

THE DELIVERY OF HEALTH AND SAFETY
TRAINING IN THE CONSTRUCTION
INDUSTRY USING VIRTUAL CLASSES

by

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THE DELIVERY OF HEALTH AND SAFETY
TRAINING IN THE CONSTRUCTION
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Abstract

Title: The delivery of health and safety training in the construction industry using virtual classes

Background

This research took place within the context of an EU Minerva funded project. The project's aim was to create an e-learning framework that combined multiple intelligence theory with open source software to deliver health and safety training for the construction industry. The project involved partners from Cyprus, the UK, Turkey, France and Ireland. This study reports on the activities carried out at Waterford Institute of Technology as part of the project.

Purpose

The research concerned the delivery of the class content through the e-learning framework developed through the Minerva Project to construction industry related students. The content was delivered through two phases of virtual classes and evaluated using an action research methodology. The evaluation results allowed for the identification of key lessons learned from the use of Multiple Intelligence (MI) theory in an e-learning framework.

Methodology

The theory of MI proposes that people learn using a number of intelligences and that the most effective learning environment is one that can target an individual's dominant intelligence areas. An online MI profiling tool was used to determine the dominant intelligence areas of a group of construction managers and the results were used to design a number of virtual classes. The virtual classes were subsequently delivered in two phases to construction students using an action research methodology. The evaluation process, completed after each phase, measured the levels of interaction and students satisfaction with the use of technology, the learning community, the class content and the role of the instructor.

Findings

The investigation found that the instructor played a key role in balancing the social, technical and educational focus of a virtual class. The evaluation process identified the role of the instructor, the level of class interactions and the stability of technology as the key aspects to the e-learning framework. The investigation produced guidelines on using MI theory within an e-learning framework. The guidelines involve presenting class content in a number of ways to allow multiple perspectives on a topic, creating a learning community through online interactions and finally allowing students to express what they have learned through personalised learning outputs.

Keywords:

Multiple Intelligence, Construction, E-learning, Virtual Class, Health and Safety.

Classification: Technology facilitated learning for the Construction Industry

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Declaration

I declare that this dissertation, in whole or in part, has not been submitted to any University as an exercise for a degree. I further declare that, except where reference is made in the text, the contents are entirely my own work. The author agrees that the library may lend or copy the thesis upon request for study purposes, subject to the normal conditions of acknowledgement.

Mannix Carney

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Chapter One: Introduction

1.1 Overview

In recent years e-learning has become a growing method of delivering education. The increase in the flexibility and availability of information and communication technology (ICT) offers the potential to change the way education is delivered. The use of ICT however results in some changes from traditional methods of education and learning. Technology offers the potential to enhance the learning experience, but it requires a paradigm shift from both instructors and learners to take full advantage from it.

When compared to traditional methods of education and learning, the use of ICT can place more control and responsibility in the hands of the learner. The challenge in using ICT for education is to empower and motivate learners through a technology driven medium. The theory of Multiple Intelligence (MI) has become an influential theory on how people learn and has the potential to enhance the ability of educators to appeal to a diverse group of people (Sanchez and Llera, 2006).

The construction industry is large and geographically spread out, project based and contains a diverse group of professions and work practices. Even with technological advances and modern plant and machinery, there are still many hazardous activities. More workers are killed, injured or suffer ill health in the construction industry each year than in any other sector in Ireland (Wall et al., 2007). Some of the challenges of providing training within the construction sector could be addressed with the innovative use of ICT. The application of MI theory has the potential to increase the effectiveness of training delivered through ICT in the construction sector. The application of MI theory within an e-learning framework to target the construction industry was the focus of a Minerva funded project. The project contained a European group of experts with experience in e-learning, MI theory and the construction industry.

1.2 EU Minerva Project

A network of organisations secured funding through the Minerva fund to create training and learning resources focused on health and safety in the construction industry. The partners involved included Nottingham Trent University in the UK,

Istanbul Technical University in Turkey, Universite de Nice Sophia-Antipolis in France, Centre for the Advancement of Research and Development in Educational Technology in Cyprus, Multimedia Instructional Design, Blended Learning Design and Waterford Institute of Technology in Ireland. The project partners used their individual expertise to design and create content for an e-learning framework that targeted health and safety training in the construction industry. Nottingham Trent University, Waterford Institute of Technology and Istanbul Technical University provided the construction industry expertise. Centre for the Advancement of Research and Development in Educational Technology, Multimedia Instructional Design and Blended Learning Design provided the e-learning expertise and technical support. Universite de Nice Sophia-Antipolis provided the learning psychology input.

The Minerva Project focused on the application of MI theory within an open source e-learning framework that focused on health and safety training for the construction industry. As this investigation took place as part of the Minerva Project, the key parts of the research were the focus on MI theory, the use of open source e-learning systems and the focus of the content on health and safety in the construction industry. This thesis is based on the work that took place at Waterford Institute of Technology as part of this project. As a result the content was delivered with a focus on the Irish construction industry. The e-learning framework was defined as the use of synchronous and asynchronous online systems to present class content and enable community building activities. The framework made use of open source technology. The content targeted falls from height in the construction industry.

The Use of E-Learning Technology

The e-learning framework used for this investigation represents the use of asynchronous and synchronous communication through online systems in order to facilitate the interactions between the instructor, the learning community and the content. The term asynchronous refers to non instant communication such as email and the use of forums, and synchronous communication refers to instant real time interactions such as web meetings and chat systems.

The Minerva Project's focus was the identification and utilisation of MI theory to influence the design and operation of the e-learning framework. MI theory has been

used in a traditional classroom environment. The Minerva Project sought to bring some of the benefits of a MI approach to the online learning environment. A virtual class can create a learning environment through the combination of presenting content in an understandable way and allowing social interactions to build on the class content. The application of MI theory can increase the potential of a virtual class to facilitate students learning, through the accessibility and relevance of the class content and social interactions. The e-learning framework sought to incorporate methods for the instructor to use MI theory to enhance the ability of students to engage with the class content and then interact with the rest of the class.

The Application of the Theory of Multiple Intelligences

The theory of MI was developed by Howard Gardner in the book *Frames of Mind* in 1983 and since then has become an influential contemporary perspective on the psychology of intelligence (McNamee et al., 2007). Based on cognitive research, Gardner proposes that people learn in a variety of ways and have diverse strength and abilities which, if recognised, can be developed to enable learners to reach their potential (Sanchez and Llera, 2006). Gardner proposes that there are eight intelligences, these are: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal and naturalist intelligence (Gardner, 1983).

Typically, people display intelligence profiles that are manifested as different areas of strengths and weaknesses and these are the reflection of the influences of inherited biology, environmental, culture and life experiences (Shearer, 2007). MI theory is not strictly an educational guideline, but it does address how people approach the process of learning (Tracey and Richey, 2007). The application of MI theory to an e-learning environment has not been the subject of detailed research to date, and could contribute to making the experience more learner centred, which is of key importance to virtual classes (Reeves and Reeves, 2008).

The partners focused on the creation of an e-learning framework which incorporates MI theory and then pilot the framework through delivering health and safety training to construction students. The targeting of the construction industry gives the e-learning framework a clear context and addresses the need for innovative training for the sector.

The Content Focus

Construction remains a labour intensive industry which involves hazardous activities that present an unusually high risk of injury and ill health. The tight constraints of time and cost which are an increasing part of the modern construction industry can potentially pose a threat to health and safety practice (Brabazon et al., 2000). Due to the fragmented nature and dynamic working patterns of the construction industry, the use of e-learning for training and education could prove an innovative and much needed solution (Suraji et al., 2006). The Minerva Project focused on developing and deploying training which targets falls from heights through the use of e-learning technology. By combining technology with instructional techniques that are influenced by MI theory, a series of virtual classes can be delivered that can effectively target the audience of construction students.

1.3 The Investigation

This investigation was based on the work carried out at Waterford Institute of Technology as part of the overall Minerva Project. The research used an action research methodology to evaluate the e-learning framework with two groups of construction students using an iterative cycle of refinement. This investigation was designed to answer broad research questions outlined in the following section.

1.3.1 Research Questions

The two research questions used to guide the research are:

- Can a MI profiling system be used to guide the instructional role and content development of an e-learning framework?
- When the e-learning framework is piloted with Irish construction students, how do they evaluate the areas of; the use of technology, the learning community, the class content and the role of the instructor?

In order to answer the research questions on the use of MI theory within an e-learning framework and the effect of the e-learning framework in terms of student evaluation the following research aim and objectives were used.

1.3.2 The Research Aim and Objectives

The aim of the research is to create an e-learning framework which incorporates MI theory and pilot the framework by delivering health and safety training to construction students.

The aim will be achieved via the following objectives:

1. Conduct a literature review on MI theory and its application to e-learning with a focus on health and safety on the construction industry.
2. Identify the key requirements for the selection of technology for the e-learning framework.
3. Apply a multiple intelligence profiling system to a target group of construction managers.
4. Design virtual classes which target falls from height in the construction industry.
5. Deliver two phases of virtual classes to construction focused students as part of an action research methodology.
6. Develop an evaluation process to enable analysis on the use of technology, the presentation of content, the role of the instructor and learning interactions within the e-learning framework.
7. Based on the analysis of the investigation, produce a guideline for the instructor to using multiple intelligence theory with e-learning.

The research will set out the requirements for an e-learning framework based on a literature review of MI theory, the technology and interactions of a virtual class and the requirements of health and safety training in the construction industry. The methodology for the investigation involves the profiling of a target audience of construction managers in order to identify dominant intelligence strengths to target through the virtual class content. The virtual classes are then deployed in two iterative

cycles using an action research methodology which uses a student evaluation questionnaire to refine the e-learning framework.

1.4 Thesis Outline

This introductory chapter sets the context for the areas covered by the research and outlines the aim and objectives that will guide the investigation. The following section outlines the content of the thesis.

Chapter Two - Literature Review

The literature review looks at the development of e-learning and the relevance of MI theory in allowing students to achieve higher level learning. It outlines the technologies and interactions that can be used for creating a virtual class. The key requirements for creating a virtual class become the basis for the evaluation process that will guide the investigation. The requirements for integrating MI theory through the technologies available to an e-learning environment will be discussed. The literature review will conclude with an introduction to the construction industry and the requirements for health and safety training.

Chapter Three – Research Methodology

The methodology looks at the research approach applied to create and develop an e-learning framework. The chapter looks at the broad research paradigms and the requirements of conducting research in an e-learning environment. Relevant research designs are compared and outlined, concluding with the selection of an action research approach. The practical application of an action research approach is then discussed, with the elements of the case study framed and the key requirements are identified. Due to the developmental nature of the investigation it is proposed that the data is collected and analysed using qualitative methods.

Chapter Four - The MIDAS Results

The requirement for an MI profiling of the target audience is established in the literature review. The system used is called Multiple Intelligence Developmental Assessment Scales (MIDAS) and it produced a detailed MI profile for a group of construction managers. The results from the target group are outlined in terms of

dominant intelligences. Based on the analysis of the MIDAS results dominant intelligence areas are identified as being relevant to the context of the construction industry and the target group of construction managers.

Chapter Five – Description of Case Study

The design of the e-learning framework is an alignment of the key criteria identified in the literature review, and the MIDAS results from the target group of construction managers. The result is a number of virtual classes which target construction health and safety and whose instructional strategy and content presentation are influenced by MI principles.

Chapter Six - Evaluation and Analysis of Learner Satisfaction

This chapter looks at the results of the evaluation questionnaire and interactivity matrix. The classes are run in two phases at WIT. The classes are delivered through a web meeting system and are recorded as an archive. The archived material is analysed and each class produced an interactivity matrix which documented the major interactions which took place during the class. The evaluation chapter produces results on the functionality of the technology with the role of the instructor, and the effect of that combination on the content presentation and the social interactions in the class. The chapter presents the conclusions of the student evaluation of the first and second phase of the virtual classes.

Chapter Seven - Discussion

This chapter identifies the challenges and successes in achieving the aim and objectives set out by the investigation. The changes which were made as a result of the evaluations are highlighted and discussed. Based on the specific findings for the application of MI in this investigation, some observations are made about the use of MI in general in an e-learning environment.

Chapter Eight – Conclusion and Recommendations

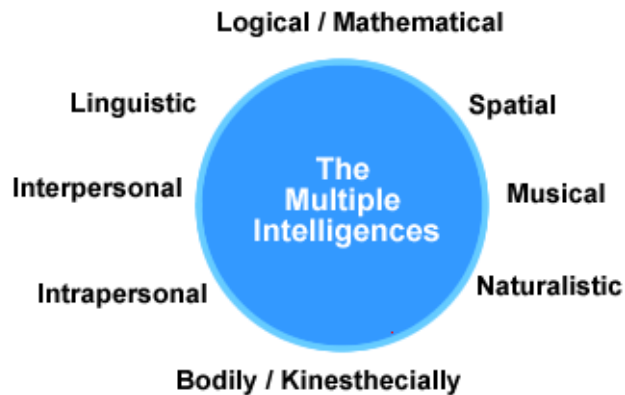
The conclusion and recommendations outlines the key conclusions of the investigation. The areas of future research are commented on and the limitations of the investigation are outlined.

Chapter Two: Literature Review

Since the late 1990s e-learning has developed into an important use of technology and changed the way training and learning can take place (Chye Seng and Al-Hawamdeh, 2001). By revolutionising the way instructional content is presented, delivered and shared, e-learning has become a tool for meeting the educational challenges of the 21st century (Alshawi et al., 2006). With the rapid growth of computer networks and advances in telecommunication, distance education has become a major setting for the delivery of remote instruction. An online learning environment can offer learners greater opportunities to learn as the environment can be tailored to the learners' needs. The experiences identified by Martin (2005) in relation to ICT in education, point to the potential of technology to transform the classroom experience for both teachers and pupils. While numerous studies have focused on the effectiveness and benefits of e-learning, relatively few researchers have looked at understanding what motivates students to become involved in an online learning process (Davis and Wong, 2007). It would seem that while e-learning makes it easier for students to connect to a learning experience regardless of their geographic location, it is also easier to drop out if the student does not feel engaged (Eom et al., 2006). The factors that affect a student's motivation vary widely depending on different attitudes and expectations among a group of people (Jameson et al., 2006). In order to succeed in creating a learning environment that can help to motivate a diverse group of students, an understanding of the different ways that people think about and approach learning is needed.

One of the influence's in the change in thinking on how students approach a learning environment was Howard Gardner (Sanchez and Llera, 2006). Gardner (1983) proposed that human intelligence should be seen as tools that facilitate knowledge construction. Gardner defined intelligences as '*the capacity to solve problems or to fashion products that are valued in one or more cultural settings*' (Gardner and Hatch, 1989 p.4). The intelligences which Gardner (1983) outlined are illustrated in figure 2.1.

Figure 2.1 The Multiple Intelligences



Source: Gardner, (1983)

MI theory proposes that the individual intelligences shown in figure 2.1 are present in all humans in varying strengths resulting in a personal 'jagged profile' of intelligence strengths and weaknesses (Jordan, 2003). A learning environment which can accommodate a range of intelligence types is better suited to meeting the needs of a diverse group of people than an environment which requires all students to use a few intelligence areas exclusively. E-learning has the potential to make use of MI principles, through its ability to create a broader more inclusive learning environment through allowing students to personalise their learning according to their intelligence profile (Sanchez and Llera, 2006).

The literature review chapter fulfils an objective of the investigation by outlining the software systems used to create a virtual class and the key interactions needed to create a learning experience in an e-learning environment. The instructor plays a key role in using the software available to create class interactions that allow students to engage with the content and form a learning community. The key aspects of using MI theory to design and deploy a virtual class are identified and the content focus on the construction industry is justified. In order to give an insight to the potential of MI theory within e-learning, the literature review starts by looking at the three principle educational theories on how people gain skills and knowledge through education.

2.1 The Focus of Learning Theory

The advances in terms of information technology in recent times has transformed every dimension of human life (Sanchez and Llera, 2006). This transformation has been termed the 'information age' (Russell, 2005). The information age has resulted in rapidly increasing and changing information which is also getting increasingly easier to access (Jonassen, 1996 and Price and Hossfeld, 2007). This has a profound effect on the way every aspect of our society operates both directly and indirectly. One area most affected by the information age, is education (Russell, 2005). The information age and the technological capabilities associated with it, have resulted in a re-conceptualisation of the learning process and the design of new instructional approaches (Jonassen, 1996).

There has been considerable progress in the development of educational psychology over the past century. The changes in society and the use of technology in education have meant that attitudes to education have developed rapidly over that period (Madden, 2007). Modern educational theories about how people gain knowledge through education have been influenced by three main theoretical view points (Mödritscher, 2006). The theoretical view points are not exclusive and are part of a complex mix of activities that result in humans gaining knowledge. Modritscher (2006) outlined the three principle learning theories of behaviourism, cognitivism and constructivism in relation to their use in an e-learning environment. Compiled from Modritscher's analysis, table 2.1 outlines the main attributes as well as the strengths and weaknesses of each theory.

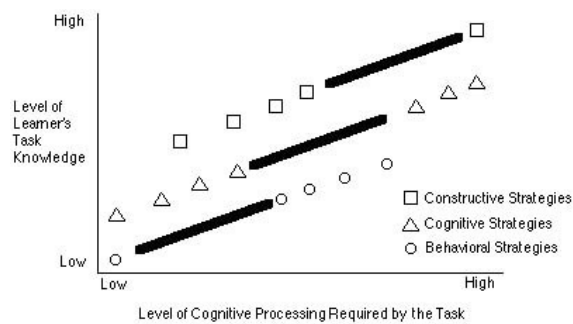
Table 2.1 Principal Attributes of Major Learning Theories

Learning Theory	Principle Attributes	Strengths	Weaknesses
Behaviourism	Based on the human mind as a 'blank slate'. Learning is based on observable changes in behaviour.	The structured, deductive approach allows basic concepts, skills and factual information to be quickly acquired by learners.	Learning is defined as what can be observed quantitatively and the effect of thought processes occurring in the mind are ignored
Cognitivism	Considers learning as an internal process that involves memory, thinking, reflection, abstraction and motivation.	Recognises the importance of individual learning styles and accommodates a variety of learning strategies.	To full accommodate a wide range individual learning styles and preferences can be a time consuming and expensive task.
Constructivist	Suggests that learners construct personal knowledge from the learning experience itself. Learning is both a personalised and active process of knowledge construction.	The flexibility and transferability of the learning process means the learner is better equipped to deal with real life situations.	Due to the flexibility it is difficult to adequately evaluate the learning process. The process also requires a high level of individual motivation from the learners.

