later.

a. Gardner’s early phase

In Gardner’s first edition of Frames of Mind, his primary hope was to examine “how various educational goals might be viewed and pursued” (p.373), and how educational progress should be ensured for everyone to fully reach his or her potential. Thus, he suggested the educators should recognise some important elements of the learning process such as: the kind of knowledge to be transmitted, the methods of transmission, the central points of learning, the people who transmit knowledge, and the general...
context of learning. Accordingly, Gardner (1983) proposed that an effective educational system should be able to balance various factors such as histories, traditions, cultures, and different combination of intelligence. On that account, Gardner (1983) offered his views on how his theoretical framework might be applicable to such an effort.

First, any educational program must have explicit goals. Second, traditional methods of assessment such as “observation learning, informal interaction, apprenticeship systems, prevalent media, varieties of school, the curriculum (explicit or implicit)” that currently exists should be examined (p.384). Third, more efforts should be made in investigating other possible learning styles that have been relatively prominent in diverse cultural communities. To the extent, he advised educators to think of ways to assess the intellectual profiles of individuals. Fourth, in assessing individual intellectual profiles, Gardner believed that the process should be started as early as in infancy because early assessment would allow an individual to obtain and reinforce his or her intellectual credentials.

Ultimately, Gardner proposed to revise the educational planning system in order to meet the individual’s intellectual profiles. After all, given a wide range of cultural settings, a variety of interest groups in the society, and even greater divergence of intellectual profiles, Gardner acknowledged that “The most I can do here is to sketch some expectations” (p.390). He, therefore, hoped that educators would explore more biological and psychological tendencies, particularly in relation to the historical and cultural context of human beings.

b. Gardner’s later phase

As Gardner’s theory has revolved more profoundly into educational community, Gardner experienced the need to provide some educational strategies from his point of view (Gardner, 1985, 1991, 1993). Two research projects, Arts PROPEL and Project Spectrum, were established to build research based on the educational implications of
MI. Together with his colleagues at Project Zero, an educational research organisation at the Harvard Graduate of Education, Gardner has put more effort into investigating the educational possibilities of MI.

Together with David Feldman at Tufts University, Gardner founded Project Spectrum as a collaborative research project to look for alternative ways to assess preschoolers. The goal was to look for all possible intellectual strengths in three or four year’s olds at the Eliot-Pearson Children’s School in Medford, Massachusetts (Ramos-Ford & Gardner, 1991).

The Project Spectrum team learned that children at this age have more than just seven cognitive strengths and various working styles. Furthermore, these strengths can be powered up only with a teaching curriculum that allows these strengths to associate with a domain or symbol system (Gardner, 1997). For example, if we want to teach a child how to play chess, we could examine that child’s spatial imagery or logical reasoning skills. Whether these measures might or might not be correlated with chess skills, Gardner and his colleagues recommended that teachers teach their students the rules of games and let them master the rules by introducing many activities whose intelligences are closely associated with chess. Once a student has been exposed to an ample set of experiences in the chess domain, he or she will exhibit his or her potential talents in that domain (Krechevsky, 1991).

The significant contribution of Project Spectrum to the educational field is its list of recommendations for assessment activities and domain-specific assessment instruments that are compatible with school curricula (Krechevsky, 1991). Accordingly, Spectrum researchers also recommended that educators allow students to grow creatively and imaginatively based on each individual’s profile or strengths and weaknesses.
The second collaborative research project that Gardner and his colleagues organised, Arts PROPEL, worked jointly with the Educational Testing Services and the Pittsburgh Public School system. Its primary goal was to create and explore assessment techniques to detect potential intelligences in the domain of art (fundamentally in three areas: imaginative writing, music, and visual arts) at the middle and secondary levels (Gardner, 1989; Zessoules, Wolf & Gardner, 1988).

Two assessment techniques that the Arts PROPEL team proposed are portfolios and domain projects. A portfolio is a typical process-folio that contains initial plans, early sketches, self-evaluations, feedback from peers, teachers or experts, and plans for following projects. Simultaneously, the domain project is designed to present the central concepts, techniques, procedures and background knowledge for a specific domain in series. Thus, it would allow students to comprehend the full context of a work, and allow teachers to alter their teaching plans when needed, but still connect to standard curriculum.

### 2.2.4.3 MI Theory from the Educational Community View

While Gardner called his theory “multiple intelligences,” many educators interpreted it as “seven ways of knowing,” “seven kinds of learning styles,” or “multiple paths of learning.” In addition, MI advocates also translated his theory into many visual forms (charts, diagrams and drawings) and also used neurological references to connect these intelligences and capacities into curriculum and assessment (Armstrong, 2000).

The most apparent translation of Gardner's theory into visual form is in David Lazear’s diagram (2003). Since his diagram, (Figure 2.2) could visually explain the basic principle of eight intelligences, other authors have adapted his visual presentations as symbols in their books (see Campbell, Campbell, & Dickinson, 2003; O’Connor &
Callahan-Young, 1994). Though later authors used different symbols for these eight intelligences (Torff, 1997; Roth, 1998), more pictures have been used to explain these multiple intelligences.

The MI theory was also translated and connected with many capacities that involved each intelligence. For example, in his “Multiple Intelligences Summary Wheel,” Lazear (2003) grouped these intelligences into three different types: “object-based” – visual-/spatial, bodily/kinesthetic and logical/mathematical; “objectless” – verbal/linguistic, musical/rhythmic and naturalist; and “personal” – interpersonal and intrapersonal. Likewise, Armstrong’s (2000) “MI theory summary chart” examines each intelligence across nine dimensions: core components, neurological systems, developmental factors, symbol systems, high end-states, ways that cultures values, evolutionary origins, presence in other species and historical factors.

*Figure 2.2: Eight Ways of Knowing (Source: Lazear, 2003)*
2.2.4.4 Review of Related Studies and Application of MI Theory

Gardner’s MI theory has been implemented in educational settings in many ways. Project Zero, of which Gardner has been co-chair for twenty-eight years, has served as a clearinghouse of sorts for MI theory’s application, and has conducted four separate research studies in the field (Project Zero, 2005).

Project Zero

The first Project Zero study is the Adult Multiple Intelligences (AMI) study. This study investigated the pedagogical strategies, curriculum and assessment of adult literacy educators (including basic education, General Education Development (GED), and English for Speakers of Other Languages ESOL). In the course of the study, literacy educators were given core instructions on MI theory specifically targeted toward adult students. Additionally, they were given written tools to use in the educational process. In return, educators gave study coordinators feedback on the tools’ usefulness, which was used to finalise the tools. Finally, the products were made available to adult literacy educators worldwide (Project Zero, 2005).

The second Project Zero study is the Multiple Intelligences Schools study, which was designed to assess the implementation of MI theory in schools. The study found, not surprisingly given Gardner’s overarching authority over Project Zero and dominance in the study’s bibliography, that MI theory is helpful to educators in many ways: defining terms for educators to use in discussing their efforts, validating the practice of educators whose work already parallels MI theory, emphasizing the arts as integral to the learning process, while encouraging a vast experience of study by students (Project Zero, 2005).

The third Project Zero study is the Practical Intelligence for School (PIFS) research project attempted to answer the question “what do students need to know in
order to succeed in school?" with the assumption that traditional academic intelligence is not the complete answer because students need to know how to learn, not just learn. The PIFS curriculum, which was integrated into the existing educational system, involved students in the transitional time of 6th and 7th grade, and encouraged students to pursue their own methods of work. In the study, students were encouraged to determine why they attended schools and the outcomes of doing schoolwork. Next, the students were given specific training in various aptitudes including reading, writing, homework and test taking. A follow-up project, the Creative Intelligence for School curriculum, attempted students’ work toward adapting school assignments to personal interests and approaches (Project Zero, 2005).

The fourth Project Zero study, Project SUMIT (Schools Using Multiple Intelligences Theory), a three-year nationwide study of MI theory in schools, sought to “identify, document and promote effective implementation of MI theory”. Project SUMIT gathered diverse information and suggestions from a variety of schools, emphasizing practices that resulted in increased success in the classroom and in the school overall (Project Zero, 2005).

In addition to the Gardner-directed Project Zero study, many other studies that have attempted to discuss the implementation of MI theory into the educational setting are briefly described next.

**General Education**

David G. Lazear, in his book Higher Order Thinking, the MI Way!, states that each of Gardner’s intelligences has its own language and symbols, and proposes a taxonomy of the intelligences whereby assessment can more easily be made (Lazear, 2003). Lazear’s taxonomy (based on Bloom’s) includes three different levels of mastery of each intelligence. The lower “Basic” level involves mere gathering and understanding of an intelligence. The middle “Complex” level includes analysing and processing an
intelligence, while the upper “Higher-Order” level denotes higher-order thinking and reasoning (Lazear, 2003).

Morris and LeBlanc (1996) determined a “strong agreement between teacher nomination and student identification of Gardner’s intelligences” (p.1). Walters (1992) proposed that schools, “must establish a meaningful context for problem-solving, provide an opportunity for students to practice using a variety of intelligence, build self-esteem by helping students develop an accurate and complete picture of their capabilities, and must establish assessment situations that facilitate and reinforce these ideas” (p.12).

‘Multiple Intelligences: A Theory for Everyone’, an article appearing in Education World, concludes by saying, “an understanding of Gardner’s theory can allow students to safely explore and learn in many ways, can help students direct their own learning while adults can help students understand and appreciate their strengths, and identify real-world activities that will stimulate more learning” (Guignon, 1998).

Dickinson (1996) has adapted Gardner’s MI theory throughout her organisation, New Horizons for Learning, and has co-authored a book titled Teaching and Learning Through the Multiple Intelligences, a very positive appraisal of Gardner’s theory.

Kallenbach and Viens (2001) worked together extensively on the AMIS (Adult Multiple Intelligences Study) project (a collaboration between Harvard Project Zero, which Gardner led, and the new England Literacy Resource Center/World Education) both in the information-gathering and compilation stages of the project.

Kallenbach and Viens (2004) findings from the AMIS study suggests that in order to fully benefit from MI theory in the classroom, it is imperative for educators to begin with a more holistic view toward their students, including an open view toward individual students’ ability and potential (p.86). Kallenbach and Viens (2004) admit that they “treaded a thin line between assisting educators in their efforts and influencing
their findings; the co-directors and teachers agreed that the final report represented the most honest and accurate representation of their findings (p.27).

*Foreign Language and Adult Education*

Graves and Akar (2000) encouraged the implementation of MI Theory in EFL/ESL reading curricula in Turkey (p.1).