Source: Compiled from (Mödritscher, 2006)

The theories of behaviourism, cognitivism and constructivism can combine with each other as a person gains knowledge through an educational process (Ertmer and Newby, 1993). Figure 2.2 illustrates the relationship between the theories as a person builds knowledge and cognitive focus over time.

Figure 2.2 The Alignment of Learning Theories.



Comparison of the associated instructional strategies of the behavioral, cognitive, and constructivist viewpoints based on the learner's level of task knowledge and the level of cognitive processing required by the task.

Source: Ertmer and Newby (1993)

The traditional paradigm in education and training is generally rooted in the behavioural and cognitive side of the learning theories (Madden, 2007). In order to take full advantage of the potential of e-learning, it is important to allow learners to

progress into the area of constructivism (Shariffudin et al., 2008). In order to make that shift, learners need to have a higher level of individual performance and motivation in order to play a more active role in the educational process. The types of activities required from learners have been described in Bloom's taxonomy as higher order learning (Mödritscher, 2006). In the 1950s Benjamin Bloom developed a taxonomy of cognitive objectives which follows the thinking processes that are required to construct knowledge (Madden, 2007). Table 2.2 outlines Bloom's taxonomy using nouns and verbs to describe the incremental steps required to use higher level thinking skills.

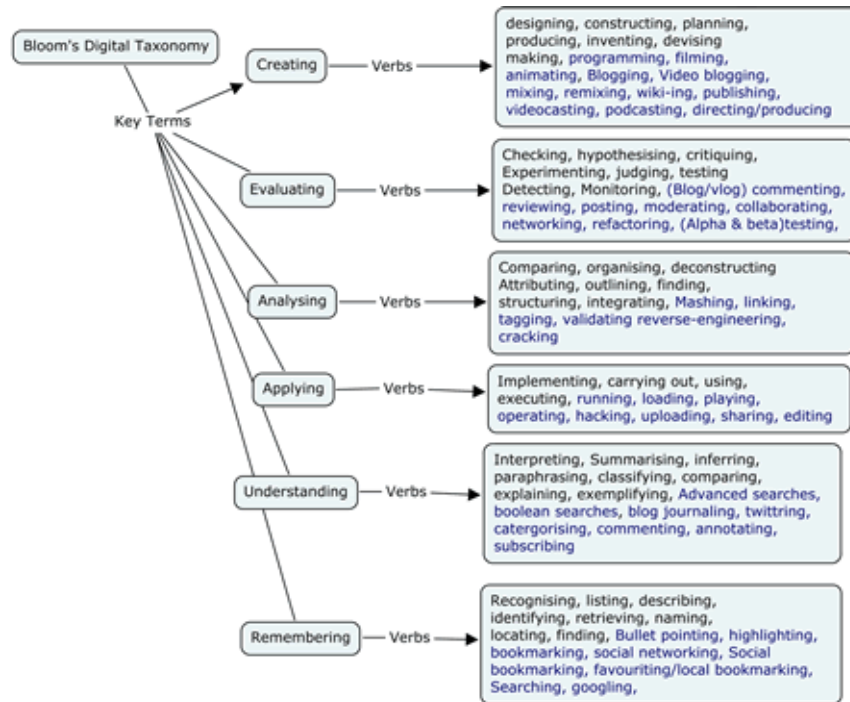
Table 2.2 Blooms Instructional Taxonomy

	Nouns	Verbs
Higher Level Thinking Skills	Evaluation	Creating
	Synthesis	Evaluating
	Analysis	Analysing
	Application	Applying
	Comprehension	Understanding
Lower Level Thinking Skills	Knowledge	Remembering

Source: Reigeluth (1999)

The basic premise for Bloom's taxonomy is that a person does not understand a concept if they do not remember it, similarly a person does not apply concepts and knowledge they do not understand (Churches, 2008). When creating a learning environment, it is important that the instructional focus seeks to bring learners from the lower order thinking skills such as; knowledge, comprehension and application, to higher order thinking skills such as; analysis, synthesis and evaluation (Madden, 2007). Bloom's taxonomy was revised by Churches (2008) in order to take into account the type of activities that can be carried out in a digital environment. Figure 2.3 illustrates these verbs and makes suggestions as to how they can be used when applying Bloom's taxonomy to the digital environment. The higher order learning objectives in this medium move from involving a passive role such as search and browsing to more active roles such as posting, collaborating and using wikis (Churches, 2008). In order to achieve higher level objectives in a learning environment, the instructional approach must start with the lower objectives and build up over time. Figure 2.3 presents Bloom's taxonomy adopted for a digital environment; the verbs in the figure describe activities that can be carried out online.

Figure 2.3 Blooms Taxonomy Adopted for the Digital Environment



Source: Churches (2008)

Transferring this process into an online environment presents some unique challenges. Technology offers a range of tools to complete Blooms learning activities as shown by Churches (2008) in figure 2.3. However in using these tools it is important to look beyond technology to how people actually learn. Technology in education reduces the burden of providing information and focuses the attention on how people learn (Sanchez and Llera, 2006). To create an online learning environment, it is important that the activities provide the learners with the lower level learning activities and then facilitates the learner to build on those activities and move into higher level learning (Churches, 2008). This simple objective with e-learning is quite difficult to achieve. The individualised nature of the internet often means there is a glass ceiling which means learners stay in the lower level learning activities (Sword and Leggott, 2007). In order to have learners engage fully with the lower level activities it is important that the educational environment is as inclusive and personalised as possible (Modritscher, 2006). The overall objective of achieving higher order learning can only take place when the class of students are first fully engaged with the lower order learning activities (Eom et al., 2006). The shift in education caused by the use of

technology from an educator's point of view requires a new approach to education which recognises individual people and understands how they learn.

The progression from lower level thinking skills to higher level thinking skills is a key challenge for an educational environment. An e-learning environment offers large opportunities and challenges in facilitating students to make that shift over a period of time. This investigation seeks to use elements of MI theory to create an e-learning framework that appeals to a range of intelligence types through the presentation of content and the creation of a learning community. The following section describes MI theory and outlines its relevance to the investigation.

2.2 Introduction to the Theory of Multiple Intelligence

One of the leading books in the arguments for a new approach to education and learning has been Gardner's (1983) '*Frames of Mind: The Theory of Multiple Intelligences*', which challenged the traditional thesis that there was a single intelligence. Gardner did not accept a stable conception of intelligence as a single entity which would be measured in a single way (Sanchez and Llera, 2006). Howard Gardner has made a significant contribution towards the shift in the way intelligence is seen in education circles (Meacham, 2003). The following quote illustrates the shift; *In the heyday of the psychometric and behaviourist eras, it was generally believed that intelligence was a single entity that was inherited; and that human beings -- initially a blank slate - could be trained to learn anything, provided that it was presented in an appropriate way. Nowadays an increasing number of researchers believe precisely the opposite; that there exists a multitude of intelligences, quite independent of each other; that each intelligence has its own strengths and constraints; that the mind is far from unencumbered at birth; and that it is unexpectedly difficult to teach things that go against early native theories that challenge the natural lines of force within intelligence and its matching domains.* (Gardner, 1993 p. 23)

This quote highlights the shift that has taken place in how educational theorist view intelligence and learning. Gardner's theory of MI is not strictly an educational theory or method. It is a theory that looks at intelligence as something that changes and

develops in accordance with the experiences a person has during their life (McNamee et al., 2007). Intelligence is seen as the result of a complex interaction between biological and environmental factors which can be taught and modified but depends on context and personal attributes (Smith, 2008). Gardner's motivation for his work was not to only discover the true nature of intelligence or how it can be developed but to find how to combine intelligence and ethics (Sanchez and Llera, 2006). The basis of Gardner's work is that each individual possesses a range of intelligence areas which are used to solve problems and fashion products that are valued in a particular cultural setting or environment (Gardner, 1983). Learning is the acquisition of the knowledge of a skill, art or trade by study or experience (Green and Tanner, 2005). As learners construct new knowledge MI can be thought of as the learners' tools to facilitate that construction (Tracey and Richey, 2007). The ways that these intelligences profiles appear in humans are defined as eight different intelligences as illustrated in figure 2.1.

2.2.1 Gardner's Eight Intelligences

The intelligences are defined as the capacity to solve problems or to fashion products that are valued in one or more cultural settings (Gardner and Hatch, 1989). In order to have strength in one particular intelligence a person must be able to resolve genuine difficulties or problems associated with that strength (Smith, 2008). The intelligence areas are as follows:

Linguistic intelligence involves sensitivity to spoken and written language, the ability to learn languages and the capacity to use language to accomplish certain goals. This intelligence includes the ability to effectively use language to express oneself rhetorically or poetically; and language as a means to remember information.

Logical / Mathematical intelligence consists of the capacity to analyse problems logically, carry out mathematical operations, and investigate issues scientifically. It involves the ability to detect patterns, reason deductively and think logically. This intelligence is most often associated with scientific and mathematical thinking.

Musical intelligence involves skill in the performance, composition, and appreciation of musical patterns. It encompasses the capacity to recognize and compose musical pitches, tones, and rhythms.

Bodily / Kinesthetic intelligence entails the potential of using one's whole body or parts of the body to solve problems. It is the ability to use mental abilities to coordinate bodily movements.

Spatial / Visual intelligence involves a three – dimensional relational sense and the ability to work with visual relationships. It is the ability to recognize and use the patterns in the completion of tasks.

Interpersonal intelligence is concerned with the capacity to understand the intentions, motivations and desires of other people. It allows people to work effectively with others. Educators, religious and political leaders and counsellors all use a well-developed interpersonal intelligence.

Intrapersonal intelligence entails the capacity to understand oneself, to appreciate one's feelings, fears and motivations. People with intrapersonal intelligence tend to be talented at reflecting on their own experiences and feelings and working alone.

Naturalist intelligence – involves the ability to distinguish among, classify and use features of a natural environment. Farmers, gardeners, botanists, geologists and archaeologists are all examples of this intelligence.

Source: Compiled from Smith, 2008 and Jordan, 2003.

The eight intelligences outlined by Gardner rarely operate independently and can be used at the same time and tend to complement each other as people develop skills or solve problems (Smith, 2008). When seeking to apply MI theory in an educational setting there are three essential principles (Jordan, 2003):

1. Learners have a range of intelligences which work together for maximum functioning of the individual.

2. Each person has an individual intelligence profile influenced by biological and cultural factors together with life experience. This results in an intelligence profile with some intelligences being more or less developed than others.
3. Intelligence can be nurtured and developed throughout life and weaker intelligences can be improved and strengthened at any time. These principles in turn determine how learning, teaching and assessment must take place.

The theory of MI has been criticised by educational professionals on a range of areas due to its open interpretation (Gardner, 1998). One of the most serious criticisms is that the identification of intelligences has been based more on intuition rather than on rigorous and comprehensive empirical research (Madden, 2007). As MI theory represents a more open definition about what human intelligence is and how it is created, educators who have identified intelligence as that which can be measured by tests will always find MI theory problematic (Sanchez and Llera, 2006).

Despite criticism, MI theory has been embraced by a wide range of educational theorists and applied by teachers to the problems of everyday teaching (Meacham, 2003). The theory has been applied to a range of educational settings ranging from pre-school to university level (Smith, 2008). The shift in focus to learners and their learning rather than teachers and how they teach, makes sense to educators who have to assimilate the enormous individual differences they encounter in educational practice (Sanchez and Llera, 2006). A number of the reasons why educators have responded well to MI theory are outlined by Kornhaber (2001, p 276) in the following quote; *..the theory validates educators' everyday experience: students think and learn in many different ways. It also provides educators with a conceptual framework for organising and reflecting on curriculum assessment and pedagogical practices. In turn, this reflection has led many educators to develop new approaches that might better meet the needs of the range of learners in their classrooms.*

Kornhabers' comment points to the value of using MI theory as the conceptual influence to designing and operating an educational approach. This broader more holistic view of intelligence is more compatible with real life learning than the more formal approach of traditional education which focuses exclusively on specific intelligence and abilities (Freund and Piotrowski, 2003).

This investigation seeks to use the elements of MI theory to provide a conceptual guide to the creation of an e-learning framework. The purpose of using MI theory is to facilitate the different intelligence areas that exist in a group of students. The following section examines how MI theory can be used as a conceptual influence within an educational setting.

2.3 Using MI theory within an Educational Setting

Gardner's work developed from the field of neuropsychology where he conducted research into understanding cognitive and emotional injury (Sanchez and Llera, 2006). This research at Harvard University allowed Gardner to study the development of cognitive abilities. This is where Gardner developed the human ability areas which could be called intelligences in his book '*Frames of Mind: The Theory of Multiple Intelligences*' (Smith, 2008). Gardner did not consider MI theory as an educational objective in itself, but rather a support for better quality education.

From Gardner's perspective, an educational process has two key areas; what the content delivered to the learner is, and how to educate the learner so that they understand. In terms of what content to cover, Gardner sees the focus shifting from large amounts of information to a small number of truly fundamental concepts (Sanchez and Llera, 2006). This is particularly true in an online learning setting as the amount of available information is unlimited. It is important that learners are given a well selected group of key concepts through which the subject area can be further explored (McCoog, 2007). The second dilemma is how to teach so that the learner understands. Focusing on learning to understand within a realistic context allows students to deal with fundamental aspects of a concept in a way which makes sense to them (McNamee et al., 2007). A group of researchers in the Harvard Project Zero who have investigated the development of learning processes in children, adults, and organisations developed a model for using MI theory in an educational setting which had three parts:

1. Multiple Perspectives – There were a number of routes of access to understanding a topic, largely corresponding to the multiple intelligences. These routes offer students several ways of understanding the material so that they can choose the most attractive, familiar or productive one.

2. Instructional Narratives – The entry points place students inside the topic, arousing their interest and desire to explore, without offering specific forms of comprehension. The use of instructive narratives can be used to present content in different ways.
3. Dealing with the essentials. The access routes open the way and motivate students. The narratives present revealing aspects of content concepts in ways that make sense to learners. By focusing the content on fundamental aspects of a concept, learners can develop a rich and expansive appreciation for a subject. (Sanchez and Llera, 2006)

The fundamental step in the process is to recognise that a learner can only comprehend and demonstrate a concept if they can develop multiple representations of that concept's essential aspects (Sanchez and Llera, 2006). An important part of achieving learning for understanding is to expose students to multiple perspectives on a core issue (Duffy and Jonassen, 1992 and Gardner, 1993).

Gardner (1993) further expanded on this in outlining a framework for using MI theory for constructing a curriculum to support learners who display diverse strengths in each of the eight intelligences. The concept was to use different perspectives as 'entry points' best envisaged as different doors, each targeting different intelligences. The use of multiple perspectives has two purposes, to tease out content complexities, and to reach a broader range of students (Gardner, 1993). As the entry points are designed to target all the intelligences, learners are empowered to find ways to get at the substance of the topic using their own intelligence.

An example of this would be if a learner displayed strong spatial intelligences and low levels of linguistic and logical mathematical intelligences, the learner would be less likely to engage in a history class that focused on the interpretation of descriptive accounts. This type of learner could be targeted by providing content which introduces history through art, architecture and geography (Blythe and Gardner, 1990). Table 2.3 lists the entry points and matches them with an example of suggested instruction. By presenting the content with as many of the entry points as are practical, the content is always accessible in a number of ways.

Table 2.3 Gardner’s Entry Points with Examples of Instruction

Entry Point	Description	Example of instruction
Narrational	The narrative entry point deals with the ‘story’ that is central to the topic	Case studies, narrative or themed stories, descriptive accounts
Logical / Quantitative	The numerical aspects of a topic, typically involves deductive or logical reasoning.	Statistics, graphs, logic reasoning tasks
Aesthetic	The aesthetic entry point engages artistic aspects of a topic. It may also focus on sensory features associated with the topic	Three-dimensional representations, images, videos, design activities
Experiential	Should provide students with an opportunity to engage with the topic in a ‘hands-on’ manner	Any ‘Hands on’ experience with the subject matter
Foundational	This entry point deals with fundamental, philosophical questions about the nature of the topic, why it exists, and/or what is its meaning.	Any questioning of the foundation or substance of a topic

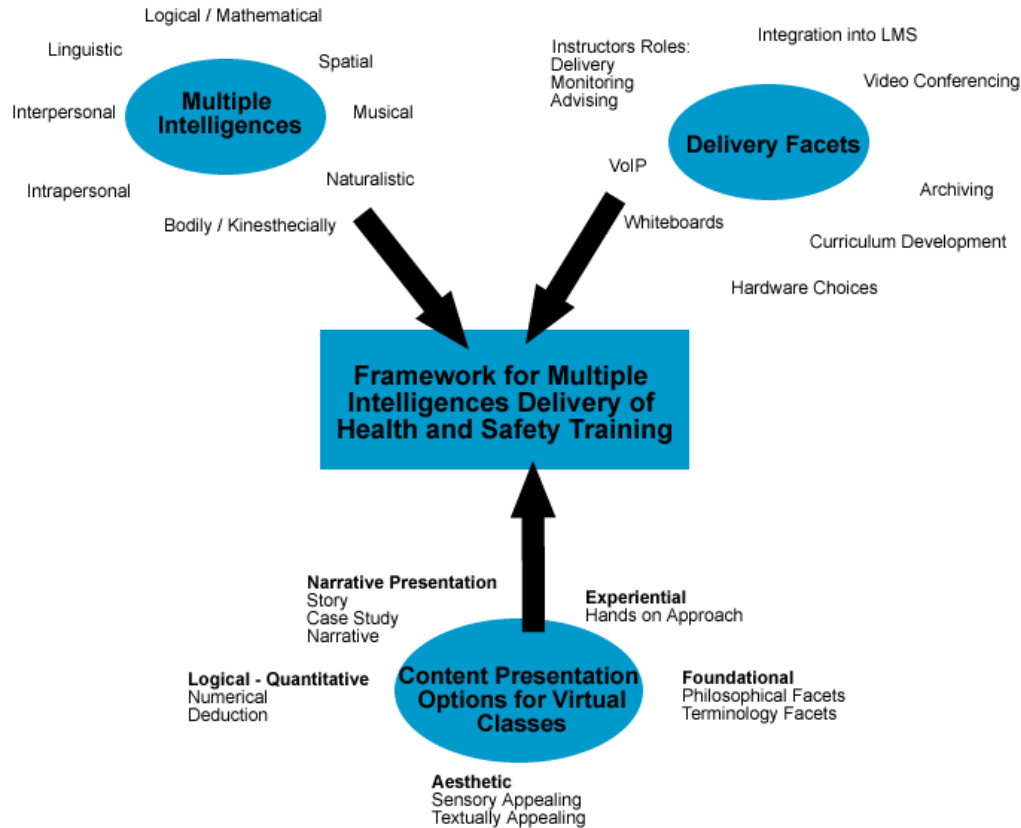
Source: (Wall et al., 2007 and Acar et al., 2008)

The use of Gardner’s entry points provides a basis for presenting content in different ways that gives learners a number of perspectives on a topic. The actual use of an entry point is dependent on the method of instruction, the learner and the required learning outcome, as Gardner (1997, p. 24) puts it: *the important pedagogical point is that any concept can be presented in more than one way, and everyone benefits when we have ‘multiple entry points’ to the same idea, theory, concept, or framework. There is no point in prescribing how many ways to present an idea; that depends on the idea, on one hand, and one’s own teaching styles and audience, on the other.*

The use of multiple entry points in presenting content requires a comprehensive analysis of the educational content, the intelligences present in the classroom and the delivery facets available to the instructor (McNamee et al., 2007). The analysis and alignment is an ongoing process which is best done with the people involved in the learning process. This flexibility between the student, the instructor and the educational content is a powerful tool in creating a learning environment that encourages and motivates students (Sanchez and Llera, 2006). Figure 2.4 illustrates the alignment of Gardner’s framework using the delivery facets available to a virtual class. The delivery facets demonstrate the elements of an e-learning framework that facilitate the synchronous and asynchronous communications, as well as the role of the instructor. The focus of this investigation is aligning the delivery facets with

content presentation options that target the MI profiles a group of construction students.