Haley (1994, 2004) conducted Multiple Intelligences Research Study, with heavy emphasis on implementation of MI theory in the classroom. Haley’s basic research goal was to determine if teachers of foreign languages are incorporating MI theory into their classrooms. Haley discovered that foreign language students benefit from implementation of MI theory in the classroom and respond well to the variety of instructional techniques afforded by such implementation.

Christison and Kennedy (1999) similarly concluded that MI theory’s applicability to learners of foreign language was positive and, like others, found that teachers also benefited from MI Theory.

*Elementary Education*

Sherman (2001) conducts extensive training to elementary educators on Gardner’s MI Theory, offering multiple examples of implementation of the theory in the classroom and specific activities to emphasise each intelligence. However, Sherman did not question MI theory in any way in his presentation paper.

Mills (2001) studied one intelligence, musical intelligence, and its role in elementary schooling, and recommended that MI learning strategies (specifically music activities) be correlated within Florida benchmarks of learning, and emphasised a need for greater involvement in MI literature from the arts community at large, and promoted music specialists’ involvement in development of curricula.

Willis and Johnson (2001) published an article outlining the effectiveness of using MI theory to help students with mathematical learning. They found that
implementation of MI theory (rather than rote memorisation in the mathematics classroom as in common place in the mathematics classroom) generates more interest and creativity in the topic.

*Higher Education*

Weber’s (2005) research suggests a Multiple Intelligence Teaching Approach (MITA) as adequate to overcome reported boredom and disengagement in class. He cites The American Freshman: National Norms for Fall, a study conducted by UCLA to assess college students’ interest in the educational process, which found high levels of boredom in the collegiate classroom (Sax et al., 1999). Weber (2001) suggests that to “engage diverse students actively in higher education classes are to understand and interact within their unique world” (p.1). Problem-Based Learning (PBL) is increasingly expanding in higher education, according to Weber, and is a perfect opportunity for the use of MI theory and application. Four similarities are shared between MI theory and PBL: 1) both begin with a question rather than an answer, 2) teachers are charged with facilitating the learning process rather than simply lecturing, 3) outcomes are based on more than just a grade (holistic approach), and 4) assessments are performance-based, and vary according to the desired outcomes (Weber, 2001, p. 2).

Weber suggests a five-phase approach to MITA. Phase one includes intentional questioning designed to stir curiosity and wonder about the subject at hand. Phase two establishes clear and specific learning objectives for focus and vision, based not solely on the students’ suggestions but as practical, content-oriented objectives that link students’ interest and content understanding. Phase three establishes rubrics to create specific assessment measures of the learning. Multiple assessments are established for one benchmark in phase four, based on multiple intelligences of the students. Assessment tasks are encouraged to be varied and creative in nature. In the final phase (phase five) of Weber’s model, reflection on the topic is encouraged. This reflection
includes examining mistakes and errors in the learning process and establishing means by which future work can be more effective. Students work along with educators throughout each phase in order to establish interest in the topic and facilitate better outcomes (Weber, 2001).

Technology and Research Applications

Tom Hoerr’s book, Becoming a Multiple Intelligences School (Hoerr, 1998), in which the review was written by Howard Gardner, suggested technology as a critical avenue through which MI Theory can be implemented. Coil (1998), conducted research, that emphasised the use of computers in assisting adult learners via MI methodology.

Campbell (1990) specifically addresses the research implications of MI theory in the article, The Research Results of a Multiple Intelligences Classroom. Campbell’s study effectively validated MI theory as an acceptable (advisable, even) approach to research in the classroom. Campbell also noted improved attitude and behaviour by students along with increased satisfaction among educators.

2.3 E-learning

Coupled with theoretical foundation in learning and learning styles and an educational methodology based on the theory of multiple intelligences, the research builds on a technology foundation from electronic learning technology.

2.3.1 E-learning - A Review of Definitions

The growth of information and communication technology has brought sea change in the lives of people in almost every sphere of life. To make the best use of the new technologies, particularly in education and training, the concept of e-learning is evolved.
E-learning is a rapidly emerging market that will increasingly influence how one learns in schools, in the work force, and at home. Technology plays a key role in ensuring that lifelong learning programs are easy to use, convenient, and effective. The market for this sector includes educational content creation and delivery in schools, colleges and universities, at home and in corporate environments.

In this teaching and learning evolution, however, several terms have been attached to characterise the innovation and creation that has been occurring. Some terms are e-learning, distributed learning, online learning, web-based learning and distance learning. The purpose of this section is to review and summarise definitions related to e-learning, and to solidify a working term and definition for this study.

Zahm (2000) described computer-based training (CBT) as usually delivered via CD-ROM or as a web download and that it is usually multimedia-based training. Karon (2000) discussed the convenience factor of well-designed computer-based training by saying that any well-designed computer-based training, whether it is networked based or delivered via the Internet, is more convenient than traditional instructor-led training or seminars. Karon went on to say that self-paced CBT courses are available when learners are ready to take them, not just when the seminar is scheduled or the instructor is available. Hall (1997) incorporated both Zahm, (2000) and Karon, (2000) definitions by underlining computer-based training as an all-encompassing term used to describe any computer-delivered training including CR-ROM and World Wide Web. Hall further explained that some people use the term CBT to refer text-only training.

Like CBT, online training was classified as an all encompassing term that refers to all training done with a computer over a network, including a company’s intranet, the company’s local area network, and the Internet (Gotschall, 2000). Gotschall supplemented that online training is also known as net-based training. Urdan and Weggen, (2000) related that online learning constitutes just one part of e-learning and
describes learning via the Internet, intranet and extranet. They added that levels of sophistication of online learning vary. It can extend from a basic online learning program that includes text and graphics of the course, exercises, testing, and record keeping, such as test scores and bookmarks to a sophisticated online learning program. Sophistication would include animations, simulations, audio and video sequences, peer and expert discussion groups, online mentoring, links to materials on the corporate intranet or the web, and communications with corporate education records. Schreiber and Berge, (1998) agreed with Gotschall, (2000) and purported that online learning is any technology-based learning, that is, information currently available for direct access. They added that this usually implies linkage to a computer.

Given the broad definition of online learning, it would seem safe to assume that web-based training is online training. Hall (1997) defined web-based training as instruction that is delivered over the Internet or over a company’s intranet. Accessibility of this training, related to Hall (1997) is through the use of a web-browser such as Netscape Navigator. Hall and Snider (2000) defined e-learning as the process of learning via computer over the Internet and intranets. Hall and Snider extended that e-learning is also referred to as web-based training, online training, distributed learning or technology for learning. Distance learning, however, was not included in the e-learning definition and was defined as its own entity as a learning process meeting three criteria. These criteria are, a geographical distance separates communication between the trainer and the participant; the communication is two-way and interactive; and some form of technology is used to facilitate the learning process.

Hall (2000) contended that e-learning will take the form of complete courses, access to content for “just-in-time” learning, access to components, a la carte courses and services, and the separation of “courses” to acquire and test knowledge versus content as an immediate, applicable resource to resolve an immediate, perhaps, one time
only problem. Learning is and will continue to be a lifelong process, that could be accessed anywhere at anytime to meet a specific need or want. Hall added that more links to real-time data and research would become readily available. Given the progression of the definitions, then, web-based training, online learning, e-learning, distributed learning, Internet-based learning and net-based learning all speak of each other (Hall and Snider, 2000; Urdan and Weggen, 2000). Similar also to e-learning and its related terms is technology-based learning (Urdan and Weggen, 2000). Urdan and Weggen shared that e-learning covers a wide set of applications and processes, including computer-based learning, web-based learning, virtual classrooms, and digital collaborations. They further customised their definition to the delivery of content via all electronic media, including the Internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV, and CD-ROM. They warned, however, that e-learning is defined more narrowly than distance learning, which would include text-based learning and courses conducted via written correspondence. Like Hall and Snider (2000), Urdan and Weggen (2000) have set apart distance learning and e-learning in their glossaries, making, however, e-learning inclusive and synonymous to all computer-related applications, tools and processes that have been strategically aligned to value-added learning and teaching processes.

Berge (1998) explained the difference between distance education and distance learning. Distance education was seen as the formal process of distance learning, with information being broad in scope, for example, college courses. While, distance learning was seen as the acquisition of knowledge and skills through mediated information and instruction, encompassing all technologies and other forms of learning at a distance. This may be why most educational institutions used the term distance education. In reviewing five institutional definitions of distance education, these were the main tenets: historically, it meant correspondence education; it is planned teaching
and learning, connects learners at a distance, designed to encourage learners’ interaction, uses audio, video and computer technologies as delivery modes. Delivery modes evolve as technology expands and grows. Gotschall (2000) described distance learning as a broadcast of lectures to distant locations, usually through video presentations. Willis (1994) in his definition of distance learning identified the acquisition of knowledge and skills as another criterion and supported the former three criteria by saying that distance learning occurred through mediated information and instruction, and encompassed all technologies and other forms of learning at a distance. Porter (1997) shared that distance learning was education or training offered to learners who are in a different location than the source or provider of instruction. Porter went on to say that the technologies used in distance learning, the structure of a course or program, and the degree of supervision for a distance learning course can be varied to meet a particular group’s needs or interests. Reverting to Halls (2000) contention of e-learning in all-inclusive form, distance learning as planned interactive courses, as the acquisition of knowledge and skills at a distance through various technological mediums would seem to be one of e-learning possible disguises.

Interestingly, Urdan and Weggen (2000) saw e-learning as a subset of distance learning, online learning a subset of e-learning and computer-based learning as a subset of online learning. Given the review of definitions on all these terms, ‘subset’ does not appear to be the most likely word to describe the relationship among these words and their forms. The definitions show a great depth of interdependence among themselves. While one person may narrowly define a term, another person could give it the all encompassing power. This communicates that e-learning, if given the all encompassing form, can be the larger circle of which all other terms would be overlapping at different times and extents given their user’s intention. Another rationale for this choice is that “just-in-time” learning is a major advantage of e-learning but not of distance learning.
Distance learning purports planned courses, or planned experiences. E-learning does not only value planned learning but also recognizes the value of the unplanned and the self directedness of the learner to maximize incidental learning to improve performance.

According to DeSantis (2002), e-learning is any form of learning that utilizes a network for delivery, interaction, or facilitation. The network could be the Internet, a school or college LAN or even a corporate WAN. The learning could take place individually (guided or instructed by a computer) or as part of a class. Online classes occurs either synchronously (at the same time) or asynchronously (at different times), or some combination of the two. This form of learning currently depends on networks and computers but will likely evolve into systems consisting of a variety of channels (e.g., wireless, satellite), and technologies (e.g., cellular phones, PDAs) as they are developed and adopted. E-learning can take the form of courses as well as modules and smaller learning objects.