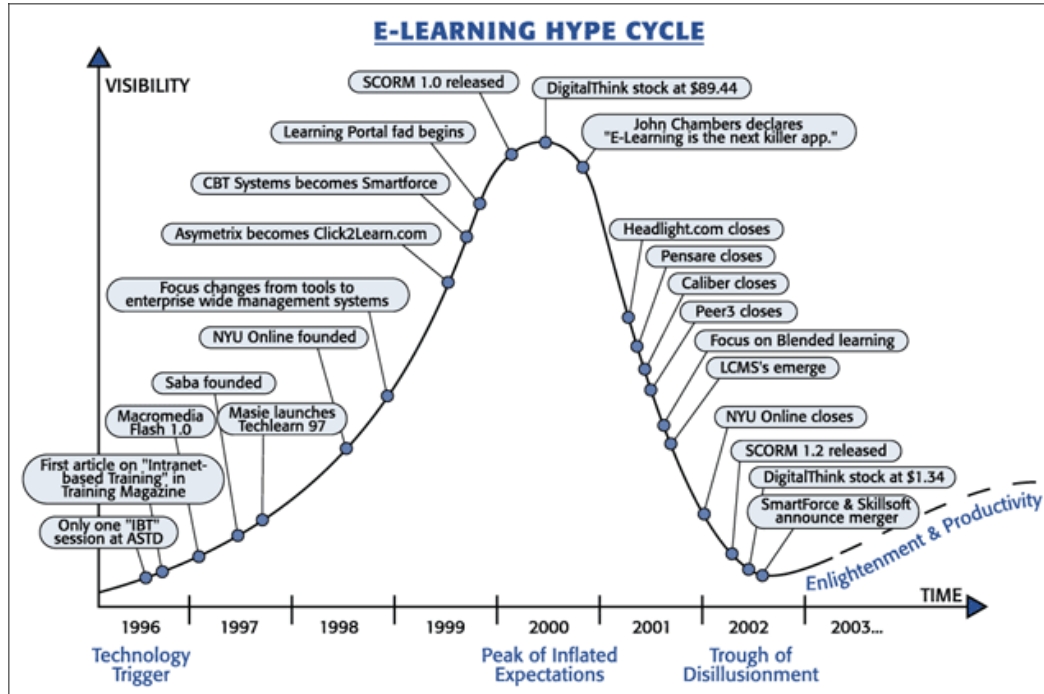
Figure 2.4 The Alignment of Technology with MI Principles



Source: (Wall et al., 2007 and Acar et al., 2008)

The use of technology in education is affected by the huge amount of change in the development of technological solutions. Figure 2.5 illustrates this change with the e-learning hype cycle which took place alongside the dot com bubble, which peaked in the year 2000. One of the features of the e-learning solutions developed over the dot com bubble is that they focused on technology aspects first, and the way people learn second (Rao, 2007). When e-learning solutions look at learning from this aspect, the focus is often on a simplistic and one dimensional concept of how people process, build and store knowledge (Freund and Piotrowski, 2003).

Figure 2.5 E-Learning Hype Cycle and “Dot-com” crash



Source: http://www.e-learningguru.com/articles/hype1_1.htm accessed 14th March 2009

The use of an MI theory influenced approach in e-learning, allows the instructor to look first at the way students like to learn and then adopt the content and delivery facets to suit those preferences (McNamee et al., 2007). By doing this, the students and their learning preferences become the primary focus. The use of MI theory as a conceptual guide allows the instructor to primarily focus on the challenges of how a group of individuals learn and secondly use e-learning technology as a tool to creating a learning environment (Freund and Piotrowski, 2003). This approach can help to avoid the exclusive focus on technology that caused the hype cycle illustrated in figure 2.5.

This investigation uses the theory of MI to focus on the way a person learns in order to guide the use and application of technology. The flexible use of technology and content allows students to learn in a way that best suits their intelligence profile. In order to influence the way technology is used, the next section of the literature review

outlines the types of technology used to create a virtual class and the interactions that are facilitated.

2.4 Design Considerations for Virtual Classes

The development of the internet has heralded the beginning of a new online teaching and learning era. Online learning is now regarded as a future direction of innovation, offering a range of learning opportunities through an ever increasing number of advanced ICT systems (Chung and Shen, 2006 and Vrasidas et al., 2003). A virtual classroom has been defined as: *an online learning and teaching environment that facilitates the collaboration and integration of discussion forums, chat rooms, quiz management, lecture notes and assignment repositories, subscription services, relevant web links, email distribution lists and desk top video conferencing into a conventional lecture based system* (Chye Seng and Al-Hawamdeh, 2001) p238.

There are a number of terms that are associated with the description of virtual classes. They include e-learning, online learning, web-based learning, distance learning, network learning and technology enabled learning (Chye Seng and Al-Hawamdeh, 2001). The structure of a virtual class is illustrated by the structured definition of e-learning as identified by Romiszowsk (2004).

Table 2.4 Structured Definition of E-Learning

	INDIVIDUAL SELF STUDY Computer Based Instruction/Learning/Teaching	GROUP COLLABORATIVE Computer Mediated Communication
ONLINE STUDY Synchronous Communication (“REAL-TIME”)	Surfing the Internet, accessing websites to obtain information or to learn (knowledge or skill)	Chat rooms with(out) video Audio/Video conferencing
OFFLINE STUDY Asynchronous Communication (“FLEXI-TIME”)	Using stand-alone courseware / Downloading material from the Internet for later local study	Asynchronous communication by email, discussion lists or a Learning Management System

Source: taken from Romiszowski (2004, page 6)

Table 2.4 outlines the combination of individual and group activities that involve synchronous and asynchronous communication. Synchronous communication refers to real time interaction such as voice over internet protocol (VoIP), video conferencing and virtual white boards. Asynchronous communication refers to delayed interaction which takes place over a period of time such as email, forums and

wikis (Bower, 2007). It is suggested that a balanced use of both forms of communication is needed to achieve an effective virtual class (Davis and Wong, 2007 and Chye Seng and Al-Hawamdeh, 2001). Asynchronous and synchronous communication channels allow learners take part in a virtual class without time and location barriers (Shih et al., 2008).

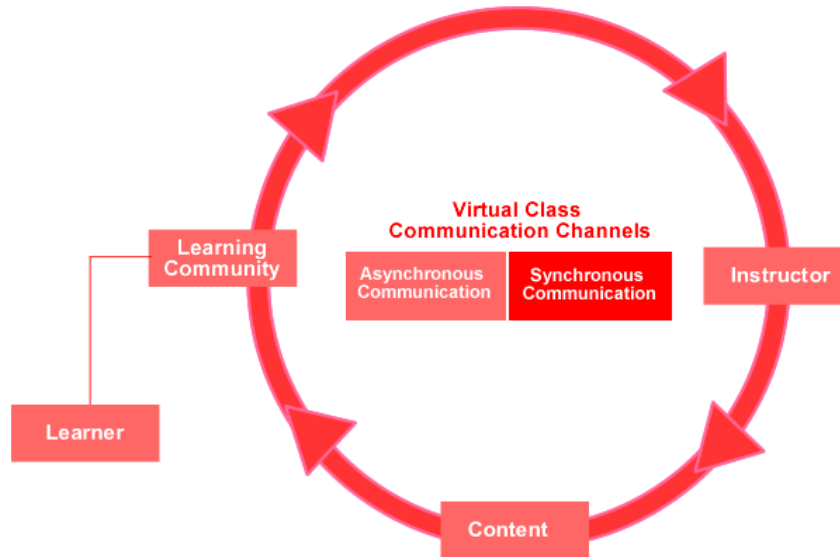
Due to the nature of the virtual class technology, the learning process allows for more self-paced activities that require self-motivation from the learner (Lohnes and Kinzer, 2007). This feature means the learning experience is quite different from a traditional classroom. The learner is given more control and flexibility in their learning process on one hand, but must take more responsibility on the other (Eom et al., 2006).

There is a body of research which has concentrated on the technological design of virtual classes. In recent times, research has started to focus on the aspects of content presentation and instruction techniques that can motivate learners individually and allow them to take advantage of the powerful learning features offered by virtual classes (Davis and Wong, 2007). Due to the scale and ease of access of available information on the internet, the focus of delivering a virtual class inevitably shifts from knowledge transmission (as in traditional classroom learning), to knowledge construction (Shariffudin et al., 2008). Due to the level of learner control and motivation used in virtual classes, the learning philosophy of social constructivism plays a large role (Mayer, 1999). In order to create this social constructivist learning environment, the virtual class technology must enable the synchronous and asynchronous communications to take place individually and within a group. These communications can aid learners in understand the class content, taking part in a learning community and ultimately constructing personalised knowledge (Cook and Crawford, 2008).

The technological delivery facets in e-learning are important elements, which enable the synchronous and asynchronous communications and allow learning interactions to take place (Dondera et al., 2008). The ability of the learning activities and technology to support each other is the most important aspect of an e-learning system (Fisher and Baird, 2005). Figure 2.6 is an illustration of the asynchronous and synchronous

communication channels being used to support the interactions between the instructor, the learning community and the class content.

Figure 2.6 An Illustration of the E-Learning Framework



Source: Carney et al. (2008)

The following section explores the key aspects of the e-learning framework and identifies the key requirements for the elements shown in figure 2.6.

2.5 The Selection of E-Learning Software

The selection of software systems are an important decision for educators in using technology in education. There are a range of products available on the market covering a whole spectrum of asynchronous and synchronous communication channels. The role of asynchronous communication can be covered by a learning management system (LMS) which is generally a server loaded application (Koochang and Harman, 2006). The synchronous communication can be handled by a dedicated web meeting system to allow students to communicate in real time (Bower, 2007). The following section looks at some of the software systems available for educational purposes.

2.5.1 The Asynchronous Environment

Asynchronous communication has been defined as collaboration opportunities and structures such as discussion threads, email, forums, the sharing of a range of documents, links, articles and other files supportive of online activities (Chung and Shen, 2006). The system which can serve as the back bone for the asynchronous activities is called an LMS. The basic features of an LMS is to provide an easy to use and stable system that gives the ability to; deliver class content, track participants' performance and provides tools for student collaboration (Alshawi et al., 2006).

A range of LMSs are available with the leading systems being Moodle and WebCT (Cole and Foster, 2007). Moodle is an open source LMS with over 28 million users world wide (source: www.moodle.org assessed February 2009 and Cole and Foster, 2007). The guiding philosophy of Moodle includes a constructivist and social constructionist approach to education, by using features such as forums and wikis to encourage student contributions (Thompson, 2007). Social constructivism allows students to learn through the management of their own learning process and interaction with the instructor and other students (Cole and Foster, 2007). The main LMSs used throughout the field of education have a range of technological tools that foster social constructivism such as discussion threads, synchronous and asynchronous chat, wikis and blog tools (Kelly et al., 2007). In the case of this investigation, in order to allow synchronous communications, a web meeting system was used. The web meeting system provided the synchronous interaction that was not available on the Moodle LMS.

2.5.2 The Synchronous Environment

Synchronous communication systems for education have been defined as presentation facilities that are able to deliver a broadcast to remote learners with multimedia features. These features include audio, still images, video, public and private texting, interactions such as polling and surveys, instant collaboration, sharable facilities, an archiving capacity and general attendee management (Chung and Shen, 2006). Web meeting systems allow for real time interactions to take place online. Real time interactions are a powerful tool in maintaining students motivation and creating a social learning experience (Bower, 2007). Selecting a web meeting system for the synchronous environment presents a number of issues and challenges. The operation

of a web meeting system involves the transfer of large amounts of information and the bandwidth requirements mean the systems are expensive to use and require a high quality internet connection (Wexler, 2007). Table 2.5 provides a comparison of some of the web meeting systems available.

Table 2.5 A Comparison of Web Meeting System Features

	Audio Support	Video Support	Chat Support	Desktop Sharing Support	Upload PPT	Upload PDF	Open Source
Adobe Acrobat Connect	Yes	Yes	Yes	Yes	Yes	Yes	No
Illuminate Live	Yes	Yes	Yes	Yes	Yes	Yes	No
WebEx	Yes	Yes	Yes	Yes	Yes	Yes	No
Microsoft Live Meeting	Yes	Yes	Yes	Yes	Yes	Yes	No
Dim Dim	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Wexler, (2007)

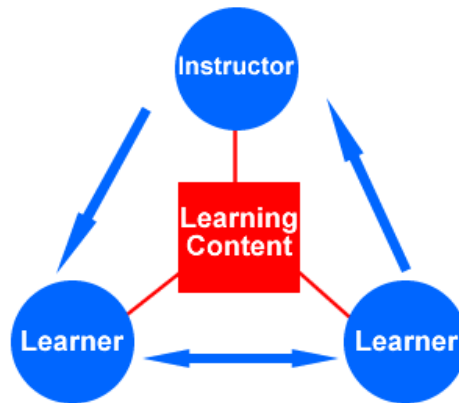
As shown in table 2.5 the web meeting systems feature a range of communication features including audio, video and chat. The systems also allow for the sharing of users desktops as well as PDF and PPT files for group viewing. In order to create a learning environment, an important aspect of e-learning systems is the interaction which take place between the class participants (Mustaro and Silveira, 2006). What tends to characterise successful learning communities is a shared commitment for a particular practice, that creates an interactional network that enables and promotes knowledge sharing and student involvement (Wenger, 2004). Regardless of the technological systems used to achieve a virtual class, the learning interactions which take place through those systems are of key importance.

2.6 The Virtual Class Interactions

The basic goals of education are deceptively simple. They usually involve the retention, understanding and active use of knowledge and skills (Duffy and Jonassen, 1992). These simple sounding aspirations are present in every learning experience and require complex and dynamic interactions over a period of time. For this reason, once the key software of a virtual class is usable and stable, however simple or complicated it may be, the focus immediately shifts to its ability to support the interaction required for a learning experience (Bower, 2007). Briggs (1999) argues that the three primary

types of interaction are: learner – content interaction, learner – instructor interaction and learner – learner interaction. These interactions are a key part of any virtual class as they facilitate peer interactions, collaborative learning and peer review (Davis and Wong, 2007). The relationship between these three types of interactions are illustrated below in figure 2.7.

Figure 2.7 Three Types of Primary Interaction



Source: (Carney et al., 2008)

2.6.1 Virtual Classes Learning Community

One of the key parts of a virtual class is its ability to create and sustain a learning community. The social aspect to education is a most important one and can be used by the instructor in the transfer of skills and information (Palloff and Pratt, 2005). Given the nature of virtual classes, in that the participants are geographically separated from each other, active learning communities can be beneficial in sustaining participants' self motivation (Palloff and Pratt, 2005).

An idea that has gained acceptance in e-learning is the one that focuses on building communities of practice for the purpose of learning (Stough et al., 2000). The social interaction between the members of the community allows the pursuit of shared goals and ideals. In the act of pursuing these goals and ideals, members construct knowledge and form social relationships (Wenger, 2004). The online tools to create these types of communities are readily available but the main issue is that they are used to create and sustain relationships over a period of time (Hung et al., 2006). Wenger (2004) proposed three fundamental characteristics of communities of practice:

- **Domain:** the area of knowledge which brings the community together gives it its identity and defines the key issues that members need to address. A community of practice is not just a personal network: it is about something. In a learning context, the domain is not simply defined by simple tasks, it is an area of knowledge that needs to be explored and developed by the whole group.
- **Community:** the group of people for whom the domain is relevant, the quality of the relationships amongst the members and the definition of the boundary between insider and outsider. A community of practice can take place through any technological medium which allows people to interact and develop relationships that enable them to address issues and solve problems.
- **Practice:** the body of knowledge, methods, tools, stories, cases and documents which members share and develop together. A community of practice is not merely a community of interest. It brings together practitioners who are involved in doing something. Over time, they accumulate practical knowledge in their domain, which makes a difference to their ability to act individually and collectively.

One of the largest challenges with e-learning environments is creating the community aspect to the virtual class (Liu, 2005). By creating a community that requires active participation and contribution for the group of students the process of learning collaboration can develop through social relationships. Over time as the social relationships deepen, an established sense of identity and belonging can develop to form a highly effective learning environment (Fisher and Baird, 2005). The creation of a strong and inclusive learning community is an important step towards increased learner satisfaction, self-regulation and motivation.

Many aspects of general good teaching practice are directly transferable from traditional face-to-face teaching to virtual classes (Hawk and Shah, 2007). The way these practices are implemented can be different due to the mechanics of the virtual classroom environment (Bower, 2006). The use of virtual classes shifts the control from the instructor to the student. As a result, online students must be self motivated to take an active role in the online environment (Davis and Wong, 2007). As students

have a more active role in the learning process, the instructor needs to be consciously aware of their students' learning styles (Mustaro and Silveira, 2006). Being aware of the ways students learn, places the instructor in a position to make informed choices about course material, design, and learning processes which broaden the opportunities for effective learning (Hawk and Shah, 2007).