2.3.1.1 Definition of E-learning in this Study Context

E-learning has many definitions and may encompass all or some of the following: technology mediated distance learning, Internet based, intranet, CD ROM, simulation strategy, game playing, video discs, multimedia and communications (e.g. e-mail or web based chat room). However, in this study, e-learning is defined as the acquisition and use of knowledge distributed and facilitated primarily by electronic means. E-learning may incorporate synchronous or asynchronous access and may be distributed geographically with varied limits of time. A shift from classroom based learning to e-learning can be summarized as follows:

- E-learning is a learning method with the advantages that the Internet provides.

One can study anywhere and anytime and still have a real-time educative
interaction (e.g. with other students, interactive learning material or with an instructor).

- E-learning education is web-delivered, typically by assembling learning experiences on the fly from the freshest information.
- E-learning provides a mix of learning methods, like virtual classrooms, simulations, collaborations and so on.
- E-learning often incorporates the learning process “learning by trying” through utilizing interactivity.
- E-learning allows for automation and integration of administration processes like registration, payment and charge-backs, monitoring learner progress and examinations, and administration of tests and examinations.
- E-learning is centered on the learner and allows for personalised education.

2.3.2 Strategic Importance of E-learning

The present and projected needs of business organisations and educational sectors amidst today’s global trends, communicate the viability and strategic value of e-learning. This section addresses the strategic importance of e-learning by first looking at the trends driving e-learning. Secondly, it looks at the business forces that surface given the trends. Thirdly, it looks at the e-learning benefits for business and educational instances.

Trends Driving E-learning

The concept of the learning organisation (Watkins and Marsick, 1993) has grown exponentially with the technological era. Mcrea, Gay and Bacon (2000) related that, corporate learning and the corporate learning organisations have ascended to a position of strategic prominence in the context of managing and growing the enterprise. Urdan
and Weggen (2000) identified the knowledge-based economy, the paradigm shift in the way education is viewed and delivered, and huge knowledge gaps as significant trends that have given rise to e-learning. The increase in complexity and velocity of the work environment brought about by technological changes are also major issues that have fueled the demand for e-learning. Mcrea, Gay and Bacon (2000) presented the shift from the industrial to the knowledge era, rapid technological change, the ever shortening product developmental cycles, lack of skilled personnel, enterprise resource planning, and migration towards value chain integration and the extended enterprise as being prominent contributors to the e-learning value chain. Mcrea, Gay and Bacon (2000) also recognized the robust economy and the increasingly competitive global business environment as central to the e-learning movement. Tapscott et al., (1998) related that the competitive environment requires companies to work together to create online networks of customers, suppliers, and value-added processes – that is, an e-business community (EBC).

_E-Business Forces_

The trends discussed above have given birth to several business issues that need to be quickly addressed if companies are to retain their competitive edge. Tapscott et al., (1998) mentioned that an e-business strategist must anchor on the following forces when analyzing an e-business community. First, the redefinition of value must be addressed because wealth creation, communication, commerce and distribution converge on common digital, networked platforms. Industry boundaries blur, causing providers to rethink the basis of value creation. Second, digital knowledge economics must be understood well because hoarding knowledge is typically counter-productive and nearly impossible. In the digital economy, knowledge must be shared. Third, information technology is driving change everywhere. Thus, every executive, in every industry, must embrace the pace and dynamics of the information technology industry.
Fourth, jobs, business processes, companies, and even entire industries face elimination or digital transformation. This means that customers will be gaining both tangible (quality and cost) and intangible benefits (information, control, relationships) while they contribute ever more value to the system. Lastly, the digital implosion drives disaggregation and specialization, undermining the economic rationality of the vertically or horizontally integrated firm. Digital knowledge reduces the time and financial costs of information and coordination. Tapscott et al., (1998) added that it is now economically feasible for large and diverse sets of people to have the information they need to make safe decisions in near real time.

**E-learning Benefits**

The e-business forces discussed above set the stage for e-learning’s strategic importance. As companies digitally transform their businesses, knowledge and training become rapidly obsolete, just-in-time training becomes a basic survival need, and identification of cost-effective ways of reaching a diverse global workforce becomes critical (Urgan and Weggen, 2000). Additionally, new learning models are needed given the skills gap and demographic changes. Flexible access to lifelong learning is highly desired. Mcrea, Gay and Bacon (2000) added that managing organizational competency, providing employees with competency roadmaps, distributing latent knowledge within the organisation, aligning business objectives and learning outcomes, and extending learning to value chain partners are bottom line e-business issues. Validating outcomes directly with increased ROI (return on investment), providing on-demand task related resources, rationalizing duplicative training, and reducing delivery costs and increasing organisational efficiency are also e-business related issues that write out the strategic importance of e-learning (Mcrea, Gay and Bacon, 2000).

Along with the e-business forces, Urdan and Weggen (2000) related that there are several factors that facilitate the strategic importance of e-learning. Firstly, Internet
access, for example, has enabled one to work from home. Second, advances in digital technologies have and continue to enrich the interactivity and media content of the web. Thirdly, increased bandwidth and better delivery platforms make e-learning feasible and attractive. Fourth, a growing selection of high-quality e-learning products and services is now available. Lastly, technology standards, which facilitate compatibility and usability of e-learning products, are emerging. Mcrea, Gay and Bacon (2000) believe that the Internet and its distributed architecture will, for the first time, give corporations the power to combine a series of discrete, unlinked and unmeasured activities into an enterprise-wide process of continuous and globally distributed learning that directly links business goals and individual learning outcomes. With the strategic importance of e-learning being unsurpassed by the old corporate learning paradigm, the projected benefits are highly attractive. Hall (2000) and Karon (2000) capitalised on the accessibility of courses via intranets and Internet, where training can be self-paced, availability of training at any time and place, training being less expensive and reduced or eliminated travel time.

Urdan and Weggen (2000) added that a higher retention of content through personalised learning is possible because technology-based solutions allow more room for individual differences in learning styles. Furthermore, they highlighted improved collaboration and productivity among students as the online environment offers case studies, story-telling, demonstrations, role-playing, and simulations among other tools. Along this line, Urdan and Weggen also commented that online training is less intimidating than instructor-led courses.

Universities and schools are also implementing e-learning, some by using separate tools and application to improve education, others by implementing complete e-learning environments as platforms for their entire education. For universities, whose main goals are about offering high quality education and not maximizing profit, the
benefits of e-learning are not always measurable in money. When implementing e-learning in a university, the objective could be to save resources, to reduce the workload on the personnel or to improve the educational quality. The use of an e-learning environment makes it possible to detach the learning process from time and place for more convenience and flexibility in choosing different teaching methods. It also reduces the administrative burden on teachers, which gives them more time to focus on individual student’s educational needs (Teir, 2002).

2.3.3 Impact of E-learning on Teaching and Learning

E-learning is expanding opportunities for teaching and learning. However, its implementation may present real challenges for educators to teach in a way that they may have never experienced themselves, using unfamiliar technology.

*Active engagement*

Children and adolescents spend an exorbitant amount of time with various forms of media outside of school (Calvert, 1999) and providing classroom instruction which mirrors the engaging production features of television or video games may capture the attention of students or motivate them to learn. Digital technologies involve a combination of media forms, from animated text, graphics and sound to full motion video. These technologies can take the form of presentations, simulations, or even games and provide teachers an extra tool to enhance their delivery of information.

Production techniques are only one aspect in engaging students to learn. Interactivity, which can be defined as empowering the user to control the environment (Philips, 1997) truly engages the learner. By having to navigate their path through the system, the metacognitive approach to learning is incorporated. Students are aware of their learning path, and must actively engage the system to progress.
Social learning

Many critics of e-learning envision an isolated learning environment, utilising rote memorisation or ‘drill-n-practice’ techniques. Despite that, e-learning offers many applications for encouraging social activity that allows students to work toward a common goal with a real-world application. Even message boards, email correspondence and chat rooms offer students a chance to discuss ideas or project tasks and to get their voice heard (Cassell, 2002).

Creating collaborative learning environments really embraces the concept of active learning – students actively “construct” their knowledge with peers and teachers, creating an arena where different discourse and learning styles can comfortably coexist (Roschelle et al., 2002).

Continuous feedback

Classroom design must be learner centered. Students need their own time with the educational content, as well as community time (time spent with others involving learning). There is a challenge in how teachers can provide equity in the classroom, especially when they must divide the number of students by the length of class time. If one student is far behind and requires extra help, other students get less attention. E-learning provides an excellent aid for teachers in providing continuous feedback to students. Multimedia applications, for instance can provide practical examples and quizzes to provide immediate results on the students’ abilities to grasp the concepts.

Transfer of learning

E-learning allows students to use knowledge they understand and apply it in different contexts. For instance, students can apply recently acquired understanding to problems that they encounter in the real world. Students have access to the data professionals use: they can witness an archeological dig, for example, or view the latest images from the Hubble Space Telescope. Using the Internet to communicate with others, students have
an opportunity to become partners with scientists, business people, or policy makers, empowering students to realise they can make an impact (Roschelle et al., 2002).

For projects that involve learning fundamental concepts and then applying them to real-world problems, forums can be created and moderated by the students themselves. Not only does a transfer of learning help children and adolescents realise they have an impact in the real world, but society gets to leverage additional knowledge and data from new sources.

*Technical advantages*

E-learning applications offer distinct technical advantages to aid in classroom learning: Firstly, they are highly scalable. Once an application is developed, it can be deployed to an infinite number of users without incurring significant additions in time or cost (Horton, 2000). Applications can be designed to the “lowest common denominator” and become transferable locally or globally despite differences in network architecture or speed. The nature of scalability permits e-learning applications to remain flexible and adapt to new learning situations.

E-learning content can be broken down into discrete units of information. Modularisation, or packaging e-learning content into reusable modules, which can be assembled for different learning needs, demonstrates another area of flexibility. For instance, modules of a Science 101 course may be integrated into a Science 301 course as a refresher material. A mathematics class may need a summary module of physics concepts, or a literature course can add history modules to set the stage of a story. Modularisation demonstrates three important concepts:

- Reusable components that can be integrated across disciplines
- Modules that are only written once, saving time and effort for future endeavors
- Content creation that force agreements and standards among instructors
Scalability and modularisation promote general cost effectiveness in designing courses. Reusable e-learning components reduce course resources even when student population increases (Twigg, 2002). The possibility of reducing personnel costs also exists; e-learning can reduce the time it takes to write lesson plans or design course content. Teachers might have opportunities to spend more time motivating and coaching students, while schools may spend less money to design curriculum (Twigg, 2002).

Of course, it will become increasingly important to utilise standardised components in e-learning applications (Rosenberg, 2001). If e-learning developers can agree on a set of standards for software design, educators will be able to incorporate e-learning tools from different vendors in a seamless fashion. Educators will spend less time trouble shooting technical challenges and more time enhancing the learning experience. Software developers will be able to create third party plug-ins to enhance traditional course management platforms such as Blackboard’s Course Management Software (Blackboard, 2006), or add tools to improve multimedia production software such as Macromedia’s Authorware (Macromedia, 2006).

2.3.4 Evolution of E-learning

Starting in the 1970s, early computer-mediated communication (CMC) technologies, such as email and computer conferencing, were employed to support efforts in online education. Although development was performed in a piecemeal fashion and early systems had definite shortcomings, online education offered important potential benefits (Harasim, 1999). Communication, interaction, and collaboration among peers and instructors were encouraged and supported despite the limitation of systems built with early networking tools.
Starting in the early 1980s, efforts focused on developing learning at any place and any time (asynchronous approaches), and providing text and multimedia content via many-to-many computer mediated learning systems. This educational approach is sometimes referred to as network-mediated collaborative learning (Harasim, 1999). In collaborative learning environments, students actively construct knowledge through a highly interactive group process, a very different approach from the one-to-one transmission model of education via instructor-delivered lectures. Although technology advances in networking during the 1980s initially supported this new form of collaborative learning, users soon encountered the limitations of systems built with generic networking tools (Harasim et al., 1995).

Early e-learning systems were built using generic networking tools, such as email, conferencing, and newsgroups. However, these tools were applied to online education rather than designed for online education (Harasim, 1999). Thus, instructors were forced to redesign their classroom lectures and activities to conform to online learning systems. In addition, models and tools were not available to support and shape the virtual learning environment, thereby increasing the administrative, organisational, and pedagogical tasks, difficulties, and costs to deliver education online (Harasim, 1999).

Analysis of shortcomings of these early e-learning systems indicated that problems arose from the facilities lacking in the generic e-learning environments. Such generic e-learning environments were found to be limited in the following ways (Harasim, 1999):

- No standard organisational schema for course material
- Not tested or proven to be effective for instructional purposes
- Lack of tools and require significant development effort and technical support
• Lack underlying models that support collaborative learning, knowledge building, and learning strategies with multiple representations of concepts and knowledge

In order to address the shortcomings of e-learning systems built with earlier generic tools, let us now consider technology facilities used to build current e-learning systems.

**Multimedia Technologies**

There are a number of different media-based technologies that provide delivery services for e-learning solutions (Cisco, 2001). These technologies include:

• Broadcast Video – live, streaming video, audio and slides

• Video on Demand – on demand pre-recorded video and/or audio with accompanying graphics that can be accessed by a learner

• Virtual classroom – combination of a browser-based Web conferencing tool and audio conferencing, as well as interactive graphics, slide shows, audio and video clips, and Web pages

Interactive graphics and sophisticated audio and video capabilities increase the Internet level in some online learning environments though some still rely on Microsoft PowerPoint (or similar presentation software) slides for presentation of content. Other systems combine PowerPoint slides with an audio or video lecture, simulating the delivery of a lecture-based in-person course. However, it is important to keep in mind that multimedia features should support learning objectives rather than detract from the presentation of Web-based learning content.

**Computer-Mediated Communication (CMC) and Collaboration**

Computer-Mediated Communication (CMC) includes such facilities as email, computer conferencing, informational web sites, network news, bulletin boards with asynchronous postings, synchronous discussion forums, and chat rooms. Saunders, Sigmon, and Bull (1998) defined Internet collaboration tools as: “protocols, hardware, and software which allow individuals to exchange information in real time, chat (typing), application
sharing (e.g. spreadsheet), and white boards (drawing)”. Rheingold (2000), a pioneer in the development of virtual communities, builds online social networks for organisations using a variety of CMC and collaboration tools. These tools allow users to incorporate text, graphics, streaming media, and/or HTML into their message board posts through a Web browser interface. In addition, Rheingold suggests using group calendaring, threaded discussion forums and online chat facilities to facilitate collaboration and learning among virtual community members. Some collaboration software provides facilities to handle personal to-do lists, calendar functions, and photo albums in addition to the more typical facilities of file sharing, and threaded discussion groups (Collabrio, 2001).

Classroom Management and Assessment

Classroom management and assessment tools are typically found in web-based learning environments such as Learning Management System (LMS), Course Management Systems (CMS), and Total e-Learning solutions. Beshears (1999) divides these types of tools into those that are intended for instructor use, those that support student work, and those that perform administrative functions.

The faculty/classroom tool set may include:

- Online grade book and grade reporting tool (i.e. to allow students to view grades)
- Quiz/Survey development tool
- Course web site backup, download, upload facilities, web-based file management
- Student account, student group, and grader account administration tools
- Student access tracking (number of articles posted/read, accessed pages)
- Page access tracking (number of people who accessed the pages and the time) and page counters
- Course web site glossary building tool
- Course web site indexing, course announcements, calendar administration tool
Facilities included in the student tool set are as follows:

- Student self-evaluations
- Student accounts and group work areas for web page publishing
- Course content annotation facility and bookmarks
- Web-based email and discussion groups, real-time chat rooms and whiteboards
- Individual grade and progress status reports and grade distribution status report

The administrative tool sets are as follows:

- Course web site creation, duplication, and deletion and course web site backups
- Course web site downloading and uploading
- Course web site statistics, including number of students in course, file space used, number of hits on site, first and last accessed date
- Course web site student account administration – batch mode account and course roster management

Learning Objects

Learning objects can be defined as “any entities, digital or non-digital, which can be used or referenced in technology-supported learning” (Innes, McGreal, & Roberts, 2000). Learning objects may be components, lesson modules, courses, or programs. Learning objects can be described as: “adaptable, affordable, accessible, discoverable, durable, interchangeable, interoperable, manageable, reliable, and re-usable” (Innes, McGreal, and Roberts, 2000). According to Dan Daniel, the chief Information Officer (CIO) for NYUonline, the term in its current usage has several meanings. A learning object should be limited to objects with the following characteristics (NYUonline, 2001):

- Instructional – acquiring a new skill or gaining proficiency in a new concept
- Discrete and focused – smaller than a lesson, module, or course, teaching a focused concept through a fairly small unit of instruction
• Self-sufficient – each object can stand on its own without relying on other content
• Targeted – appropriate to the learner’s skill level, not too easy and not beyond skill level
• Interactive – offering opportunities for the learner to interact with the material
• Reusable – learning objects should be constructed so that they can be assembled into larger courses and mixed and matched in various ways to create new courses
• Searchable – to be able to reuse a learning object, must be easy to identify and access. Objects can be stored in online searchable repositories or libraries
• Valid – concepts presented should have practical, real-world application
• Standards compliant – learning objects should run on standard web platforms and require no special plug-ins or additional applications to run. Learning objects should adhere to applicable standards.

In this study, learning object refers to the learning content of the topics for selected course. Each learning object has a meta-data tag that defines its properties. For example, the meta-data tag would contain the name of the learning object, the creator, type of file, interactivity of the content, grade level, and appropriateness for types of intelligences in addition to other information that the author may provide.

2.3.5 Categorisation Schemes for E-learning

Harasim \textit{et al.} (1995) describe seven models or learning approaches used for educational computer networks. The categorisation into seven different learning approaches is depicted in Table 2.2.
### Literature Review

Table 2.2  
**E-learning Approaches**

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<tr>
<td>4.</td>
<td>Tutor support</td>
</tr>
<tr>
<td></td>
<td>To implement face-to-face tutor-student interaction online</td>
</tr>
<tr>
<td>5.</td>
<td>Access to Network Resources</td>
</tr>
<tr>
<td></td>
<td>Making the information on the Internet and other electronic</td>
</tr>
<tr>
<td></td>
<td>media available to students</td>
</tr>
<tr>
<td>6.</td>
<td>Informal Peer Interaction</td>
</tr>
<tr>
<td></td>
<td>To facilitate communication on the network in an informal</td>
</tr>
<tr>
<td></td>
<td>manner</td>
</tr>
<tr>
<td>7.</td>
<td>Structured Group Activity</td>
</tr>
<tr>
<td></td>
<td>Curriculum-based group learning activities online</td>
</tr>
</tbody>
</table>

The top four categories: e-lectures, ask-an-expert, mentorship, and tutor support are based on the use of instructors, mentors, and experts to serve as online resource personnel and provide support to students (Harasim et al., 1995). The lower three categories are student centered, involving the student or learner in accessing relevant information, interacting with peers, and participating in structured group activities.

Khan (2000) lists various names used for e-learning activities: “Web-Based Instruction (WBI), Web-Based Training (WBT), Web-Based Learning (WBL), and Internet-Based Training (IBT)”. According to (Smith et al., 2001), a study conducted by the Distributed Center (sic) for Learning Technologies at Mount Allison University for TeleEducation in New Brunswick, Canada categorises online learning environments into three categories: self-paced, group-learning, or Learning Management Systems.

A survey conducted for Industry Canada by Gram et al., (1998) classified new media development and delivery tools into the following categories. However, many of the tools have disappeared through market consolidation, while others have added new functionality.

- Media Creation Tools – HTML, PDF, various text formats, and graphics tools
- Web Publishing Tools – HTML editors, Macromedia Dreamweaver
- Conferencing tools – chat, Internet telephony, videoconferencing, collaboration tools
- Internet Enabled Authoring Systems
- Integrated Distributed Learning Environments

Jackson (2001) suggests categorising online learning systems by format or function. The following types of online learning systems are categorised by format:

- Directed study (or Asynchronous “Self study”)
- Instructor-led Events (or synchronous “live, real-time” learning)
- Small Group Collaboration

These are types of e-learning systems which are categorised by function (Jackson, 2001)

- Authoring tools – multimedia creation tools
- Course Management Systems (CMS) – content delivery, assessment, and administration
- Educational Delivery Systems – real-time “virtual classrooms” or “collaboration tools”
- Learning Management Systems (LMS) – similar to course management systems with an integrated view of all active courses, with assessment and goals tracking facilities
- Learning Content Management Systems (LCMS) – integrates standard Learning Management System features, authoring tools, and knowledge management tools

In the Consortium for Information Technology in Education (CITE) study, Smith et al., (2001) organise e-learning systems into synchronous environments, course management systems, learning management systems, total e-learning solutions, and related e-learning tools. E-learning systems generally arise from the use of Internet and Web technology.