2.6.2 Role of the Instructor

A number of studies have pointed to interaction with the instructor as being linked to positive learner achievement and satisfaction in a virtual class (Hutchins, 2003 and Melrose and Bergeron, 2006). It is important that instructors encourage learners to contribute to discussions, take part in exercises, provide guidance and support and recognise individual contributions (Fisher and Baird, 2005). Due to the physical separation that takes place in a virtual class experience, it is key that the instructor supports learners in order to sustain and reward their motivation (Hogan and McKnight, 2007).

Tham and Werner (2005) have described the roles of online instructors as the wearing of different hats that involve technical, pedagogical and social roles;

1. The Technological Hat – Using the available technology to enhance student learning is not an easy task for instructors. Instructors must be prepared to understand the application of software and also the implications of technology for adopting different strategies in teaching.
2. The Pedagogical Hat – Creativity is needed to design a course that brings students 'nearer' in an online learning environment. In the invisible classroom, the tools / applications used to monitor or raise the intellectual skills of students require the educator to adopt the right tools and not simply use the tools that are available.
3. The Social Hat – The instructor has to establish some form of rapport with the students. In the online environment, the technological communication tools should be used to establish a friendly, cohesive, and comfortable e-learning environment. This is not easy, since non-verbal messages can not be detected through this medium. This hat plays a key part in providing opportunities to increase student learning and to ensure student motivation remains high.

The environment in which the instructor must perform these roles has been called 'the invisible classroom' as the social and physical communications need to take place using technological tools (Tham and Werner, 2005). Previous research studies have suggested that an interactive style and collaborative type activities are strongly associated with high levels of user satisfaction and learning outcomes (Eom et al., 2006). The instructor must strike a balance in providing the students with activities and projects which allow them to fulfil their dual identity as an individual and a member within a learning community. This balance creates a learning environment that encourages social motivation but also allows students to be in control of their own learning process (Fisher and Baird, 2005). While not all of the learning activities can be collaborative, a number of activities that encourage interaction can prevent a virtual class from becoming entirely passive. Instructor immediacy is defined as an affective expression of emotional closeness between the instructor and the student (Hutchins, 2003). Instructor immediacy is important to the development of any learning community as it is founded on the premise that people are drawn to people and things that they like and can feel part of (Melrose and Bergeron, 2006).

Presenting information in an online environment poses some challenges to the instructor in gaining and maintaining a relationship with a geographically separated group of students. Table 2.6 outlines Gagne's Events of Learning, which provide a number of sequential steps that can be used to guide the instructor in creating a learning environment (Madden, 2007).

Table 2.6 Gagnes Events of Learning

Event	Relation to Learning Process	Description
1 Gain attention	Reception of pattern of neural impulses	Appeal to the learner's interests. Create interest.
2 Inform learner of objective	Activation of a process of executive control	Tell the learner what he or she is going to be able to do.
3 Stimulate recall of learning	Retrieval of prior learning to working memory	Recall learned material that may need to be incorporated into the newly learned capability.
4 Present stimuli	Engagement of selective perception	Display or communicate the elements involved in the performance of the objective.
5 Guide learning	Semantic encoding and cueing	Provide hints, prompts, questions or dialogue that suggests a line of thought.
6 Elicit performance	Activation of response organisation	Get the learners to show that they know how to do the task, even if in limited circumstances or to a limited range.
7 Provide feedback	Reinforcement	Tell the learner about the degree of correctness of his or her performance.
8 Assess performance	Activation of retrieval; making reinforcement possible	Get the learners to show that they know how to do the task, through repetition of the performance (to ensure reliability) and under the same conditions (to ensure validity).
9 Enhance retention and transfer	Provision of cues and strategies for retrieval	Provide for practice opportunities over time that incorporates variety.

Source: (Gagne et al., 2004)

A major strength of virtual classes, is the ability to present content in a range of ways that can be browsed at the students' own pace (Benbunan-Fitch and Arbaugh, 2006). Content can be presented through web pages, videos, interactive learning objects, links to external web pages and podcasts. An effective way of presenting content and encouraging engagement is to build on asynchronous interaction such as class forums. Due to the large amount of information available through the internet, learners can personalise their learning through surfing the net. However this often leads to students taking a passive role within an online community (Modritscher, 2006). The use of learner involvement through the use of forums and web chats are important to encouraging learners to analyse the class content in a social context, creating a deeper learning environment.

The technologies that enable the asynchronous and synchronous communications required to create a learning environment are an important part of a virtual class. The

literature review has identified a number of software systems that can enable the communication needed to create a virtual class; these systems need to be stable and easy to use. This investigation used a combination of the Moodle LMS and DimDim web meeting system as the software systems which allow for interactions on both a group and individual level. The research focused on using these systems for the creation of a learning community through the role of the instructor in leading the class interactions. A number of previous studies on e-learning indicate that a strong community and leadership from the instructor are the single most important aspects of the successful operation of a virtual class (Eom et al., 2006 and Bower, 2007).

The literature suggests that the instructor plays a key role in facilitating the use of technology to present content and create an inclusive learning community. In order to evaluate the e-learning framework developed as part of this investigation, the focus will be on evaluating the instructor role in use of technology, presentation of content and facilitating a learning community from the students' perspective.

2.7 Multiple Intelligence and E-Learning

Traditional learning environments tend to focus on stimulating just two of the eight intelligences, logical mathematical and linguistic (Green and Tanner, 2005). This results in the creation of learning environments that are less engaging and stimulating for people strong in intelligence areas outside of logical mathematical and linguistic (Jordan, 2003). The difference with MI theory is that the personalisation of learning is achieved through engaging learners through their own abilities and preferences. Guild (2007) compared shared features of MI theory, learning styles and cognitive based learning in a paper entitled 'Where do the Learning Theories Overlap' and found that these theories are students centred and share a focus on higher level learning activities. The instructors' role is seen as a reflective practitioner and facilitator, with the learners becoming active partners in the learning process (Guild, 1997).

Online learning which is based on the MI theory has the potential to increase student motivation and commitment (Green and Tanner, 2005). The use of MI theory creates an inclusive learning environment through allowing students to become aware and use their own intelligence strengths; and not be marginalised by traditional ways of learning (McNamee et al., 2007). If a learner is not fully engaged in a traditional class,

they may lose focus for a few minutes and then return to the class (Chung and Shen, 2006). In an online environment once a learner feels marginalised, they generally leave and do something else, giving a far greater need for an inclusive learning environment (Hawk and Shah, 2007). The MI approach is compatible with many contemporary theorists who have argued that in order to achieve effective instruction; the learner should be profiled by learning need, learning style, intelligences and presentation preferences in order to allow content and individuals to be uniquely matched (Shariffudin et al., 2008). The online learning environment is an example of versatile technologies that could make it easier to personalise education (Gardner, 1983).

Students often struggle to carry out higher order learning activities within a group using e-learning technology (Barbera, 2004). The careful use of MI principles can add to the ability of students to personalise their learning, and achieve higher order learning within a learning community (McNamee et al., 2007). There are a number of ways to address the intelligences by using online technology. Table 2.7 outlines how the eight intelligences can be targeted using an e-learning environment.

Table 2.7 Ways of Using E-Learning to Target Multiple Intelligences

Intelligences	Ways in which intelligences can be targeted in an e-learning environment.
Logical / Mathematical	<ul style="list-style-type: none"> • Discussing percentages and statistical information with other learners • Analysis of a case study • Interviewing a subject matter expert to get the answer to a problem • Developing theories or conclusions based on facts in evidence
Interpersonal	<ul style="list-style-type: none"> • Creating small groups to allow for group discussion • Role-playing the same case study from several points of view • Analysis of case studies for motivations, conflict, feelings, or intent • Using verbal skills to build consensus or agreement
Visual / Spatial	<ul style="list-style-type: none"> • Illustrate key points with detailed graphics and visual effects in PowerPoint presentations • Watch a video that is relevant to the content of the class • Interpret and apply charts that summarize statistics • Use flow charts or maps to arrive at a solution or destination • Interpret visual metaphors that capture a key fact or concept • Share mind-mapping software or graphic organisers to understand a problem or collaborate on a solution • Design, draw on, modify and correct a diagram using a whiteboard and digital mark up tools
Intrapersonal	<ul style="list-style-type: none"> • Surveys that focus on how learners feel about a particular subject or fact • Role play that allows learners to share their own response to a particular scenario • Discussing how class participants have solved problems and learned in the past and how they apply that knowledge in the future • The use of discussion forums, wikis and blogs to share personal knowledge
Verbal / Linguistic	<ul style="list-style-type: none"> • Telling stories that illustrate a key learning point • Creating activities that involve reading and interpreting a written case study • Exchanging ideas and information with the instructor and class members using a web meeting system • Analysis of case studies • Activities that involve memorising key information and dates
Kinesthetic	<ul style="list-style-type: none"> • Provide the class with podcasts on the class content. Learners can download the podcasts and listen to them while jogging or driving. This allows learning to take place in a physical environment • Involve the learners in web conferencing that allows them to take an active role • Create activities that involve the learners collecting pictures and videos from a physical environment to share with the rest of the class
Musical	<ul style="list-style-type: none"> • The selection of a song to communicate the key points of a message • The use of sound effect to accentuate the key points of a presentation
Naturalistic	<ul style="list-style-type: none"> • Targeting naturalist intelligences is difficult in virtual class is difficult as the medium is limited to using a computer. Some elements can be incorporated however by asking learners to take pictures of items in a real life setting and posting them for discussion with the rest of the class

Source: Compiled from a number of sources (Green and Tanner, 2005 and McCoog, 2007 and Meacham, 2003)

The activities attached to MI are not all exclusive to a particular intelligence, but the combination of a range of activities can engage a group of people with different intelligence strengths. In an online environment it is often difficult for an instructor to gauge the dominant intelligences in the group of people they are instructing (Tham and Werner, 2005). Tham and Werner (2005) identify the understanding of the characteristics of the 'invisible student' as an important aspect of the online learning environment. Due to the physical distance between the participants some steps are required to gain a picture of the class in terms of their MI strengths and weakness. When designing and planning activities within an online environment, the use of a MI profiling system can be useful in determining the dominant intelligences in a particular group (Morris, 2002).

2.7.1 The Use of MI Profiling

MI profiling can be of particular value when assessing those who have reached a professional 'end state', and commonly utilise dominant intelligences necessary within their professional environment (Gardner, 1997). There are a range of MI profiling systems and questionnaires available, however many of these systems take a narrow and prescriptive approach to MI theory (Moon et al., 2005). As there is no definitive method to measure a person's exact intelligence profile, profiling systems offer guidelines for estimating a person's dominant intelligence areas (McKenzie, 2004).

One system which attempts to provide a practical, reliable and valid method of MI assessment is called Multiple Intelligence Development Assessment Scales (MIDAS). The MIDAS is one of the most widely used self reporting MI profiling tools (Freund and Piotrowski, 2003 and Moon et al., 2005 and Shearer, 2007). It has been commented on by Gardner (2006) and complemented for providing a method for an individual to gain a deeper understanding of their own MI profile (McNamee et al., 2007). The MIDAS has been subject too a number of studies of its reliability and validity and was found to offer a reasonable estimate of an individuals' MI strengths and weaknesses (Shearer, 2007 and Morris, 2008). The MIDAS is a self report measure of intellectual disposition which is made up of one hundred and nineteen multiple choice questions. As the MIDAS is not a test, the questions require students to assess their own intelligences based on their own abilities, interests, skills and

activities (Morris, 2008). As the MIDAS questionnaire can be delivered online and has the ability to give a detailed MI assessment to the individual student and an average MI profile for the whole group, it represents a valuable tool to using MI theory in an e-learning environment (McNamee et al., 2007). An objective of this investigation is to use a MI profiling system to sample a group of construction managers in order to determine their dominant intelligence areas. The dominant intelligence areas can be targeted in the design and operation of the e-learning framework that uses a construction industry context.

It is an important point that while the theory of MI represents a universal conceptualisation of intelligence, the actual use of the theory in education is dependent on the context of content, the students and the required learning outcome (McNamee et al., 2007). The use of multiple entry points for instruction is a dynamic process that requires the careful selection of realistic entry points that can lead to in-depth access to the content area (Dondera et al., 2008). Kornhaber (2004) carried out a study of the method used by teachers to use MI theory and multiple entry points in the classroom. Kornhaber (2004, p 234) outline this in the following quote: *It is important to strike a balance between always engaging a student through his or her strongest intelligences and tackling what's to be learned in a substantive way. The balance should be tilted to allow students strengths to be engaged substantively, rather than superficially, in the learning at hand.*

An engaging e-learning environment can be created by using learning activities that target the dominant intelligences of a group and uses realistic problems and scenarios as entry points (Shariffudin et al., 2008). In order to fulfil the objectives of this investigation the area of construction health and safety training was selected to form the focus for the virtual class content. The content focus provided an area that was relevant to the construction industry and to the available audience of students at WIT. The investigation is a blend of MI theory, e-learning technology and construction focused content. The MIDAS profiling system will be used to identify the dominant intelligence areas in a group of construction managers. The identified intelligence areas will be targeted using a virtual class that blends e-learning technology with content and relevant learning activities from table 2.6. The following section looks at the challenges of training within the construction industry.

2.8 The Irish Construction Industry

The Irish construction industry is large and is made up of a diverse spectrum of people. Projects are complex and clients look for increased performance in terms of project time frames and cost control. When the requirements of building regulations and health and safety legislation are added to this already complex and fragmented industry, it becomes clear new approaches to training need to be looked at to meet these challenges (Bennett and Foster, 2006 and Fadier and De la Garza, 2006).

The Egan Report (1998) entitled *Rethinking Construction* identified one of the key challenges in the construction industry as the training of staff, as the amount of training in the industry had reduced by half since the 1970s. When compared with other industries such as car manufacturing and offshore engineering, too few people were being trained to replace the aging skilled workforce and too few people were acquiring the skills required to make use of new techniques and technologies.

Ten years on from the Egan Report (1998), the Irish construction industry has undergone a unprecedented construction boom followed, by a sharp slow down in growth (FORFAS, 2008). A report entitled *A Review of the Employment and Skills Needs of the Construction Industry in Ireland* published in December 2008 indicates that many of the problems identified by Egan, in terms of training and development still exist in the Irish construction industry. This is the case after 10 years of unprecedented construction growth and investment within the construction sector. The crisis in regards to training and development within the sector needs to be addressed in a serious and systematic way (Chung and Shen, 2006).

One area of possible innovation is the potential offered by technology in providing training and continuous learning to the construction industry work force (Egan, 1998 and FORFAS, 2008 and Wall and Phillips, 2007). Egan (1998) expressed caution about the role of technology itself as being the answer to greater efficiency and quality in the sector, as many of the construction industry's problems are the result of deep rooted cultural and process related issues. Technology however, can provide a supporting role to improvements made throughout the industry. This is particularly true as the Irish construction industry faces a large drop in profits as well as the need

for innovation and change in a competitive and harsh economic environment (FORFAS, 2008). A technological innovation which would address the training needs in the industry would be the use of web based technologies to deliver training. In a report entitled *The Egan Review; Skills for Sustainable Communities* published in 2004, Egan recommends an increase in continuous professional development (CPD) as well as an increase in the sharing of information and ideas among professional groups through an online knowledge management system. The role of integrating technology into the delivery of training and CPD can play a part in overcoming some of the challenges to the construction sector (Wall and Ahmed, 2008). The focus of this investigation in using ICT within the context of the construction industry is an important area of innovation and is a key tool in meeting the industries challenges. One of the key challenges facing the construction sector is its health and safety record. The following section outlines the key aspects of health and safety training in the Irish construction industry.

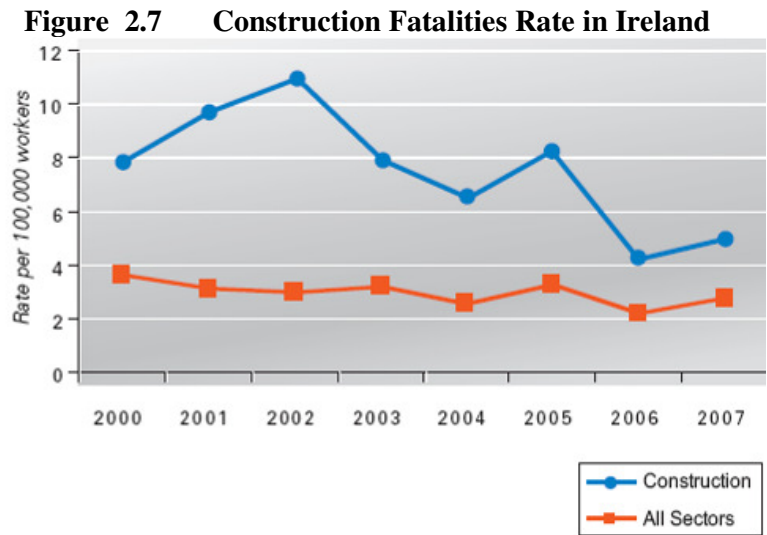
2.9 Health and Safety in the Construction Industry

One of the key issues identified by the Egan Review (1998) was the poor health and safety record of the industry. The review observed that most accidents seem to happen when people are poorly trained. Construction sites can be busy places with a constantly changing work environment, resulting in the need to continuously manage risk (Lin and Mills, 2001). Due to the pressures of time and resources, high risk activities are often addressed first, while lower risk activities are given less attention. Unfortunately the majority of construction accidents occur as a result of these low risk routine hazards and activities (Hare et al., 2006).

In order to improve health and safety in the construction industry, it is important to have an understanding of the industry's culture. Suraji et al. (2006), specifically describes that the culture of the industry as a macho and authoritarian one. The industry abounds with conflicts of interests due to different views and objectives among the parties involved (Suraji et al., 2006). One of the key initiatives that can make a positive impact on health and safety statistics is education. It is clear that the industry is in need of not only increased training, but relevant and specific training

that reaches to all those involved in the construction process, from the front line operatives to the high level strategic decision makers (Fadier and De la Garza, 2006).

One of the challenges in attempting to increase health and safety training under its current model, is that it becomes another operational cost for those who work on the front line such as building contractors and subcontractors (Suraji et al., 2006). In order to see a real change in the health and safety record, health and safety must be a primary concern all the way to the top of the construction industry and include stakeholders such as clients and end users. A key expression of that primary concern would be a comprehensive health and safety training program that would involve all the parties in the construction process and be tailored to meet the roles and responsibilities of all involved (Lin and Mills, 2001). Instead of being seen as an additional burden, health and safety responsibilities should be seen as an opportunity to innovate and change (Suraji et al., 2006). A construction company who can control their health and safety record is in a good position to compete in an increasingly dynamic and competitive economy (Baiden et al., 2006). The Irish construction industry experiences a high level of accidents and fatalities in the workplace. Figure 2.7 compares the average rate of worker fatality in the construction sector in Ireland with all other sectors. While the rate of fatalities per 100,000 workers has decreased from 2000 – 2007, the construction sector still has a relatively high worker fatality rate (HSA, 2008).



Source: HSA, (2008)

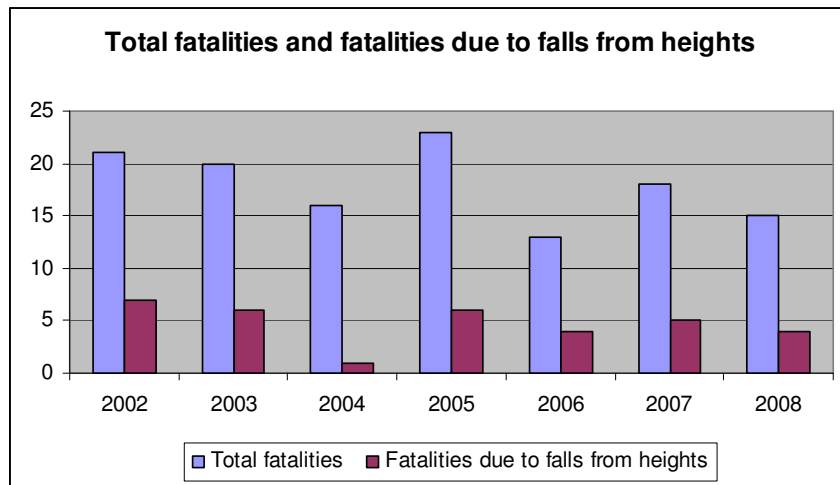
One of the key barriers to ongoing training is the ever changing workplace that construction workers operate in. Making health and safety the top priority makes sense from a legislative and moral stand point as well as making good business sense (Brabazon et al., 2000). The use of flexible technology which can develop and sustain training programs regardless of an employee's work location has the potential to change the construction industry's use of employee training and development (Hare et al., 2006). The Irish construction industry is highly fragmented with a majority of small companies employing less than fifty people. According to CSO figures in 2006, 70% of construction companies had less than fifty employees. It is difficult for such small companies to provide off the job training due to the high cost and disruptive effect on their business (FORFAS, 2008).

An example of mandatory health and safety training of everybody who works on a construction site in Ireland is the Safe Pass Health and Safety Awareness Training Programme (FORFAS, 2008). The Safe Pass system is designed to provide workers on a construction site with the basic knowledge of health and safety, and enable them to work on-site without being a risk to themselves or others (source: www.fas.ie accessed February 2009). The course is one day in duration and must be completed every four years in order for the certification to remain valid. One of the key areas covered by the safe pass course is the area of falls from height on construction sites. This is due to the fact that the largest cause of injury and death on Irish construction sites are falls from heights (HSA, 2008).

2.10 Falls from Height

Due to the complex and temporary nature of the construction process there is a large range of activities that can result in a fall (Chia-Fen Chia, 2005). Figure 2.8 presents the total number of fatalities in the construction industry in Ireland each year since 2002 to 2008 with the proportion of fatalities resulting from falls from heights alone. While there is a lower level of fatalities in 2004, over the seven year period falls from height make up a significant proportion of total construction industry fatalities.

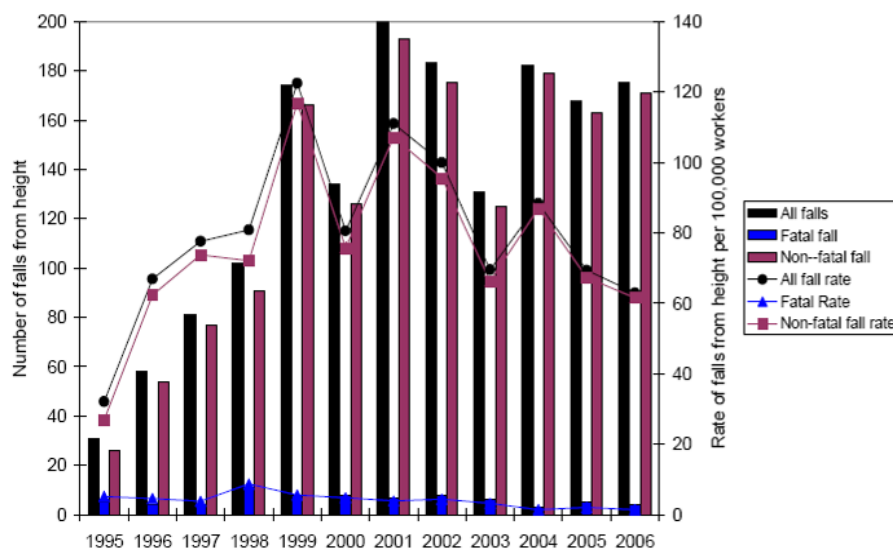
Figure 2.8 Total Fatalities Verses Fatalities Due to Falls From Heights.



Source: compiled from www.hsa.ie accessed February 2009.

Figure 2.9 compares the rates of non-fatal falls from height and fatal falls from height in the Irish construction industry from 1995 to 2006. The results clearly show a large amount of non-fatal falls in comparison to the fatal falls. A significant reduction in total falls from height in the construction industry would have a significant impact on the number of fatalities in the industry.

Figure 2.9 Rates of Non-Fatal and Fatal Falls from Heights.



Source: (HSA, 2007)

The statistics in figures 2.8 and 2.9 demonstrate the number of fatalities that take place on Irish construction sites every year and illustrates that significant proportion of fatalities that are caused by falls from height. An innovative health and safety course that targets falls from height could have a large impact on the amount of fatalities and injuries that take place on Irish construction sites.

2.11 Summary

The literature review has identified the potential for MI theory to improve students learning experience with e-learning. The increased availability of information has changed the way society approaches education. The focus of education has shifted to how students analyse information and communicate with others. These activities correlate with the higher level learning activities identified on Blooms Taxonomy. The performance of higher level activities, especially through collaboration with others, remains a challenge for educators using e-learning technology. The theory of MI is a conceptualisation of intelligence which sees intelligence as tools people use to solve problems and tasks rather than a purely measurable ability. By facilitating an individuals intelligence areas, within an e-learning environment, students can take part in that environment using their strongest abilities.

The definition of e-learning outlined in the literature involved a blend of synchronous and asynchronous communications which could be completed both individually and as a group. The features required from the synchronous and asynchronous technologies are explored and the interactions necessary for a virtual class are outlined. The challenge for the instructor is to present the class content using the asynchronous and synchronous technology in a way that made sense to the students and facilitated the development of a learning community.

The adoption of MI theory to an e-learning environment involves a number of steps. The eight intelligences identified by Gardner are presented and examples of learning activities are given. In order to identify the dominant intelligences in a target group of learners a MI profiling questionnaire can be used. A number of MI profiling systems have been discussed and the MIDAS system has been identified as the most suitable for identifying dominant intelligence areas in a target audience. With a MI approach the content can be presented using a number of perspectives on a key topic or concept.

Gardner (1993) calls this the use of multiple entry points. By using as many of the entry points as is suitable to the class content, students can achieve a fuller understanding of a concept.

The literature review identified health and safety training as an area suitable of the application of e-learning within the Irish construction industry. The construction industry is a sector which is in need of flexible and cost effective training solutions. The use of e-learning technology has potential to address the sectors culturally fragmented and geographically separated work force. The topic of health and safety is of particular concern. The industry has the largest proportion of accidents and fatalities compared to all other industries. The level of accidents and fatalities is of legal, financial and moral concern to the industry. Since 2002 to 2008 the largest single cause of accident and death on construction sites has been falls from height. The requirements for health and safety training require the issue to become a larger part of the way business is done in the construction industry. An innovative approach could involve the use of e-learning tools in addressing this challenge. The need of behaviour changing results means that training must involve the higher level learning objectives identified by Blooms taxonomy being achieved using e-learning systems. The diverse nature of the workforce in the construction industry suggests that MI theory would add to the effectiveness of the blend of training and technology. The research methodology in chapter three outlines the research design and methodology required to fulfil the aims and objectives set out in the introduction.

Chapter Three: Research Methodology

The literature review has outlined some of the aspects of MI theory, e-learning and health and safety in the construction industry. The aim of this investigation is to create an e-learning framework which incorporates MI theory and pilot the framework by delivering health and safety training to construction students. This chapter outlines the philosophical and methodological approach used to achieve the aim and objectives of this investigation through the design, implementation and evaluation of the e-learning framework.

In order to achieve the aim and objectives of the investigation there is a requirement for the use of a flexibly designed methodology. The purpose of this chapter is to describe the interrelationships between philosophy, methodology and method. To achieve this, the methodology will look at the philosophical position of the research, the methodology adopted and the methods employed in the context of the subject under investigation. According to Denscombe (2002, p8) in order to qualify as social research an investigation needs to; *Have clearly stated aims that are related to existing knowledge and needs and are investigated within limitations imposed through time, money and opportunity.*

All research is required to contribute something new to knowledge using precise and valid data that is collected and used in a justifiable way, to produce findings from which generalisations can be made (McNeill and Chapman, 2005). This chapter looks at the methodology adopted and methods employed in the context of the subject of using e-learning and MI learning principles

As this research involves the use of virtual classes to deliver content to construction managers, it is important to select a research method which is appropriate to this environment. The research covers areas of education and the use of technology and could be described as social research. There are three major research types identified in the Handbook of Research for Educational Communication and Technology (Jonassen, 1996). They are;

1. Experimental research, which typically involves an experimental group and a control group to test hypotheses regarding certain treatments.
2. Descriptive research, which gathers data from events or participants responses to describe, explain, and validate or explore a particular issue.

3. Developmental research, which systematically studies design, development, and evaluation processes of certain educational interventions.

In terms of the three research approaches, as this research involves developing and refining an e-learning framework, the investigation falls under the area of developmental research. In a paper entitled '*Research and Trends in the Field of E-Learning from 2001 - 2005: A Content Analysis of Cognitive Studies in Selected Journals*', Shih et al. (2008) analysed 444 papers written on cognition in e-learning from 2001 - 2005. The paper highlighted a dilemma for research on e-learning technology. The dilemma was the relationship between internal validity – the control of variables to allow for the creation of a functioning e-learning case study and external validity – the ability to generalise findings to real life settings (Shih et al., 2008).

The challenge from a methodological point of view for this investigation is to use a research method which allows the flexibility required to create a functioning virtual class. The virtual class must be improved over time through an evaluation process and produce results which cast light on the use of MI theory in an e-learning environment. In order to select a suitable research methodology for the investigation it is important to first look at the nature of research and the role of research paradigms.

3.1 The Nature of Research

Research is typically viewed as a systematic investigation, the result of these efforts is the creation of knowledge and involves the following points (McNeill and Chapman, 2005);

1. A quest for knowledge and understanding
2. A means of generating, testing and validating knowledge
3. Advancing knowledge and understanding.

The basis of the research process is to answer a research question by provoking suitable evidence supported by appropriate arguments. The model of research can be referred to as research paradigm. A research paradigm is a theoretical framework which includes a system by which people view events (De Villiers, 2005). Denzin and Lincoln (2005) define a research paradigm as the basic belief system or world view

that guides the investigator. There are two principle research paradigms termed positivism and interpretivism. The positivist paradigm views knowledge as absolute and objective and that a single objective reality exists external to human beings (Robson, 2005). Positivist methods originate in the natural sciences, but can be applied in social sciences (De Villiers, 2005). Interpretivism by contrast seeks to find new interpretations by viewing knowledge as being made up of multiple realities which are time and context dependant. Interpretive research originated in the social sciences and is widely used in educational research (De Villiers, 2005).

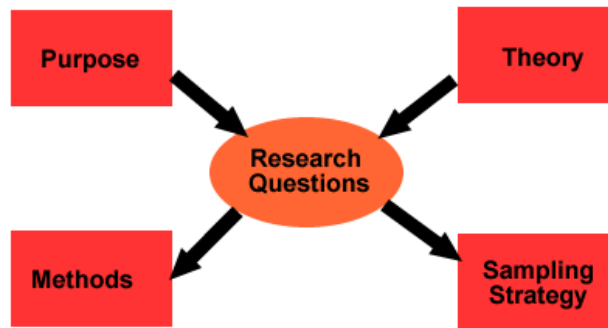
These two distinct paradigms hold contrasting views on the definition of knowledge and have been the subject of long standing debate in science, with positivism aligning with quantitative methods and interpretivism aligning with qualitative methods (Denzin and Lincoln, 2005). In selecting a research paradigm for researching in an e-learning environment, the focus should be seeing the e-learning system as a facilitator of learning, as opposed to simply a delivery mechanism of education (Gibbs and Gosper, 2006). This means the area of research within e-learning tends falls more into the area of interperitivism, as the focus is on understanding human behaviour rather than simply explaining it (De Villiers, 2005).

3.2 Research Methodology

Research methodology, “*occupies a middle ground between discussions of method and discussion of issues in the philosophy of social science.*” (Schwandt, 1994 p161)

Robson (2005) illustrates research methodology as a framework for research design which uses research questions to link the investigations purpose and theory with method and sampling strategy. This is illustrated in figure 3.1.

Figure 3.1 Framework for Research Design

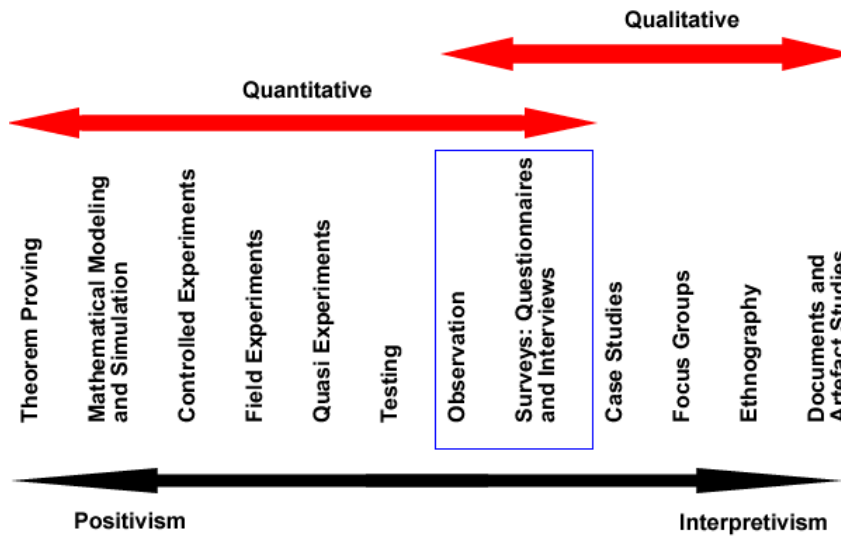


Source: Robson (2005)

One of the most important considerations of an investigation relates to the methods used to sample and analysis the gathered information (McNeill and Chapman, 2005). In broad terms the two main research methods used to gather information are quantitative and qualitative. Fellows and Liu (2003) suggest that quantitative approaches adopt scientific method in which an initial study of literature and theory yields precise aims and objectives with a hypothesis to be tested. In qualitative research an exploration of the subject is undertaken first; with the goal being to gain an understanding and collect information as data to allow theories to emerge (Fellows and Liu, 2003).

While qualitative and quantitative data collection methods can be used together in the same study, Robson (2005) suggests that qualitative focused methods can be called flexible research designs and quantitative focused methods can be called fixed research designs. Robson (2005) recommends a fixed design strategy when it is possible to use to rigid data collection design which can be finalised before data collection takes place. If this is not possible, a flexible design can be used which evolves during the data collection process. Figure 3.2 illustrates the overlap of quantitative and qualitative research methods and how some examples of these research methods align with positivist and interpretivist research paradigms. A range of different research designs are also shown to illustrate how the two research paradigms and data collection methods interact.

Figure 3.2 Research Methods and Strategies



Source: De Villiers (2005)

The investigation requires a data collection method which can evolve with the design of the e-learning framework. A suitable methodology would be a flexible research design which uses qualitative data collection methods. There are a number of approaches to qualitative data collection in the area of social science. Three of the main approaches in flexible research design are outlined in table 3.3.

Table 3.3 Comparing Research Traditions in Qualitative Research.

	Grounded Theory	Ethnography	Case Study
Focus	Developing a theory grounded in data from the field.	Describing and interpreting a culture or social group	Developing an in-depth analysis of a single case or multiple cases
Discipline Origin	Sociology	Cultural anthropology, sociology	Political science, sociology, evaluation, urban studies, many other social sciences
Data Collection	Typically interviews with 20-30 individuals to 'saturate' categories and detail a theory	Primarily observations and interviews during extended time in the field.	Multiple sources – documents archival records, interviews, observations, physical artefacts
Data Analysis	Open coding, axial coding, selective coding, conditional matrix	Description, analysis, interpretation	Description, themes, assertions
Narrative Form	Theory or theoretical model	Description of the cultural behaviour of the group	In-depth study of a 'case' or 'cases'

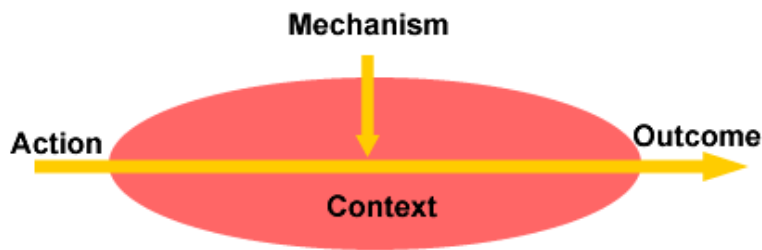
Source: Robson (2005)

Table 3.3 compares the research traditions of three common qualitative research traditions outlined by Robson (2005). Grounded Theory, Ethnography and Case Studies are all widely used in the area of Social Science. An ethnographic approach involves a detailed descriptive analysis and interpretation of a culture-sharing group. Typically an Ethnography Study could take place over a long period of time with the researcher being fully immersed in lives of the social group being observed (Hollway and Jefferson, 2007).