The research in incorporating multiple intelligences to e-learning employs the same type of technology approach as Internet-based online learning systems (Gram et al., 1998), (Harasim, 1999), (Harasim et al., 1995), (Smith, 2001).
2.3.6 Existing E-learning Systems

In addition to web-based application technology, the prototype developed to formatively evaluate the approach of incorporating sound pedagogy and accommodating multiple intelligences to e-learning uses an Internet/Web framework for content delivery. In order to understand the different technology development threads, it is useful to consider systems that have arisen from the development of Internet-based e-learning systems.

Most e-learning systems, shown in Tables B.1 – B.8 (refer Appendix B), use a standard Web browser to provide access to educational materials. Some systems employ a combination of telecommunications technologies, such as audio conference facilities through standard telephone lines along with information delivery via a standard Web browser. The remainder of this section employs the categorisation schema developed for the CITE study (Smith et al., 2001) to discuss various web-based software tools for e-learning. Tables B.1 through B.8 provide a comparison of e-learning environments using information from the CITE study as well as the author’s experience in using demonstration versions of the software.

A major distinction among existing e-learning systems is whether these systems offer synchronous capabilities or asynchronous facilities, or a combination thereof. Synchronous facilities provide a virtual classroom setting, employing technology to move the entire classroom onto the Internet, along with the whiteboard, interaction with the instructor, and support for lecture facilities. The concept behind synchronous system is the desire to support the interaction that occurs in a physical classroom in which a group of students meets at the same time with the instructor. In a physical classroom, the instructor conveys the same information to the entire group of students at the same time, answering questions during the course of the lecture. Synchronous online learning
systems attempt to mirror this interaction, using the Internet as the delivery vehicle to alleviate location-dependence. Systems offering synchronous facilities are described briefly in Table B.1. Tables B.2 through B.8 offer a brief description of self-paced systems based on asynchronous delivery of instructional materials.

Table B.1 provides brief descriptions of synchronous learning environments. Synchronous learning environments use audio or video conferencing (or a combination thereof) as their primary delivery modality. Synchronous learning environments may offer asynchronous facilities as well as student management and progress tracking features (Smith et al., 2001).

Tables B.2, B.3, and B.4 provide brief descriptions of systems that are considered to be Course Management Systems. Course Management Systems (CMS) focus on the development and delivery of self-directed or self-paced education, providing administrative support to track student enrollment and progress toward completing courses, along with assessment and grading facilities. With student management and tracking facilities as well as content-creation tools, CMS are generally lower-cost systems used by educational institutions (Smith et al., 2001).

Table B.5 provides information on Learning Management Systems (LMS), which focus on the management of the learning process and are designed, for large-scale corporate enterprise customers. With support for third-party courseware, LMS generally do not include content development tools. Content is usually stored separately in an enterprise-class SQL database, increasing scalability but also increasing the cost of such solutions (Smith et al., 2001).

Table B.6 describes online learning systems that are considered to be Total E-learning Solutions which are complete e-learning packages, including learning environments hosted by vendors. With content included or developed in conjunction
with subject matter experts from customer organisations, these packages are customised as needed for individual organisations (Smith et al., 2001).

Tools for e-learning

Different types of technology are supporting a wide range of educational settings and learning situations. Many organisations today think in a direction of implementing an e-learning concept where an e-learning portal or a Learning Management System (LMS) plays a central role. A LMS is a system often containing functionality for administrating courses and skill management. It may also include tools and functionality for statistics tracking, communication and collaborative learning possibilities.

A simpler system for handling e-learning is a portal that is more of a common place for administration and distribution of e-learning courses, perhaps with communication possibilities in various forms but not as much functionality and intelligence as a LMS. Some organisations choose to buy not only the solutions for an e-learning concept in the form of a portal or LMS but also all e-learning courses from content providers. Others choose to follow the trend of buying tools that enable one to create his/her own content. An extension of this solution is to use an ASP (Application Service Provider) solution that provides developers both with a tool and the service to create a site on an external domain. Table B.7 and B.8 provide brief descriptions of tools that are used to support online learning systems. Related e-learning tools do not constitute entire online learning environments but can be used to develop content or support learning activities (Smith et al., 2001).

The prototype system for this study is an e-learning prototype, delivering content via web-based e-learning technology. However, the prototype system differs from the e-learning system presented in Tables B.1 through B.8. This is because the e-learning prototype system focuses on content delivery based on sound pedagogy to meet the need of specific learners. An integration of the theory of multiple intelligences
(Gardner, 1993) and Web-based online learning technology (Harasim, 1999) has neither been prototyped nor formatively evaluated in e-learning systems prior to this research study.

2.3.7 Features Review on Existing E-learning Systems and Their Adherence to Accepted Learning Pedagogy

Following an understanding of various approaches of e-learning applications discussed in earlier sections, we investigated the following question:

Do current e-learning systems support and enhance accepted learning pedagogy while accommodating multiple intelligences?

Current e-learning systems were reviewed and classified into three categories. The first classification was book publishers. Publishers such as Prentice-Hall and Course Technologies are providing increasingly web-based lecture notes as well as inline testing capabilities. In addition, instructors may purchase commercial products (the second classification) such as TopClass, Blackboard and WebCT to help facilitate the development of web-based courseware as well as web-based management of courses and learners. Finally, many instructors incorporate features from the publishers, utilize commercial products, or develop their own courseware entirely. We defined this third classification as custom courseware.

Custom web-based courseware is usually built from a combination of groupware, testing software, administrative management, and some forms of HTML (Hypertext Markup Language—the language of web browsers) writers to publish lecture notes and authoring software. Authoring software commonly used for creating lesson content are Frontpage, Learning Space, TopClass, WebCT, Toolbook, Director, and many more. These systems are usually incompatible with each other, and require the use
of templates or knowledge in HTML, scripting languages, etc to enter learning content. For this reason, many existing e-learning systems under these three categories use only text with some still images; they do not take advantage of the Web’s multimedia capability. The custom courseware products were selected from the top 5% of tutorials on the web as ranked by Lycos based on specific functions.

Table 2.3 benchmarks samples from all three classifications. It uses the implementation issues (summary of pedagogical and administrative needs) as the benchmarking criteria. Review of results on the implementation techniques are shown in Table 2.3.

Table 2.3
Benchmarking E-learning Systems

<table>
<thead>
<tr>
<th>Implementation Techniques</th>
<th>Publishers</th>
<th>Commercial Courseware</th>
<th>Custom Courseware</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online help for navigation &amp; use</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Navigation tools to help go back/forward</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Skip and access to table/contents</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Consistent interface</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Student controlled sequence</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Glossary</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Email/chat to instructor or peers</td>
<td>Y</td>
<td>Y</td>
<td>I</td>
</tr>
<tr>
<td>FAQ’s</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Search engines</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Hyperlinks to definitions</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Links to external material</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Lecture material online</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Module objectives defined</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Prerequisites defined</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Text</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Images</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Sound</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Video</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
### Table 2.3
Benchmarking E-learning Systems (continuation)

<table>
<thead>
<tr>
<th>Implementation Techniques</th>
<th>Publishers</th>
<th>Commercial Courseware</th>
<th>Custom Courseware</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Course Technology</td>
<td>Prentice Hall</td>
<td>WebCT</td>
</tr>
<tr>
<td>Real life examples</td>
<td>Y</td>
<td>N</td>
<td>I</td>
</tr>
<tr>
<td>Simulation</td>
<td>N</td>
<td>N</td>
<td>I</td>
</tr>
<tr>
<td>Modeling</td>
<td>N</td>
<td>N</td>
<td>I</td>
</tr>
<tr>
<td>Annotation &amp; notes</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Supplements</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Groupwork</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Problem sets and Projects</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

| Online Tests              |             |                       |                   |                   |
| Multiple choice           | Y           | Y                     | Y                 | Y                 | Y         | Y       | Y     | Y     | N       |                     |
| T/F                       | Y           | Y                     | Y                 | Y                 | Y         | Y       | Y     | Y     | N       |                     |
| Short answers             | Y           | N                     | Y                 | Y                 | NA        | Y       | N     | N     | N       |                     |
| Essay                     | Y           | Y                     | Y                 | Y                 | Y         | N       | N     | N     | N       |                     |
| Matching                  | Y           | N                     | Y                 | Y                 | N         | Y       | N     | N     | N       |                     |
| Online grading            | N           | NA                    | Y                 | Y                 | Y         | N       | N     | N     | N       |                     |

| Variation of style of feedback |             |                       |                   |                   |
| Yes correct or not correct   | Y           | Y                     | Y                 | Y                 | Y         | Y       | Y     | Y     | N       |                     |
| Complete sentences correction| Y           | N                     | Y                 | Y                 | Y         | N       | Y     | Y     | Y       |                     |
| Feedback positioned consistently| Y          | Y                     | Y                 | Y                 | Y         | Y       | Y     | Y     | Y       |                     |
| Re-learn hyperlinks         | Y           | Y                     | Y                 | Y                 | N         | Y       | N     | N     | N       |                     |
| Instant feedback            | Y           | Y                     | Y                 | Y                 | Y         | Y       | Y     | Y     | Y       |                     |
| Delayed feedback            | N           | N                     | N                 | Y                 | N         | Y       | N     | N     | N       |                     |
| Adaptive feedback           | N           | N                     | N                 | N                 | N         | N       | N     | N     | N       |                     |
| Logged participation        | N           | N                     | NA                | NA                | NA        | Y       | N     | N     | N       |                     |
| Database of grades          | Y           | N                     | Y                 | Y                 | Y         | Y       | N     | N     | N       |                     |
| E-mail, bulletin boards, listserv etc. | Y | N | Y | N | N | Y | Y | Y | N |
| Score averages, test analysis by questions | Y | N | Y | Y | N | Y | Y | N | N |
| Passwords                  | Y           | Y                     | Y                 | Y                 | Y         | Y       | Y     | Y     | Y       |                     |
| ID Swipe Cards             | N           | N                     | N                 | N                 | N         | N       | N     | N     | N       |                     |
| Thumbprints                | N           | N                     | N                 | N                 | N         | N       | N     | N     | N       |                     |
| Ease of use                | N           | N                     | B                 | B                 | C         | A       | B     | B     | B       |                     |
| Learning curve of instructor| N          | N                     | B                 | B                 | A         | B       | B     | B     | B       |                     |
| No HTML knowledge required for Test | N | N | Y | Y | Y | Y | Y | N | N |
| No HTML knowledge required to prepare of course material | N | N | N | N | N | Y | N | N | N |

**Legend:**
- **Y**: Feature supported
- **N**: Feature not supported
- **I**: Feature can be incorporated (requires HTML knowledge)
- **NA**: Not Available
- **A**: Good
- **B**: Average
- **C**: Poor
2.4 The Need to Incorporate MI Theory in E-Learning

What is of interest to us from the review of multiple intelligences theory is that it offers some vital clues in developing an alternative to the instrumentalist philosophy of education that has dominated e-learning. This theory suggests that education should focus on educating these intelligences. Such an education will develop the true potentials of the students where hopefully it will enable them to discern the technological conundrum that plagues humanity.