A Grounded Theory study seeks to generate a theory which relates to the particular situation forming the focus of the study. This theory is ‘grounded’ in data obtained from the actions, interactions and process of the people which have been observed. (Robson, 2005). A Case Study is a research strategy which focuses on a case in its own right, taking the context into account (Yin, 2002). Case study design can be used in different situations to contribute to the knowledge of individual, group, organisational, social, political and related phenomena (Wall et al., 2007).

As this investigation is based on creating an e-learning framework which can be run through iterative cycles, a qualitative design that would allow for analysis of that framework would be the case study design. One of the methods recommended for the application of e-learning using an interpretivist paradigm is action research (De Villiers, 2005). By using the e-learning framework as the case study, the iterative process of evaluation can be used to refine and develop the framework. The use of a case study with an action research refinement process allows the research methodology to be produce rigorous as well as practical results. Figure 3.3 illustrates the key parts to an output orientated research methodology.

Figure 3.3 Illustration of the Research Case Study



Source: Hart (2006)

In the case of this investigation a case study approach can be used to create an e-learning framework which uses student evaluation to improve the framework's design and operation. The use of an action agenda within a research investigation is common in areas of educational research (Robson, 2005). The action research approach allows for an action and a mechanism to take place within the case study context which will lead to an outcome, this is illustrated in figure 3.3. Action research provides a method to solve current practice problems while expanding scientific knowledge (Baskerville and Myers, 2004). The unique feature of action research is the emphasis placed on changing or influencing an aspect of the research focus. Action research has been described as the process of; firstly the improvement of a practice of some kind; secondly the improvement of the understanding of a practice by its practitioners; and thirdly, the improvement of the situation in which the practice takes place (Robson, 2005). The underlying philosophy is one of pragmatism, a process that concentrates on asking the right questions and then getting empirical answers to those questions (Baskerville and Myers, 2004). Action research is an iterative process involving researchers as practitioners acting together in a particular cycle of activities including; problematic diagnostics, action interventions, and reflective learning (Farrimond et al., 2006). The criteria for action research as a research method is outlined in the following section.

3.3 The Selection of Action Research as a Research Method

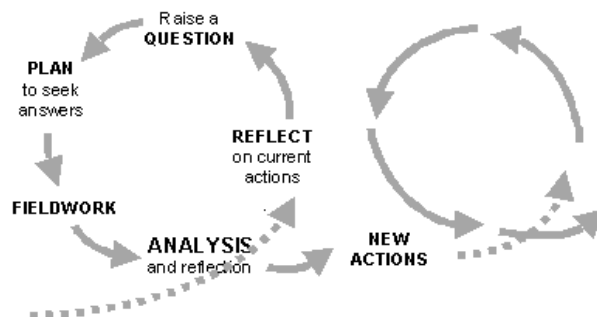
Action research has been described as “*..the practical application of the scientific method or other form of disciplined inquiry to the process of dealing with everyday problems*” (Vockell and Asher, 1995 p445)

Action research has been accepted as a valid research method in applied research fields such as organisational development and education (Somekh, 2006). It has been described as the touchstone of most good organizational development practice and remains the primary methodology for the practice of organisational development (Baskerville and Myers, 2004).

Action research was first conceived in the 1940s by Kurt Lewin, who was seeking to draw together the theory and practice of social change (Farrimond et al., 2006). Since its initial introduction, action research has been recognised as a viable qualitative methodology that can be used in many disciplines. It is particularly appropriate for research involving instructional design and technology in education, since it is a reflective process of progressive problem solving (Denzin and Lincoln, 2005). It is uniquely appropriate as it can be used to conduct research within the learning communities developed through virtual classes.

Action research allows for collected data to be used immediately, problems that are identified through the data collection process can be analysed and alternative actions can be developed and tested (Figl et al., 2005). One of the reasons action research is popular in educational research is that it allows for a methodology which can deal with the complex and dynamic nature of real world situations (Avison et al., 1999). In action research, the researcher wants to try out a theory with practitioners in real life situations, gain feedback from this experience, modified theory as a result of this feedback and try it again (Baskerville and Myers, 2004). Action research can be seen as a two stage process. The first stage is a diagnostic stage which involves collaborative analysis of the research focus by the researcher. The second stage is the therapeutic stage which involves collaborative change. In this stage, change can be introduced and the effects studied (Baskerville and Myers, 2004). These iterative cycles are illustrated in figure 3.4.

Figure 3.4 The Cycles of Action Research



Source: (Wall et al., 2007)

Action research has been identified by Somekh (2006) as being a research method well suited to the use of innovative ICT in education. The flexible and developmental nature of action research allows researchers to identify and overcome barriers and build on unique knowledge and situations (Vockell and Asher, 1995). As action research is flexible in nature, it is important to have an established quality criteria in order for the results to be meaningful.

3.4 Quality Criteria for Action Research.

Quality, goodness, validity, trustworthiness, credibility and workability have all been suggested as terms to describe good action research (Herr and Anderson, 2005). The key feature of action research is its action-oriented outcomes. Action researchers, like all researchers are not only interested in whether knowledge generated from the research is valid and trust-worthy, but they are also interested in outcomes that go beyond knowledge generation (Herr and Anderson, 2005 and Coghlan and Brannick, 2005). One of the tests of the validity of this type of research is the extent to which action occurs, which then leads to a resolution of the problems that led to the study. This practical outcome based focus means that action researchers must be competent at both research methods and solving the problems outlined in the study (Herr and Anderson, 2005). The quality of good action research is a balance between the quality of action which emerges from and the quality of data on which the action was based.

Rigorous action research rather than simply solving a problem, forces the researcher to reframe the problem in a more complex way, often leading to a new set of questions (Herr and Anderson, 2005). This ongoing reframing of problems leads to a spiralling process over a period of time (Coghlan and Brannick, 2005). The ability for action research results to be transferred to other settings is often referred to as external validity or transferability (Somekh, 2006). As action research is primarily concerned with solving real world problems as opposed to simply producing results, the burden of proof with transferability lies less with the action researcher and more with the person wanting to transfer the results (Herr and Anderson, 2005). By ensuring that the results are an accurate reflection of the research context, a person seeking to transfer those results could use empirical evidence to compare the contextual similarity (Cook and Crawford, 2008). In this situation the responsibility of the action researcher is to

provide enough descriptive data about the research context to allow comparisons to take place (Coghlan and Brannick, 2005).

In order to ensure the quality of outputs from this action research investigation, the methodology must focus on combining the creation of a functioning virtual class and the accurate and careful recording of the case study process. The use of potentially unstable technology and the involvement of varying groups of people, means flexibility is required in ensuring the virtual classes functions. The following section outlines how that flexibility is matched with data collection to ensure the investigation can produce valid outputs.

3.5 Research Methodology Applied

The research methodology used to conduct the investigation sought to sample a target group of construction managers using the MIDAS questionnaire to identify a number of dominant intelligences. The dominant intelligences were used to design the content of the virtual classes and give the instructional focus. Once the virtual classes were designed they were delivered to students at WIT with as much interaction and student involvement as possible. A student satisfaction evaluation and an interactivity matrix were used to measure the operation of the virtual classes. The investigation sought to use MI theory in two ways, firstly to use MI profiling to guide the overall focus of the class content and secondly to use MI principles to encourage student interaction and engagement.

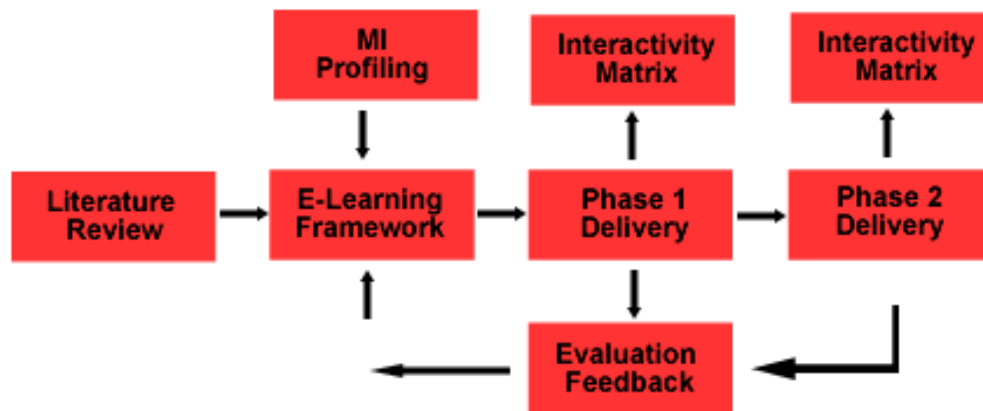
In order to create the e-learning framework used for the investigation, a combination of an open source LMS called Moodle and a web meeting system called DimDim were used. The combination of Moodle and DimDim provided the synchronous and asynchronous communications identified in the literature review as necessary for an e-learning environment. In order to create the action research methodology the following questions were used;

1. What are the dominant MI areas in a sample group of construction managers?
2. How did the students evaluate the use of the synchronous and asynchronous features of DimDim and Moodle that were used throughout the classes?

3. How did students evaluate the pace and level of interaction with the instructor?
4. How did students engage with the way content was presented on the class LMS?
5. How did the students engage with the learning community created through the e-learning framework?
6. What was the quantity and type of class interactions created during the use of DimDim?

These research questions were answered through the e-learning framework and the iterative cycles as illustrated in figure 3.5. This figure illustrates how the MI profiling was used to identify the dominant intelligence areas for the e-learning framework and how a combination of student evaluation and the interactivity matrix results were used to refine the framework through iterative cycles.

Figure 3.5 An Illustration of the Investigations Methodology



3.5.1 MI Profiling

The MI profiling was carried out using a sample group of forty construction managers from the partner countries involved in the Socrates Minerva project. There were

respondents from a range of professions related to the construction industry from Ireland, the UK and Turkey. This profiling questionnaire gave an average MI profile for the group of construction managers. The average MI profile was used to design the content for the virtual class framework and influence the instructor's role in leading the virtual class. As outlined in the literature review the MIDAS is a self completed MI profiling system which gives an indication of MI strengths and weakness. The results of the MIDAS profiling are analysed and discussed in chapter four.

3.5.2 Virtual Class Delivery

The virtual classes were delivered in two phases at WIT. The first phase was carried out with undergraduate construction management students as part of their health and safety course work. The second phase was carried out with a group of part time masters students who were enrolled on a masters program in construction project management. Each of the web meetings sessions were recorded as archived classes. The archived material was reviewed and the class interactions were analysed through an interactivity matrix which allowed the type and quantity of class interactions to be compared. The interactivity matrix detailed the class by recording; the title, the presenter, the amount of students, the date, the duration of the class and the number of slides presented. The class interactions were then divided into group wide and individual categories. The group wide responses were simple text replies and use of the thumbs up indicators. The individual responses were separated into public text chat and speaking. Taking the class details such as class sizes, duration and number of slides and comparing them to the class interactions allowed ratios to be given for the average amount of time given between interactions and the average amount of interactions per student. A high level of interactivity was one of the key aspects identified in the literature review as facilitating the creation of a learning community. The interactivity matrix measured the level on interaction and allowed comparison between phases one and two. The description of the case study is presented in chapter five and the results from the interactivity matrix for each virtual class delivered are presented in chapter six.

3.5.3 Evaluation

An evaluation questionnaire was designed to gather the students' opinion on the virtual class in which they had participated. The evaluation questionnaire focused on

two areas as identified in the literature review. The students were asked to evaluate the role of the instructor in using the available technological features, as well as the presentation of content and the learning community within the virtual class. The evaluation used a Likert scale satisfaction rating system to gather data on the areas identified. The Likert scale is known as a summated rating approach which is suitable for gauging a person's opinion by asking them to rate a statement ranging from highly unfavourable to neutral to highly favourable (Robson, 2005). Students could also fill out a text box on each of the areas if they had a comment. An outline of the evaluation questions and the evaluation results are presented in chapter six.

3.5.4 Interpreting Data and Acting on Evidence

The evaluation data gathered from the first phase of the framework was used to redesign the second phase. The virtual classes run in the first phase were archived and the archived material was analysed in terms of the types and amount of interactions that went on during the class. This allowed the combining of the students' satisfaction levels with detailed aspects of the virtual class experience, particular comments made by the students and clear data on the type and quantity of interaction during the classes.

The evaluation questionnaire had a total sample size of 55 students over the two phases of virtual classes. The questions used a Likert scale or a yes / no option. The Likert scale asked students to rate a statement using five options ranging from strongly disagree to strongly agree. The results for each question were presented in a graph and the Likert questions produced a mean score that allowed comparison between the two phases of virtual classes. comparison between phases one and two. The interactivity matrix data was recorded based on observations of the recorded archived classes. A qualitative analysis process reviewed the Likert results from the evaluation questionnaire and combined them with the interactivity matrix results. The action research methodology allowed the small sample size and specialised focus of the investigation to produce practical results (Denscombe, 2002). By combining these sources of data, the use of technology and content presentation could be adjusted and the instructor's strategy could be redesigned. The changes made to the framework as a result of the evaluation results are outlined in chapter six.

3.6 Summary

The research methodology chapter is an alignment of the aim and objectives of this investigation with the research methodology that will guide the investigation. Due to the developmental nature of this investigation the research paradigm most suitable was an interpretivist one, and included research designs which involved the use of qualitative data collection and analysis. As the research methodology was designed with an action orientated outcome in mind, an action research design was used. The purpose of the methodology was to provide structure for an investigation on a virtual class prototype which had been designed based on a literature review and the MI profile of a group of construction industry managers. By delivering the virtual classes to a similar group of construction related students, the MI influenced design elements of the virtual class could be evaluated in terms of their effect on student satisfaction and interactions during the virtual class. Using a case study approach, the e-learning framework with action research cycles allowed the investigation to first create a virtual class that functioned properly and then allowed it to be observed and evaluated. This aspect of the methodology was of key importance as the nature of the technology used in the e-learning framework is in its early stages and requires flexibility in dealing with unexpected technical problems. Chapter four presents the MIDAS results and analysis which were used in identifying the defining features of the MI profile associated with construction managers. The results were then used in the design and implementation of the e-learning framework.

Chapter Four: MIDAS

Chapter Two identified the need for an instructor to be aware of the dominant intelligence areas in their student group when using MI theory in an educational setting. This chapter contains the presentation and analysis of the MI profiling results which were gathered from a group of forty construction managers. The MI profiling system used was called MIDAS. MIDAS stands for Multiple Intelligence Developmental Assessment Scales; it is an online measurement tool which provides an effective method for obtaining a descriptive understanding of a persons' MI profile. The MIDAS questionnaire is a research based, self-reported measure of intellectual disposition for a diverse group of people. The individual MI profiles are built up by the participants completing an online questionnaire containing one hundred and nineteen questions which takes approximately 30 minutes to complete. The MIDAS results give a score for each of the eight intelligence areas based on a build up of a wider group of 24 subscale results. The MIDAS uses the range of subscales to give people a deeper understanding of their intelligence areas.

The MIDAS questions used to measure each intelligence strength and a sample of a completed MIDAS result is available in appendix A. The average MIDAS results gained from the sample are open to interpretation. The group of experts who made up the Socrates Minerva funded project, aligned the class content, the e-learning technology and the target audience in order to create the e-learning framework. As identified in the literature review, the use of an MI profiling system requires careful interpretation in order to allow the targeting of a group of students' collective intelligence strengths on one hand and avoid inaccurate generalisations on the other. This chapter outlines how the MI profiling results were interpreted to guide the overall design and operation of the e-learning framework.

Due to the physical separation between the instructor and the learners, the MIDAS results have benefits for use in virtual classes. The MIDAS allows the instructor to gain an appreciation for the dominant intelligences that exist in the target audience. By combining the targeting of the dominant intelligences as identified by the MIDAS results with activities and examples relevant to the class content, the instructor can integrate MI principles into the virtual class design.

4.1 MI Profiling

The MIDAS system is made up of a self completed questionnaire which asks learners to assess their own intelligence strengths in a structured way. Each learner gets a personalised copy of their results emailed to them and the instructor gets access to a detailed MI analysis of the whole class. Figure 4.1 illustrates how the MIDAS allows the instructor to blend the content presentation through the use of multiple entry points with the collective intelligence profile of the students.

Figure 4.1 Multiple Entry Points as a Part of Multiple Intelligences

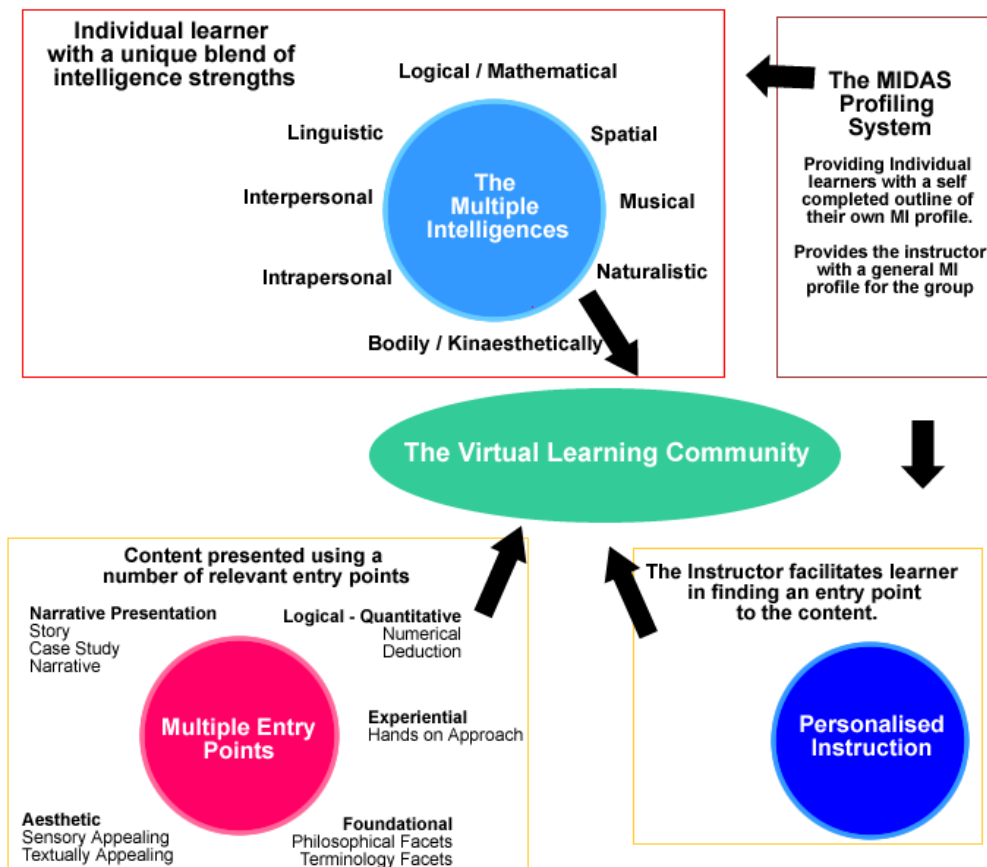


Figure 4.1 illustrates the multiple entry points identified in the literature review as methods of presenting content in order to give students multiple perspectives on a topic. The intelligence areas are identified in the literature as the basis of MI theory and are present in varying degrees in all groups of people. The role of the MIDAS questionnaire is to allow the instructor to gauge the collective MI profile of the group

of construction managers and to use the information to combine the content presentation and instruction within the virtual learning community. Figure 4.1 illustrates the two functions of the MIDAS questionnaire. The individual students are given a personalised copy of their own MI profile on one hand and the instructor is given a picture of the collective MI strengths in their group of students on the other.

If there are particular intelligences which emerge as more dominant amongst the group of construction managers, then these intelligences are likely to be most relevant to the way the group like to learn. The MIDAS system is designed upon the MI principle that the measure of a person's proficiency in a particular intelligence is measured through their ability to use it to solve problems within their cultural setting or environment (Shearer, 2007).

The MIDAS questionnaire was particularly suitable for identifying dominant intelligence areas amongst construction managers, as it had already been used to compare profession based groups (Shearer, 2007). The MIDAS system consists of one hundred and nineteen online questions that generate an MI profile for each participant. The MIDAS is an assessment that describes abilities in terms of strengths and weaknesses however; the scores are not like test scores because they not based on a comparison to other people. The MIDAS system breaks the eight intelligences identified in the literature review, down into sub-scales which are outlined in the following section. The average score is given for each sub-scale and the combined subscales make up the total average for each intelligence area. The dominant intelligence areas identified from the MIDAS results were targeted in the design and delivery of the virtual classes developed as part of this investigation.

4.2 Analysis of the MIDAS Results

The analysis goes through each intelligence strength and comments on the score for each intelligence. The MIDAS results contain a subscale of intelligence strengths which make up the overall eight intelligence scores that constitute a MI profile. The average intelligence scores over 50 were interpreted as stronger intelligence areas and scores under 50 were interpreted as weaker intelligence areas for the purposes of defining dominant intelligence areas from the group of construction managers. The results of each of the subscales are presented and commented on in the following

section. The analysis starts with the relatively stronger intelligence areas identified through the MIDAS results. The results are presented in order, with the strongest intelligence areas presented first.

4.2.1 The Relatively Stronger Intelligence Groups

The relatively stronger intelligence areas identified in the sample group were intrapersonal, visual / spatial, logical / mathematical, interpersonal and verbal / linguistic. The scores for each of these intelligences are outlined in the following section.

Table 4.1 Intrapersonal Results

Intrapersonal	Mean Score	Definition of Subscale
Spatial Problem Solving	67.53	Self awareness to problem solve while moving self or objects through space
Personal Knowledge / Efficacy	63.84	Awareness of one's own ideas, abilities; able to achieve personal goals
Effectiveness	63.38	Ability to relate oneself well to others and manage personal relationships
Calculation	65.06	Meta-cognition involving numerical operations
Average	63.42	

The highest average score from the group was in the intrapersonal intelligences with the average scores being over 63. Intrapersonal intelligence tends to be displayed in groups of high achievers (Smith, 2008). Intrapersonal learners tend to enjoy working alone and are talented at reflecting on their experiences and feelings (Green and Tanner, 2005). The highest score in the subscales was spatial problem solving.

The second highest intelligence area was visual / spatial, and it is presented in table 4.2.

Table 4.2 Visual / Spatial Results

Visual / Spatial	Mean Score	Definition of Subscale
Space Awareness	69.06	To solve problems of spatial orientation and moving objects through space such as driving a car
Working with Objects	54.58	To make, build, fix, or assemble things
Artistic Design	52.88	To create artistic designs, drawings, paintings or other crafts
Average	60.20	

The results indicate the group have a high level of visual / spatial intelligence with the average score being over 60. There is a particularly high level of spatial awareness which indicates the participants enjoy solving problems in a realistic context. They tend to learn well with visual inputs that require input and analysis (Green and Tanner, 2005). Engaging a visual / spatial learner can involve incorporating visual aspects into the class. Internet research allows learners to collect information which appeals to them visually and once their research is complete they can share their work with the rest of the class (Smith, 2008).

The average scores for the logical / mathematical results are shown in table 4.3.

Table 4.3 Logical / Mathematical Results

Logical / Mathematical	Mean Score	Definition of Subscale
School Mathematics	72.71	Performs well in math at school
Everyday Problem Solving	63.33	Able to use logical reasoning to solve everyday problems, curiosity
Everyday Mathematics	61.31	Uses math effectively in everyday life
Strategy Games	50.83	Good at games of skill and strategy
Average	59.39	

The results show the group is strong in the areas of the logical / mathematical intelligences as the average score is over 59. The areas of particular strength are school mathematics and every day problem solving.

Table 4.4 outlines the average interpersonal results.

Table 4.4 Interpersonal Results

Interpersonal	Mean Score	Definition of Subscale
Social Persuasion	63.96	Ability for influencing other people
Social Sensitivity	58.65	Sensitivity to and understanding of other people's moods, feelings and point of view
Interpersonal Work	53.80	Interest and skill for jobs involving working with people
Average	58.84	

The results indicate the learners have a high level of interpersonal intelligence with

the highest score in social persuasion. These learners tend to enjoy working in groups and gain energy from interactions with others. They also tend to be especially good at starting discussions and encouraging participation from other class members (Smith, 2008). The highest sub scale in this intelligence is social persuasion.

The verbal linguistic intelligence scores are outlined in table 4.5.

Table 4.5 Verbal / Linguistic Results

Verbal / Linguistic	Mean Score	Definition of Subscale
Written-academic	68.39	To use words well in writing reports, letters, stories, verbal memory, reading / writing
Rhetorical Skill	56.96	To use language effectively for interpersonal negotiation and persuasion
Expressive Sensitivity	48.71	Skill in the use of words for expressive and practical purposes
Average	56.35	

The group of respondents show high levels of linguistic intelligence particularly in the area of written-academic skills. Linguistic learners tend to be sensitive to the meaning of language and words. The most prominent score in the subscales was the written academic score which suggests skill at reading and writing detailed reports.

4.2.2 The Relatively Weaker Intelligence Groups

The average scores for naturalistic, kinesthetic and musical intelligences were all below 50 and were identified as relatively weaker intelligence areas among the sample of construction managers in terms of dominant intelligence. The results for these intelligences are outlined in the following section. Table 4.6 outlines the naturalistic intelligence results.

Table 4.6 Naturalistic Results

Naturalist	Mean Score	Definition of Subscale
Science	54.13	Knowledge of natural living energy forces including cooking, weather and physics
Plant Care	42.34	Ability to work with plants, i.e., gardening, farming and horticulture
Animal Care	35.12	Skill for understanding animal behaviour, needs, characteristics
Average	44.20	

The group have a relatively low level of naturalist intelligence. One sub scales that is higher is naturalist science, which could indicate skill at operating outdoors and having to plan and deal with the forces of nature (Smith, 2008). Table 4.7 outlines the average scores for the kinesthetic results.

Table 4.7 Kinesthetic Results

Kinesthetic	Mean Score	Definition of Subscale
Athletics	46.46	Ability to move the whole body for physical activities such as balancing, coordination and sports
Dexterity	38.44	To use the hands with dexterity and skill for detailed activities and expressive moment
Average	42.51	

The kinesthetic results are one of the lowest scores intelligence areas. Kinesthetic intelligences are generally associated with activities that involve movement and control such as sports people and dancers (Green and Tanner, 2005).

The lowest average score for the group was the musical results as shown in table 4.8.

Table 4.8 Musical Results

Musical	Mean Score	Definition of Subscale
Vocal Ability	29.34	A good voice for singing in tune and in harmony
Instrumental Skill	20.00	Skill and experience in playing a musical instrument
Composer	21.56	Makes up songs or poetry and has tunes on her mind
Appreciation	47.02	Actively enjoys listening to music of some kind
Average	34.69	

Musical intelligence was the lowest score of the whole MIDAS survey. The highest sub-scale is musical appreciation. This means that the use of music in class content such as videos and presentation would be very useful in gaining attention and maintaining interest in the content (Green and Tanner, 2005).

4.3 Summary of the MIDAS Scores

The group of 40 construction managers who completed the MIDAS questionnaire showed dominant intelligence strengths in the areas of logical / mathematical, intrapersonal, visual / spatial, and intrapersonal intelligences. The areas of naturalistic,

kinesthetic and musical intelligences were relatively weaker amongst the group.

In order to compare the group of construction managers with an academic group which had been already tested by Dr. Shearer, the results were compared to those of engineering majors. The MIDAS profiling scales has been used extensively on student groups through out the USA and Canada (Shearer, 2007). The closest student group to the sample of construction managers were engineering graduates. The average scores for the MI strengths for the group of construction managers profiled by this investigation are compared to the group of engineering graduates in table 4.9. There was a close similarity in intelligence levels particularly in the dominant intelligence areas.

Table 4.9 Comparison of Intelligence Strengths

	Profiled Construction Managers N=40	MIDAS Engineering Graduates N=93
Intrapersonal	63.42	63.09
Visual / Spatial	60.20	60.72
Logical / Mathematical	59.39	63.89
Interpersonal	58.84	54.83
Linguistic	56.35	55.13
Naturalistic	44.20	48.60
Kinesthetic	42.51	43.83
Musical	34.69	46.64

Source: Compiled from Shearer (2007) and McNamee (2008)

Shearer (2007) identified the dominant intelligence areas associated with engineering graduates as focusing on the visual / spatial, logical / mathematical and intrapersonal intelligences. These three intelligences tend to contribute the following;

- Visual / Spatial - ability to identify and solve problems in a visual and physical environment.
- Logical / Mathematical - ability in problem solving, decision making and mathematical reasoning
- Intrapersonal - ability in analytical thinking, academic success and self-awareness

The group of 40 construction managers shows similarities to the MIDAS scores

typical for engineering majors indication that the dominant intelligence strengths for the group was a blend of visual / spatial, logical / mathematical and intrapersonal. The unique feature of the MI strengths observed in the group of construction managers profiles is the blend of visual and logical abilities with particular focus on spatial problem solving. This can be explained within the context of a construction site as the majority of construction activities involve the use of problem solving and analytical skills in order to create physical buildings from a complex mix of two dimensional drawings, conceptual requirements and a whole range of personal relationships. The e-learning framework was designed to use Gardner's entry points are shown in table 4.10 and the dominant intelligences identified by the MIDAS results. Table 4.10 outlines how the multiple entry points as identified in the literature review were adopted for the purposes of this investigation.

Table 4.10 Using Multiple Entry Points to Present Content

Entry point	Learners respond to
Aesthetic	A 3D model of a construction site was made in Adobe Flash which illustrated the main causes of falls from height in an interactive way.
Narrative	A case study was used to present a realistic construction industry scenario that involved the focus of the class content.
Logical/quantitative	A number of statistical results were included in the content in regard to the construction industry and the amount of accidents due to falls from height.
Foundational	Students were asked to think about the root causes of accidents on sites and give their own examples of how to address these issues.
Experiential	Students were asked to give their own experiences of dealing with accidents on construction sites.

In order to align the use of multiple entry points in table 4.10 and the dominant intelligence areas identified by the MIDAS results within the context of construction health and safety training, the content was delivered through three channels. The LMS was used to present content visually and interactively. The forums were used to facilitate asynchronous interactions based on the content and students' own experiences and the web meeting system DimDim was used for the synchronous interactions.

The alignment of the MIDAS results, the e-learning framework and MI theory with health and safety related content was one of the key objectives of the Socrates Minerva funded project partners. Over the duration of the project the partners contributed their expertise in order to achieve this objective. The output from the

project partners for the design of the e-learning framework using the MIDAS results and multiple entry points as outlined in the following section in terms of the interactive content, the asynchronous interaction and the synchronous interaction.

4.3.1 Interactive Content

The defining feature of the sample group's MI profile was the relationship between visual and logical intelligences. In order to target this blend of abilities with interactive content the aesthetic or visual entry point was selected as the most appropriate. In order to present the hazards of falls from height in a visual way a 3D model was used to show the hazards in the locations they could occur. The narrative entry point was then used to connect the hazards illustrated in the 3D model through a case study which allowed the learners to connect the abstract hazards to a real life context. Further entry points such as the foundational and logical aspects were demonstrated by providing the learners with videos and statistics of the consequences and realities of falls from height.

4.3.2 Asynchronous Interaction

The asynchronous interactions were through the use of a class forum. The learners were asked to link the content presented in the class to experiences of their own. The self paced nature of using a forum allowed learners to review the content at their own pace and then start to relate it to their own experiences with the rest of the class.

4.3.3 Synchronous Interactions

The synchronous interactions took place through the DimDim web meeting system. The use of DimDim largely targeted the interpersonal intelligence and built upon the individualised access of the class content and the social interaction which started with the class forums. The learners were asked to give their own experiences based on the class content.

MI theory is a definition and a conceptualisation of human intelligence rather than a particular approach for education. However in creating an educational environment which takes MI theory into account there are two important aspects. Firstly the content should be presented in as many ways as is appropriate to the student's context. Secondly the instructor should be aware of the dominant intelligence areas among the

group of learners they are teaching. In order to achieve this, the investigation made use of the five entry points as identified by Gardner in presenting the content and carried out a MI profiling of a group of construction managers. The profiling system was carried out online using a self completed questionnaire called MIDAS. The results showed the distinctive feature of the group of construction managers to be strong in visual and logical areas with an emphasis on spatial problem solving.

The dominant intelligences areas identified by the MIDAS scores were aligned with the e-learning technology and construction industry focused content. The e-learning environment was used to host the class content and interactions and the content focused on visual and realistic scenarios. The class interactions used case studies to engage learners and encourage learners to share their own experiences. A description of how the MIDAS results were used in the operation of the e-learning framework is outlined in chapter five.

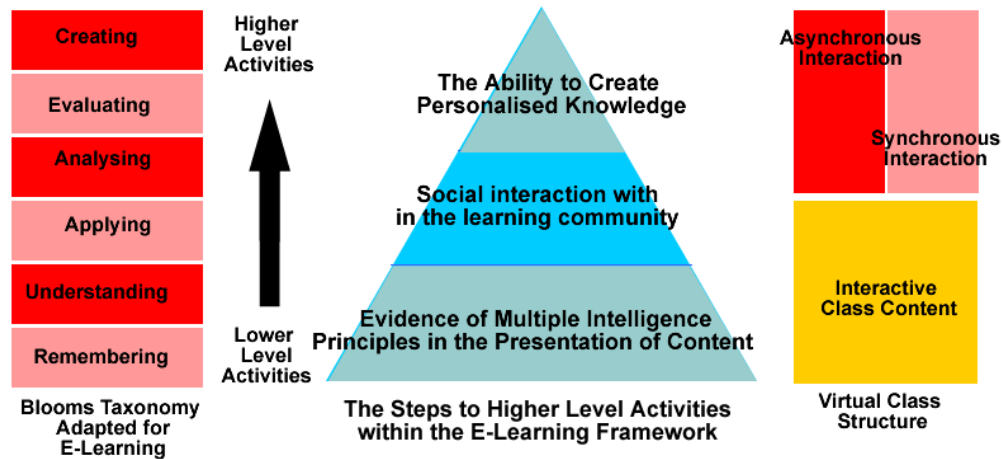
Chapter Five: Description of Case Study

5.1 Overview

This chapter outlines how the elements of the e-learning framework were combined in order to fulfil the research aim and objectives. The framework consisted of an alignment of the technology used to deliver the virtual classes, the instructional guidelines and content and the integration of MI principles. The MIDAS sample carried out in Chapter Four identified the dominant intelligences identified in a group of construction managers. The key MI strength identified by the MIDAS results was the blend of visual / spatial and logical / mathematical intelligences, with a focus on spatial problem solving. This chapter outlines how the Socrates Minerva funded project under which this investigation took place, aligned the MIDAS results, e-learning technology and construction health and safety content into four virtual classes which were delivered in two phases at WIT.

The aim of the investigation was to create an e-learning framework which incorporated MI theory and to pilot it by delivering health and safety training to construction students. The elements of the e-learning framework as compiled from the literature review are shown in Figure 5.1. An objective of the investigation is the identification and utilisation of MI theory to influence the design and operation of the e-learning framework. The purpose is to create a learning environment which aids students in moving up Blooms taxonomy from lower level to higher level learning activities. By using MI principles in the presentation of interactive content, the virtual classes use asynchronous and synchronous interactions to create a social learning environment and bring learners to higher level learning activities and the creation of personalised knowledge.

Figure 5.1 An Illustration of the E-Learning Framework



As the class content focused on areas that required behavioural change, the focus of the instruction was on facilitating higher level learning activities. This meant allowing students to first become familiar with the context and application of the interactive class content through lower level activities, and then focus on the higher level activities through asynchronous and synchronous interactions. Figure 5.1 illustrates how the lower level activities of understanding and remembering are associated with the interactive class content. The asynchronous and synchronous interactions of the virtual class are used to create a learning community which involves the activities of applying and analysing. The combination of interactive content and the creation of a learning community facilitate students in engaging in the higher level activities of evaluating and creating and can result in student developing personalised knowledge. The asynchronous and synchronous elements of the framework involve the use of forums and a web meeting system. The challenge for the instructor was to link the content to the asynchronous and synchronous interactions in order to create a learning community.