Therefore, the ideal of e-learning should focus on this end whereby the curriculum of e-learning should be designed to educate the potential intelligences found in the students. The main challenges that face e-learning is to create such a curriculum together with the appropriate hardware and software. Such a task requires a multidisciplinary approach that is guided by the vision of a holistic education that will not just give the students a set of technical skills but also enable them to develop their potential as members of humanity. This ideal forms the very essence of education itself.

Technology has changed our way of life in all aspects and tremendously impacted our educational systems. Klaus (2002) pointed out the Internet as an abundant informational resource and its increasing potential for language learning. McKenzie (2002) showed how instructional strategies could be applied to eight different intelligences and help learners succeed. McKenzie maintained that flexible teaching methods should be applied in class based on Howard Gardner’s evolving work on multiple intelligences and technologies could play important roles to enliven current lesson plans and build a repertoire of the teaching methods. McKenzie maintained that to make appropriate media selection, we should first look at the learners and the learning objective.
The e-learning application that incorporates multiple intelligences seems ideal for instructors who already provide students learning opportunities that involve maps, documents, graphics, broadsides, video and audio clips, and other forms of primary and secondary resources. In addition, computer technology and the Internet seem to only enhance the opportunity to combine these resources into comprehensive multiple intelligences lesson plans that can potentially address each of eight student capacities for learning (Nelson, 1998). Gardner even refers to this marriage between technology and his MI theory as a “comfortable fit” (Gardner, 1997).

There needs to be an educationally focused debate that informs the quality of the e-learning material itself. Consideration must be given to how the materials are structured, how they are indexed so that they can be matched to individual learners, and the way in which text, graphical images, video and audio are used. Educational resources in electronic format can, if appropriately structured, aid customization and differentiation to the needs of individual learners. If underpinned by assessment systems, such educational resources can begin to provide a managed learning environment, offering both learners and teachers good quality feedback on learning as an aid to professional judgment.

Gardner’s work on multiple intelligences argues that we learn through language, mathematical analysis, special relationships, musical thinking, use of the body to solve problems or to make things, an understanding of other individuals and an understanding of ourselves. Gardner asserts that where individuals differ is in the strength of these intelligences and the way in which such intelligences are invoked and combined to carry out different tasks, solve diverse problems, and progress in various domains. He challenges the contention of an education system that assumes that everyone can learn the same materials in the same way and a uniform, universal measure suffices to test student learning.
As we work to build an e-learning environment, the key task is to take full account of how individuals learn and respond. The e-learning environment has to engage and motivate students in learning, and make learning online enjoyable. E-learning must be a cohesive community learning activity and must be seen as part of a broad range of opportunities that blend face-to-face interaction with self-study, participatory learning and communication. In order to achieve these, we need to understand instructional design. Instructional design is a pedagogic or teaching device that makes instruction as well as the instructional material more engaging, effective and efficient. In the following sections, literature on learning theories and instructional design was reviewed.

2.5 Theoretical Foundation in Instructional Design

Learning theories have significant bearing on instructional design, as there is a logical development from learning to instruction. Instructional design optimises learning outcomes while learning theories are the backbone of any instructional design. Instructional design is the articulation or the manifestation of the learning theories, and its main aim is to optimise learning by using the known theories of learning.

Strain (1994) states that a wide divergence of views exists among the researchers in instructional design regarding the relative contribution of various schools of psychology and claims that instructional design has grown out of the systems approach with its roots firmly in behaviourists psychology that has dominated instructional design since the 1960s. However, Hannafin and Reiber (1989) point out that instructional design developed in the 1980s by Gagne, Merrill, Reigeluth and Scandura is largely due to the influence of cognitive theories of learning. Of course the emphasis has been on how information is retrieved, selected, processed and perceived. More recent
developments are due to constructivist learning theories. Instructional designers no longer depend on one theory. They draw upon and incorporate from different learning theories, mix those with other information and apply the results to meet human needs (Van Patten, 1989).

Three basic learning theories, namely, Behaviorism, Cognitivism and Constructivism are examined. These three schools of learning theories have implications for instructional design. A brief introduction to the three learning theories is given in the following section.

2.5.1 Learning Theories and their Implications for Instructional Design

Behaviourists emphasise changes in behaviour as the outcome of learning (Thorndike, 1913; Pavlov, 1927; Skinner, 1974; Watson, 1930). Behaviourist principle of reinforcement, retention and transfer of learning are important design considerations, as learning is facilitated by reinforcing the correct performances. Statements of behavioural objectives allow the learners to know specifically when they have achieved their objectives. In this way, learners can monitor their own progress. The knowledge of objectives serves as a reinforcing agent. The frequency of reinforcement is also a design issue. Presenting the content of the instruction in smaller steps, followed by testing and reinforcing performance immediately, does this. Retention of the information for the learners is also important for the instructional designer. Materials that provide more reinforcing activities help in the retention of what has been learnt.

Cognitive psychologists contend that learning is an internal process that cannot be observed directly (Ausubel, 1974; Piaget, 1990; Vygotsky, 1978; Bruner, 1974). Learners first remember and then retrieve information from the memory. Cognitivists emphasise how the human mind works. They put particular emphasis on memory. The
implication of this theory for the instructional designers is that they could use various techniques like chunking, mnemonics and meaningful organization of content and give practice for storing and retrieving information. Practice implies provision of increased opportunities to the learners for reward and reinforcement. Cognitive structures are created through practice, which leads to an efficient use of long-term memory. For example, instructional designers include pictures used in video programmes or practice exercises in the self-learning material that offer opportunities for practice. Practice is important in learning cognitive tasks as well as motor skills.

Constructivists promote an open ended learning experience where methods and results of learning are not easily measured and are different for each learner (Jonassen, 1991; Perkins, 1999; Mead, 1938). The implication of constructivism for the instructional designer is that the learners should attach themselves to the content domains. Constructivists believe that learning occurs when it is situated, contextual, problem based, social and authentic.

Constructivist learning encourages learners to acquire necessary knowledge and skills for finding meaningful solutions to the real-world problems. Their learning involves learner-centered, goal-directed and situated activities. There are experiences in the traditional classroom where constructivist learning process is practiced across various subject disciplines, but to transform the constructivist learning to the e-learning environment remains challenging. There are two main reasons: 1) It requires adequate learning content design skills to ensure flexibility, reusability and interoperability to meeting learners’ requirements; 2) Learning content design must allow a sound educational purpose to enforce knowledge construction.

Learning theories influence instructional design in a significant way. Learning theories becomes an essential element in the preparation of instructional design professionals because they permeate all dimensions of instructional design (Schiffman,
There is no one single theory which designers keep in mind while designing the instructional strategies and content. Ertmer and Newby (1993) feel that the behavioural approach can effectively facilitate mastery of the content, cognitive strategies are useful in teaching problem solving tactics and constructivist strategies are suited for dealing with ill-defined problems.

### 2.5.2 Learning Theories and their Implication for E-learning

The different schools of thought on learning suggest how learning theories can be used to develop effective e-learning materials. Concepts that support quality design of web-based instruction were identified from each of the behaviorist, cognitivist and constructivist schools of learning.

The behaviorist school looks at overt behaviours that can be observed and measured as indicators of learning (Good & Brophy, 1990). Cognitivists see learning as an internal process that involves memory, thinking and reflection, abstraction, motivation and metacognition. The cognitive school recognises the importance of individuals' differences, and of including a variety of learning strategies on online instruction to accommodate these differences. Constructivists see learners as being active rather than passive. Learners should be allowed to construct knowledge rather than being given knowledge through instruction (Duffy & Cunningham, 1996). Table 2.4 shows the three different schools of learning and implication for electronic learning.
<table>
<thead>
<tr>
<th>Learning Theories</th>
<th>Implications for E-learning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behaviorist</strong></td>
<td>• Learners should be told the explicit outcomes of the learning</td>
</tr>
<tr>
<td></td>
<td>• Learners must be tested to determine whether or not they have achieved the learning outcome</td>
</tr>
<tr>
<td></td>
<td>• Learning materials must be sequenced appropriately to promote learning</td>
</tr>
<tr>
<td></td>
<td>• Learners must be provided with feedback</td>
</tr>
<tr>
<td><strong>Cognitive</strong></td>
<td>Part 1: Memory</td>
</tr>
<tr>
<td></td>
<td>• Strategies to allow learners to perceive and attend to information:</td>
</tr>
<tr>
<td></td>
<td>• Important information should be placed in the center</td>
</tr>
<tr>
<td></td>
<td>• Information critical for learning should be highlighted</td>
</tr>
<tr>
<td></td>
<td>• Learners should be told why they should take the lesson</td>
</tr>
<tr>
<td></td>
<td>• Links to both simpler and more complicated materials</td>
</tr>
<tr>
<td></td>
<td>• Strategies to allow learners to retrieve existing information from long-term memory:</td>
</tr>
<tr>
<td></td>
<td>• Use advance organizers</td>
</tr>
<tr>
<td></td>
<td>• Provide conceptual models</td>
</tr>
<tr>
<td></td>
<td>• Use pre-instructional questions</td>
</tr>
<tr>
<td></td>
<td>• Use prerequisite test questions</td>
</tr>
<tr>
<td></td>
<td>• Information should be chunked. If there are many items in a lesson, the items should be organised in the form of information maps to show their organisation.</td>
</tr>
<tr>
<td></td>
<td>• Include online strategies to allow learners to apply the information in real life.</td>
</tr>
<tr>
<td></td>
<td>Part 2: Individual Differences</td>
</tr>
<tr>
<td></td>
<td>• Electronic learning materials should include activities for the different learning styles, so that learners can select appropriate activities based on their preferences.</td>
</tr>
<tr>
<td></td>
<td>• In addition to activities, adequate supports should be provided for students with different learning styles.</td>
</tr>
<tr>
<td></td>
<td>• Information should be presented in different modes to accommodate individual differences in processing and to facilitate transfer to long-term memory.</td>
</tr>
<tr>
<td></td>
<td>• Learners should be motivated to learn.</td>
</tr>
<tr>
<td></td>
<td>• Encourage learners to use their metacognitive skills to help in the learning process.</td>
</tr>
<tr>
<td></td>
<td>• Online strategies that facilitate the transfer of learning should be used to encourage application in different and real-life situations.</td>
</tr>
</tbody>
</table>
Table 2.4  
Learning Theories and Implications for E-learning (adapted: Ally, 2003) (continuation)

| Constructivism | • Learning should be an active process. |
|               | • Learners should construct their own knowledge. |
|               | • Collaborative and cooperative learning should be encouraged to facilitate constructivist learning (Hooper & Hannafin, 1991; Johnson & Johnson, 1996; Palloff & Pratt. 1999). |
|               | • Learners should be given control of the learning process. |
|               | • Learners should be given time and opportunity to reflect. |
|               | • Learning should be made meaningful for learners. |
|               | • Learning should be interactive to promote higher-level learning and social presence, and to help develop personal meaning. Interaction is also critical to creating a sense of presence and a sense of community for online learners, and to promoting transformational learning (Murphy & Cifuentes, 2001). |

Based on the three learning theories and the implications of e-learning, the researcher identified a series of instructional design concepts to provide a foundation of pedagogy for e-learning. They were chosen as they repetitively surfaced as the keys to effective learning in research. In addition, these concepts may utilize the web’s interactivity in their implementation.

2.5.3 Instructional Design: Theory and Models

There are various instructional design theories and models developed by various authors. Reigeluth (1999) defines an instructional design theory as the one “that offers explicit guidance on how to better help people learn and develop”. Instructional design theories are important as they provide guidance at three levels (Reigeluth, 1999). These are:

• methods that best facilitate learning under different situations,

• learning tool features that best allow an array of alternative methods to be made available to learners,
system features that best allow an instructional design team to design quality learning tools.

In the following section, the different models of instructional design for e-learning (Siemens, 2002) are summarised with their features. All these models are suitable for the design of instruction of course units (e-learning, multimedia and in print) and have the following components in common:

- Identify and analyse the instructional objectives,
- Plan and design solutions to the instructional objectives,
- Implement the solutions, and
- Evaluate and revise objectives, strategies, etc.

The ADDIE (analyse, design, develop, implement and evaluate) instructional design model is a basic model that holds true for any type of learning, including Web-based (Hall, 1997; p.81). During analysis, the designer develops a clear understanding of the “gaps” between the desired outcomes or behaviours, and the audience’s existing knowledge and skills. The design phase documents specific learning objectives, assessment instruments, exercises and content. The actual creation of learning materials is completed in the development phase. During implementation, these materials are delivered or distributed to the student group. After delivery, the effectiveness of the training materials is evaluated.

![ADDIE Model](image_url)

*Figure 2.3: ADDIE Model, adapted from (Kruse, 2004)*
Algo-Heuristic suggests that all cognitive activities can be analysed into operations of an algorithmic, semi-algorithmic, heuristic, or semi-heuristic nature (Landa, 1976). Once discovered, these operations and their systems can serve as the basis for instructional strategies and methods. The theory specifies that students ought to be taught not only knowledge but the algorithms and heuristics of experts as well.

Dick, Carey and Carey model is systematic in nature (Dick et al., 2001). The model is a procedural system including ten major process components (nine basic steps in an iterative cycle and culminating evaluation of the effectiveness of the instruction).

The nine components in an iterative cycle include:

- Assess needs to identify instructional goal(s): to identify what the learners are expected to be able to do at the end of the instruction
- Conduct instructional analysis: to determine a step-by-step of what learners are doing when they are performing the goal; to determine what skills and knowledge are required
- Analyse learners and contexts: to identify learners’ present skills, preferences and attitudes as well as the characteristics of the instructional setting; the useful information about the target population includes entry behaviours, prior knowledge of the topic area, attitudes toward content and potential delivery systems, academic motivation, attitudes toward the organisation

- Write performance objectives: to specify what the learners will be able to do with the statements of the skills to be learned, the conditions, and the criteria

- Develop assessment instruments: to develop a criteria-referenced assessment consistent with the performance objectives

- Develop instructional strategy: to develop strategies in pre-instructional activities (motivation, objectives and entry behaviour), presentation of information (instructional sequence, information, and examples), learner’s participation (practice and feedback), testing (pretest and posttest) and follow through activities (remediation, enrichment, memorisation and transfer)

- Develop and select instructional media: to use the instructional strategies to produce the instruction

- Design and conduct formative evaluation: to collect data that are used to identify how to improve the instruction

- Revise instruction: to use the data from the formative evaluation to examine the validity of the instructional analysis, learner and context analysis, performance objectives, assessment instruments, instructional strategies, and instruction

The final process is to design and conduct summative evaluation, which is an evaluation of the value of the instruction.

Robert Gagne’s approach to instructional design is considered a seminal model that has influenced many other design approaches and particularly the Dick and Carey systems approach. Gagne (1985) proposed that events of learning and categories of
learning outcomes together provide a framework for an account of learning conditions. In “The Conditions of Learning”, Gagne acknowledges that he was considering the question “What factors really can make a difference to instruction?” when developing his learning and instructional design theories. His model proposes that the condition of learning, some internal and some external to the learner, that affect the process of learning make up the events of learning. When deliberately planned, those events constitute instruction. Thus it is reasonable to define instruction as being made up of events external to the learner which is designed to promote learning (Gagne, 1985).

Gagne’s model proposed nine events of learning or instruction as shown in Figure 2.5. These events are specific functions of communication behaviours that he identified as components of instruction. Gagne’s divided these nine events into two groups: the first five represent communication behaviours that occur before the acquisition of information. The last four occur after acquisition has developed. According to Gagne, the events of instruction are labels that serve to relate the internal processes to the external events that constitute instruction; that is they provide names for the total set of events (internal and external) that must be considered to take place during each phase of learning (Gagne, 1985).

Figure 2.5: Robert Gagne’s Nine Steps of Instruction, adapted from (Clark, 1999)
The **minimalist** theory of Carroll (1998) is a framework for the design of instruction, especially training materials for computer users. The theory suggests that all learning tasks should be meaningful and self-contained activities, learners should be given realistic projects as quickly as possible, instruction should permit self-directed reasoning and improvising by increasing the number of active learning activities, training materials and activities should provide for error recognition and recovery and, there should be a close linkage between the training and actual system.

**Kemp, Morrison and Ross** (2001) present an instructional development model (Figure 2.6) with a focus on curriculum planning.

![Figure 2.6: Kemp, Morrison and Ross Model, adapted from (Kemp et al., 2001)](image)

Kemp, Morrison and Ross have identified nine elements that should receive attention in a comprehensive instructional development plan:

- Identify instructional problem, and specify goals for designing an instructional program
- Examine learners’ characteristics that should receive attention during planning
- Identify subject content, and analyse task components related to stated goals and purposes
- State instructional objectives for the learner
- Sequence content within each instructional unit for logical learning
- Design instructional strategies so that each learner can master the objectives
- Plan the instructional message and delivery
- Develop evaluation instruments to assess objectives
- Select resources to support instruction and learning activities

**Rapid Prototyping** model is both a systems and a product development model which has been used successfully in software engineering. Given the similarities between software design and instructional design, Tripp and Bichelmeyer (1990) argue that rapid prototyping is a viable model for instructional design, especially for computer-based instruction. In particular, it is increasingly popular in software development contexts due to its perceived benefits of improving quality while simultaneously reducing development costs. Generally, rapid prototyping model involves learners and/or subject matter experts (SMEs) interacting with prototypes and instructional designers in a continuous review cycle. Developing a prototype is practically the first step, with front-end analysis is generally reduced or converted into an on-going, interactive process between subject-matter, objectives, and materials. Evaluation is a recurring event that moves from global issues (navigation, structure, design, motif, color scheme, etc.) to fine tuning of instructional content (e.g., semantics). Generally, this model makes course development and analysis simultaneous processes with evaluation loops recurring frequently throughout the life of the project.

**Empathic instructional design** is a five-step process. The following are the five steps to empathic design that can be juxtaposed with traditional instructional design processes (Nichani, 2002):
• **Observe**: Observe users doing their daily tasks with the goal of identifying learning needs to real performance problems, and studying contexts under which they occur.

• **Capture Date**: Capture the practice using photographic and video toolsets. Record the sounds of the working environment. Ask open-ended questions. Make notes of problems faced and solutions rendered. Chart out daily routines.

• **Reflect and Analyse**: Shared the captured data in its many forms with the team. Analyse the data. Picture the current state of performance. Visualise the desired state of performance. Identify “real” learning needs.

• **Brainstorm for Solutions**: Start the brainstorming session once learning gaps are identified. Discuss solutions for their appropriateness to learners and their contexts.

• **Develop prototypes**: Once a set of solutions are decided upon, small working prototypes are built and tested with learners to determine its learnability, the effectiveness of the solution in enabling learning.

Finally, the **Seels and Glasgow** (1990) model as can be seen in Figure 2.7 is made up of three phases: needs analysis, instructional design, and implementation and evaluation. This division allows a project to be planned, resourced and managed as three phases. Presetera (2002) explains that the Seels and Glasgow model leads to efficiency in project planning, resource allocation, and the control of the product development cycle while recognizing that instructional designers are often asked to either manage a project or work within an established project management framework.
The first phase, needs analysis, includes the establishment of the instructional goals, requirements, and context. The second phase, instructional design, begins after phase one is complete and is made up of six steps: task analysis; instructional analysis; objectives and tests; formative evaluation, materials development, instructional strategy and delivery systems all of which are joined by feedback and interaction. The third phase, implementation and evaluation, includes the development and production of materials, delivery of the training, and summative evaluation. The steps and phases in this model can be applied in a linear fashion but they are often applied iteratively. In particular, the steps in the instructional design phase are interdependent and concurrent and may involve iterative cycling (Gustafson and Branch, 2001).

Product-oriented models are normally used to produce an instructional package. Product production requires a team and a significant resource commitment and so calls for strong project management to stay within time and budget. A team would include an experienced instructional designer to perform some front-end analysis, develop the materials (rather than select them), and perform a significant amount of formative evaluation. The end product is likely to be widely distributed using a moderately to highly technical delivery media (Gustafson and Branch, 2001).
2.5.3.1 Appropriateness of the Models for E-learning

All the models contain the elements necessary to design effective e-learning. While these models were all developed to create facilitated or self-study products to be delivered via non-Internet technologies (paper-based, multimedia, audio and video), each has strengths that could be exploited in the development of e-learning.

The same instructional design issues are valid for both traditional and e-learning: structure, content, motivation and feedback, interaction (communication), and involvement (activities) (Siragusa, 2000). Each of these issues is considered below, demonstrating that it is not a model that prescribes the resolution of the issues but rather choices and decisions made within steps of a model.

Structure

When designing e-learning the depth and breadth of contents need to be considered. Decisions must be made on what information should be presented first and what can be provided, at the learner’s request, through techniques such as hyperlinks. In making such decisions one considers the content, context, and learner characteristics. These same considerations and decisions are made in relation to the positioning and sequencing of content when designing paper-based instruction.

Positioning refers to designing information in a way that helps learners understand the importance of each piece of content and how each piece relates to the rest of the learning. Sequencing is the order of succession or the arrangement of content based on the instructional strategy. Most of the models include steps in which content is analysed and instructional strategies set. E-learning lets one employ a diversity of options for presenting and interacting with information.
Content

The same thoroughness must be applied to content design and presentation in e-learning as one applies when creating paper-based self-study. Often, in classroom-based learning, much of the content is in the heads of the instructor not in the hands of the learner. The instructor presents materials in a structured format watching for cues from the learners to indicate their understanding and responding to requests for clarification or further explanation. In asynchronous e-learning one cannot watch for clues and the learners cannot raise their hand.

The design approach does not differ from traditional learning programs. If learning is well designed, based on models discussed in this study, learners should have access to all the required information, examples, and activities presented in a clear and concise manner.

Motivation and Feedback

Motivation is internal to the learner, not something that can be provided by an instructor or a learning program. Edwards (1999) describes motivation as “the collection of accounts of choices, intensities, and feelings of acts” while Cantor (1992) defines motivation as “the inner drive that, from birth, causes us all to act”. So, while one may not be able to instill motivation in a learner one can attempt to stimulate learner receptors and link new information to existing knowledge in order to encourage motivation. E-learning technologies make it easier to provide immediate feedback and remediation in the form of additional examples or the presentation of the same material in a different way.

Interaction

Designed interactivity or interaction involves learners with the content. In both traditional learning and e-learning interactivity is what involves learners with the content and encourage cognition. As Kennedy (2004) describes it, interactivity is the
“continuous dynamic interplay between instructional events, students’ actions (functional interactivity) and their cognition (cognitive interactivity)”.

**Involvement**

Siragusa (2000) defines involvement as involving learners in the instructional process by having them perform activities. Like motivation, only the learners can control their own level of involvement. However, well designed and engaging activities that have a clear and direct relationship to the real-life task being trained are more likely to encourage learner involvement.

### 2.5.4 Discussion

Gustafson and Branch (2001) have developed taxonomy of models based on specific characteristics. The taxonomy describes models as being classroom-oriented, product-oriented, or systems-oriented. Classroom-oriented models usually have an output of one or a few hours of instruction; product-oriented models have an output of an instructional package; and, systems-oriented models have an output of a course or curriculum. Classroom-oriented models assume an instructor, students, a classroom, and a piece of instruction that needs to be improved (Prestera, 2002). Product-oriented models focus on making production more efficient and systems-oriented models aims to provide a complete instructional system for managing learning needs (Prestera, 2002).

Three other key characteristics in the taxonomy are the level of instructional design skill required to use a model, the amount of front-end analysis, and the amount of formative evaluation (try out and revision) included in a model. If we first consider the amount of instructional design skill required, classroom-oriented models require a low level, product-oriented a high level, and systems-oriented a high to very high level of skill. Next considering the amount of front-end analysis, classroom oriented models
require a low level of analysis, product-oriented a low to medium level, and systems-oriented a very high level of analysis. Lastly, in terms of formative evaluation, classroom-oriented models perform a low to medium level of evaluation, product-oriented a high level, and systems-oriented a medium to high level.

The models discussed and compared in this study each represents one of the orientations described in the Gustafson and Branch taxonomy. Presented here are the instructional design models that are considered in terms of their appropriateness for use in e-learning design based on various pedagogical strategies in order to cater for multiple intelligences. Note that these models, each contains the five ADDIE components: analysis, design, development, implementation, and evaluation although not all in the same order or as discrete steps unto themselves.

**Dick and Carey** Systems Approach Model is very close to this study; nevertheless both systems vary in the basic components adopted. This approach has been considered for this study because it is so comprehensive and also symbolic of established instructional design practices. Furthermore, this systems approach model guides the instructional designers in completing their analysis and decides what needs to be taught, to whom and how before selecting a medium, which is related to the main emphasis of this research that is catering for students with diverse learning styles. However, the novelty of the approach in this regard lies in developing multiplicity of instructional strategies based on sound pedagogy to accommodate MI theory which is not adopted by the Dick and Carey approach.

**Seels and Glasgow** model is closest in scope to this study especially from the point of view of how a project is to be planned, resourced and managed as three phases. The three phases (needs analysis, instructional design, and implementation and evaluation) and the steps within these phases can be applied in a linear fashion but they are often applied iteratively. This product-oriented model, which is normally used to
produce an instructional package, is adhered to some extent. This would include performing some front-end analysis, developing the materials (rather than selecting them), and performing a significant amount of formative evaluation. The end product is likely to be widely distributed using a moderately to highly technical delivery media.

**Morrisson, Ross and Kemp** model shares very little ground with this study as it lacks in connectivity between elements and the ability to start at any place within the model. Furthermore, this classroom-oriented model is designed to focus on content and appeal to teachers, whereas in SCEnE approach the emphasis is on student-centered teaching and learning. The model highlights environmental factors in an educational setting, i.e. the resources and the support (budget, facilities, time, equipment, personnel and materials) which is not of much concern in our studies. However, the nine elements in this model are considered for the development of SCEnE as it identifies proper sequencing of instructions. The model also recognises that not all nine elements are required for all projects.

Using a systems approach is not enough to successfully develop e-learning courseware. To further enhance effectively designed e-learning courseware, the researcher has considered instructional design principles. Using learner-centered instructional design principles to develop e-learning courseware increases its effectiveness of the materials presented. **Gagne’s Nine Events of Instruction** provides crucial design elements for this study. Moreover, in this study, Gagne’s nine events of instruction serve as a template for developing and delivering a unit of instruction. Gagne’s theory stipulates that there are several types or levels of learning. Although the five major categories of learning that have been identified by Gagne are not adapted for this study, the significance of the classification that is, different types of learners require different type of instruction is followed tightly. Different types of learning for this study are based on MI theory. The strength of this task-focused model is that the design
emphasises front-end analysis with the learner in mind. Furthermore, the fact that all the steps of the model are sequenced makes it easy for the instructor or instructional designers to implement and follow. Using this sequence helps to ensure that the learners master the desired objective.

Table 2.5
Factors Review of the Models Related to E-learning

<table>
<thead>
<tr>
<th>Factors</th>
<th>Morrison, Ross &amp; Kemp</th>
<th>Seels &amp; Glasgow</th>
<th>Dick, Carey and Carey</th>
<th>Robert Gagne’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to apply phases and steps iteratively</td>
<td>The design of the model allows for the iterative application of phases and steps.</td>
<td>Within each of the three phases, the steps can be applied iteratively. There is some flexibility for overlapping the phases.</td>
<td>Once the instructional goal has been established, the other phases can be applied iteratively.</td>
<td>The events of instruction are organised and well with the evaluations in each of the nine events.</td>
</tr>
<tr>
<td>Focus on instructional strategy and media selection</td>
<td>This model allows for instructional strategy and media to be selected before the content is analysed since one can start at any phase. However, one can choose to analyse the content first.</td>
<td>Selection of instructional strategy takes place in same project phase as analysis.</td>
<td>Media selection is strongly linked to instructional strategies and both are based on learning objectives, context, and content being addressed.</td>
<td>The model provides the framework for developing instructional strategies that are independent of the knowledge content. Emphasizes on desired learning outcomes rather than subject knowledge.</td>
</tr>
</tbody>
</table>
Table 2.5  
*Factors Review of the Models Related to E-learning (continuation)*

<table>
<thead>
<tr>
<th>Factors (continuation)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure:</strong></td>
<td>All four models contain an instructional strategy step in which diverse options for positioning and sequencing can be considered.</td>
</tr>
<tr>
<td><strong>Content design:</strong></td>
<td>All four models have steps or phases in which content design is addressed.</td>
</tr>
<tr>
<td><strong>Motivation and feedback:</strong></td>
<td>Motivational and feedback approaches and mechanisms are supported in all four models. The rigours of the four models may ensure that the required level of detail is available to make solid design decisions. (adapted: Ally, 2003)</td>
</tr>
<tr>
<td><strong>Interaction and involvement:</strong></td>
<td>The level of interaction and the degree of learner involvement are design decisions that are considered in the instructional strategy phase of each of the models. These decisions would then inform decisions related to the selection of instructional media.</td>
</tr>
</tbody>
</table>

*Note:* Created based on information from Morrison, Ross and Kemp’s, 2001 Designing effective instruction; Seels and Glasow’s, 1990 Exercises in instructional strategy; Dick, Carey and Carey, 2001 The systematic design of instruction; Robert Gagne’s, 1985 The conditions of learning and the theory of instruction; and Siragusa’s, 2000 Instructional design meets online learning in higher education.

All the four models described above, each having different orientation, are robust, complete, and clear. Each model includes: analysis to establish what strategies would best suit the content, the context, and the learners; the establishment of instructional or performance objectives; the identification of the most appropriate media; the development of instructional strategies; as well as formative and summative evaluation. Table 2.5 shows the comparison of factors to highlight the appropriateness of the models for an e-learning environment that accommodates multiple intelligences.
2.6 Summary

The current diversity of perspectives and approaches prevalent in e-learning can prove over-whelming to researchers and practitioners alike. With foundation knowledge in learning styles namely theory of multiple intelligences, electronic learning technologies and an understanding of how the instructional design concepts and web-based design concepts are interwoven and instantiated in the development of the student-centric e-learning environment, the researcher discuss the needs and details of the conceptual framework for this research in the following chapter.