The key feature of technology in education is that it does not seriously impede a student's progress in term of being unstable or difficult to use. The key technical features required by the e-learning framework were;

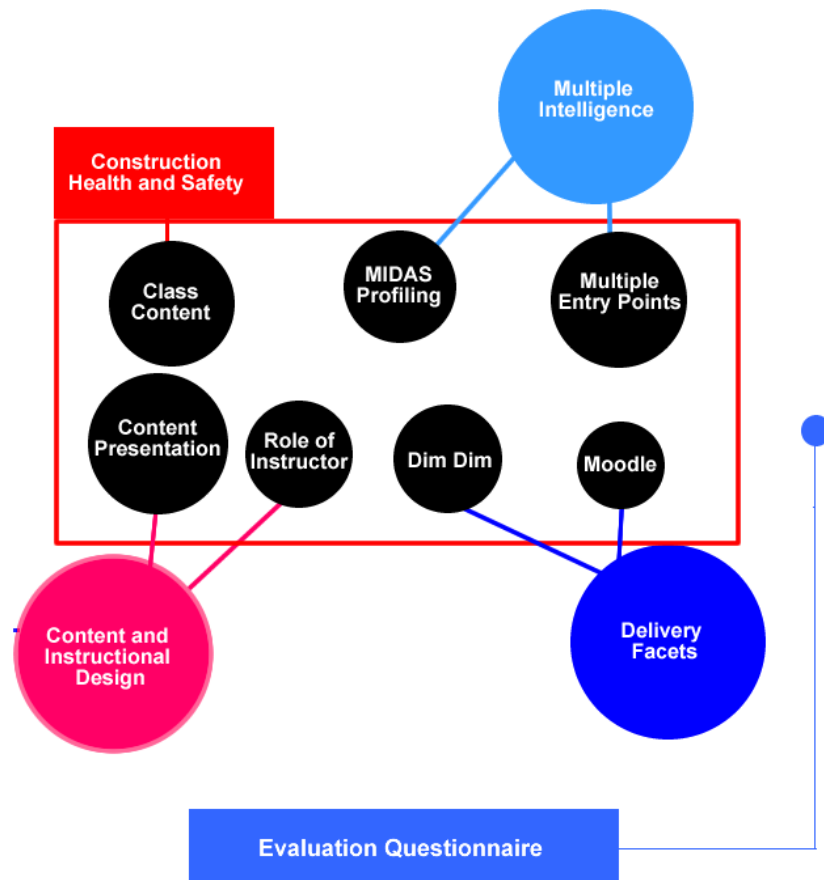
- Flexibility in content presentation methods in both a synchronous and asynchronous environment.
- A cost efficient system which, where possible makes use of open source software in order to reduce licensing costs.
- A synchronous web meeting system that would enable the sharing of presentations along with audio broadcasting.
- The ability to archive the synchronous sessions.
- An asynchronous environment which could be used as a repository for learning objects such as files and resources as well as collaborative activities such as forums.

The educational content presented through the virtual classes, aimed to promote learning for understanding through the application of knowledge and concepts within the context of situations for which that knowledge is appropriate. The use of multiple entry points to offer students a number of perspectives on content was introduced in the literature review. The virtual class content used a number of entry points that were suitable to the context of a construction site. The following section outlines how the e-learning framework was designed and operated at WIT.

5.2 Description of the E-Learning Framework

Figure 5.2 illustrated the elements which made up the e-learning framework. The elements are made up of the delivery methods of Moodle and DimDim, the interactive content and the role of the instructor as well as the content focus on health and safety training in the construction industry.

Figure 5.2 The E-Learning Framework



The following section describes how the elements of the e-learning framework illustrated in figure 5.2 were deployed in two phases at WIT. The first part of this chapter describes the delivery facets that were used and the content and instructional design aspects. The second part of the chapter describes the two phases of virtual classes delivery at WIT and details each class with an interactivity matrix. The evaluation results for phase one and two are presented and analysed in chapter six.

5.3 Delivery Facets

As the framework was for educational purposes and had a limited budget it was preferable to use open source software as the hosting technology for the project. Moodle was the LMS chosen to facilitate the asynchronous activities during the virtual classes. Moodle is an open source LMS which has strong roots in the constructivist education approach and is a well designed and easy to use system (Cole

and Foster, 2007). DimDim was the web meeting system which was used to facilitate the synchronous part of the virtual class. It is a completely browser based conferencing system which allows for real time interaction to take place around a shared PowerPoint slide or PDF file. Figure 5.3 illustrates how the features of Moodle and DimDim were combined to create a virtual class that has synchronous and asynchronous communication options.

Figure 5.3 The Virtual Class Technical Configuration

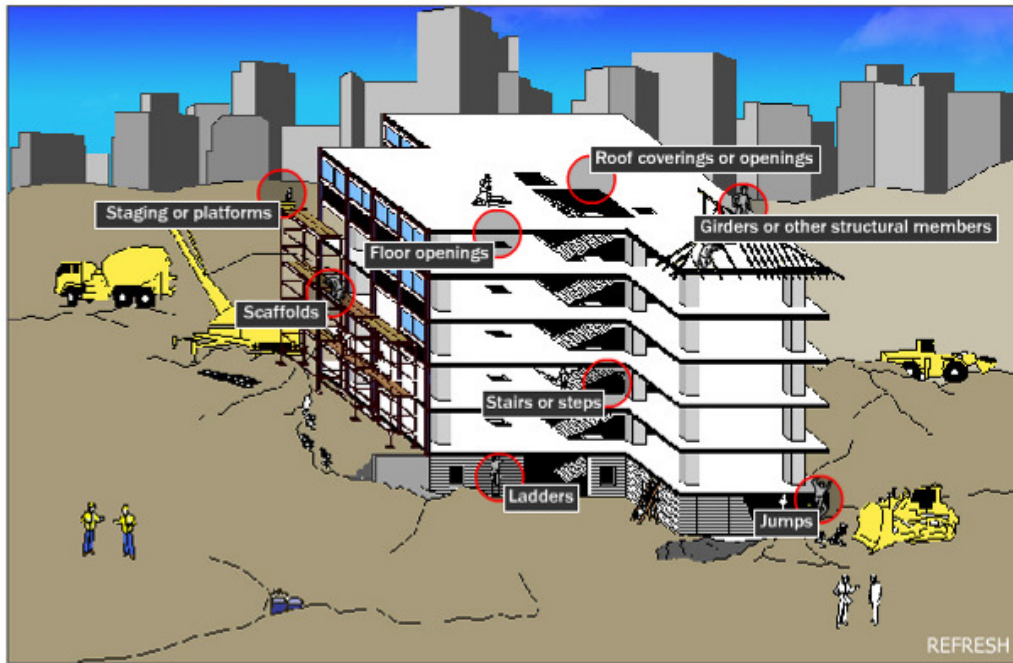
MOODLE	DIM DIM
Upload and Share Materials	Desktop & Application Sharing
Forums and Chats	Multi User Chat
Quizzes and Surveys	Audio
Gather and Review Assignments	Video
Archived Material	Shared Whiteboard

The use of Moodle and DimDim involved two main activities. The first activity was setting up the class content on the Moodle LMS. This stage involved using a 3D model of a construction site to appeal to the aesthetic entry point and to provide a context for the narrative and logical / quantitative entry points. The second activity involved the use of DimDim. The instructor used the features of DimDim to allow for an interactive discussion on the class content that makes use of the interpersonal and linguistic intelligences of the learners.

Spatial problem solving was one of the highest scoring intelligences from the MIDAS results. The characteristics of this intelligence is the ability to solve problems of spatial orientation and deal with objects in a physical space. In order to target this intelligence in an online environment, a 3D model of a construction site was created using Adobe flash. The creation of the interactive model was one of the outputs of the Socrates Minerva Action Project and formed the basis of the class content developed. The health and safety hazards that result in falls from height were shown in an interactive way that allowed learners to engage with the model. By interacting with the model students could use spatial awareness and spatial problem solving to

approach health and safety issues within a construction context. A static image of the 3D model is shown in figure 5.4, which illustrates the main causes of falls from height on a construction site.

Figure 5.4 **The 3D Model**



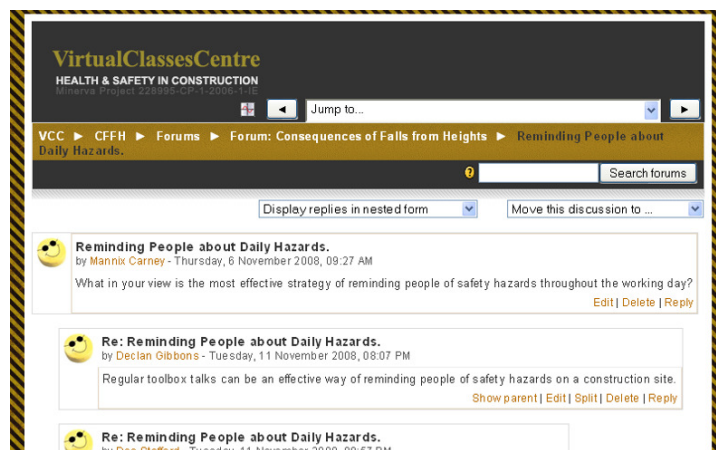
The virtual class content targeted the students’ visual / spatial intelligences using the 3D model. The rest of the class expanded on the more complex aspects of the content using additional entry points. The narrative entry point uses stories as vehicles of instruction; they represent methods of presenting complex educational content in a way that is engaging and memorable. The students were presented with a case study which presented the health and safety problem in a real life situation. The case study was designed to engage the learners by asking them for their contribution through the class forum. An example of a case study presented in connection with the 3D model is available in appendix B and a copy of the 3D model is available on the CD ROM in appendix C.

5.4 The Class Presentation

In order for the students to use the virtual class effectively they were given an induction session before the class took place. The learners were given the induction in

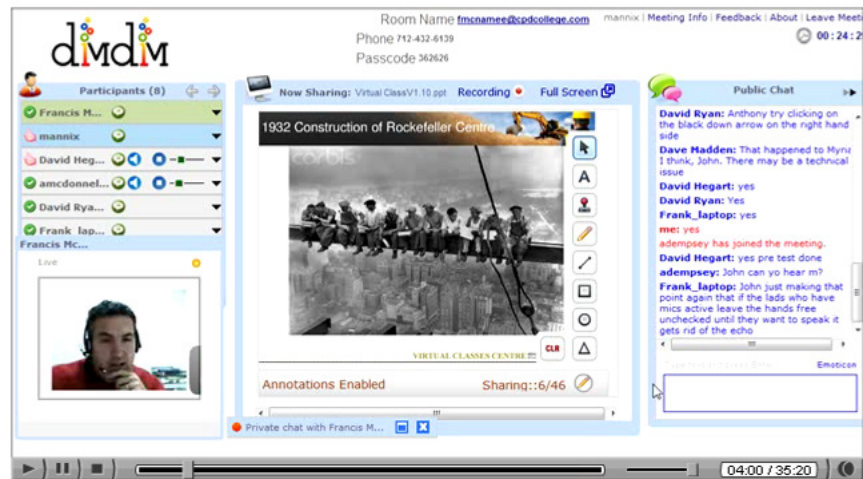
a computer lab, where everyone had access to the virtual class and could receive instruction from a data projector. Everybody logged onto the Moodle LMS using their user names and were shown how to access the class content, access the surveys and make contributions to the forum. The learners also logged onto the DimDim web meeting system and familiarised themselves with its features such as typing public and private messages, using the microphone and using the whiteboard features. The students were required to go to the project website www.virtualclassescentre.com. Each learner had an individual username and password which allowed them to log into the Moodle LMS, this enabled their individual contributions to the surveys and forums to be monitored. The forums used on the Moodle LMS are illustrated in figure 5.5.

Figure 5.5 The Moodle LMS



The students were given access to the presentation that would be used during the web meeting session, this allowed them to familiarise themselves with the content. There were also a range of videos and links to external websites that give the learner some background information on issues relevant to falls from height in construction. Students were encouraged to comment on this information as well as contribute their own information through the forums. The sessions from the DimDim web meeting system were recorded and made available as archived content to support subsequent classes. This archived content allowed learners to review the class at their own pace and familiarise themselves with the web meeting activities and layout. A screen shot of DimDim in operation during a virtual class is shown in figure 5.6.

Figure 5.6 The DimDim Interface



The DimDim web meeting system offered the following features;

- General presentation delivery – PowerPoint slides and PDF documents could be uploaded
- Screen sharing – desktops and applications could be shared
- Webcam – a video of the instructor could be seen
- VoIP (voice over internet protocol) – all participants could speak with each other.
- Text Chat – could be sent to the group or privately to individuals.
- White Board – the shared PowerPoint could be drawn and written on collaboratively.
- Polling – each participant could indicate their mood.
- Recording – the session could be recorded and embedded on the class website.

The aim of the synchronous part was to tie together individual contributions from the asynchronous section to create a real time social experience. The DimDim system allows the class to view a presentation controlled by the instructor. Students could type into the text box area as well as message each other privately. The instructor could talk to the class and pass the microphone to up to three class members. Students could respond to the instructor through out the class by using a personal indicator icon which gives the choice of a number of mood symbols. DimDim allows the instructor to lead a class through the PowerPoint presentation as well as stimulating discussion

through comments that can be spoken or typed by all the participants. The DimDim guide is available in the appendix D.

5.5 The Role of the Instructor

The role of the instructor was very important in running a class that engaged the learners. Based on the evaluation process outlined in chapter six, a step by step guide based on Gagnes events of learning was developed for each of the virtual classes. The step by step guide was used by the instructor in providing a structure to the web meeting and to give reminders about how to link MI activities to the content. The guide was used in conjunction with the PowerPoint presentation which was presented through DimDim in each class. The guides for each of the virtual classes delivered at WIT are given in the appendix E. The PowerPoint presentations to which the instructor's guides were linked are outlined in the following section.

5.6 The Class Content

The class content was one of the key inputs of the Socrates Minerva Action project partners. The project partners involved in the project included; Nottingham Trent University in the UK, Istanbul Technical University in Turkey, Universite de Nice Sophia-Antipolis in France, Centre for the Advancement of Research and Development in Educational Technology in Cyprus, Multimedia Instructional Design, Blended Learning Design and Waterford Institute of Technology in Ireland.

There were a number of construction industry partners who gave input into the virtual class content. The objective was to create four classes that covered an area relevant to falls from height in the construction industry. The PowerPoint files which contained content that drove the DimDim sessions are included in appendix F. The synchronous content was delivered through a PowerPoint presentation and the asynchronous content was access through the project website for the students to interact with. The content for each of the virtual classes is outlined in the following section and can be access on the project website at www.virtualclassescentre.com:

- **Identifying the hazards of falls from height**

This class focused on getting the participants to think outside the box and identify hazards as they may occur on an actual building site. The class also

presented a copy of the PowerPoint slides used during the class and a number of images of fall hazards. There were also links to relevant websites, videos and PDF documents on falls from height on construction sites.

- **Awareness of the consequences of falls from height**

This class focused on the human cost of an accident and their impact. The class demonstrated the consequences in terms of death, injury, financial cost and social cost. The class linked to a number of case studies, newspaper articles and videos which demonstrated the consequences of falls from height in a real setting.

- **The use of mobile elevating work platforms (MEWP)**

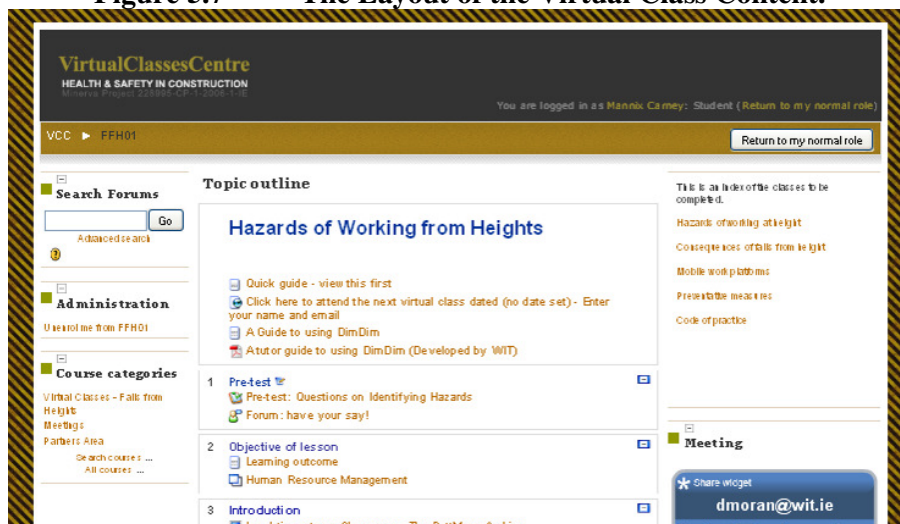
The course outlined the main types of MEWPs and their uses. It then looked at the safety issues associated with the operation of the equipment. The class presented a news paper clipping which reported on an accident involving a MEWP. There were a number of videos which demonstrated the safe operation of MEWPs.

- **Preventative measures**

This class focused on the measures that can be taken to stop accidents from happening and reduce the impact of accidents that do occur. The content covered risk assessment on site and the personal protective equipment which can be used to reduce the risk of falls from height. The class also covered steps to reduce the impact of falls and risk assessment procedures.

The layout of the asynchronous content through the Moodle LMS is shown in figure 5.7.

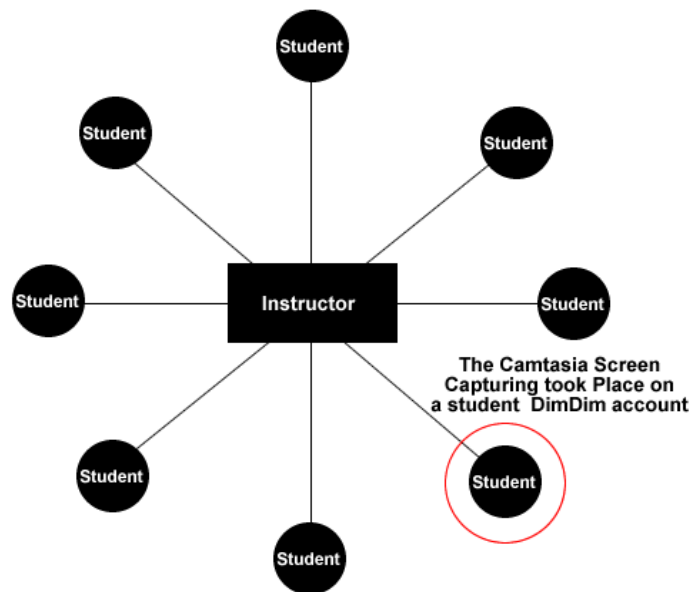
Figure 5.7 The Layout of the Virtual Class Content.



Each class page in Moodle included a class forum where learners were asked to apply the content to their own situation and comment on the content in general.

All the synchronous sessions given at WIT were recorded as an archived class. A screen capturing system called Camtasia was used to record the web meeting sessions. The software took a video of the web meeting system and saved the video in a format that could be uploaded to the class LMS. Figure 5.6 illustrates how the live DimDim sessions were recorded.

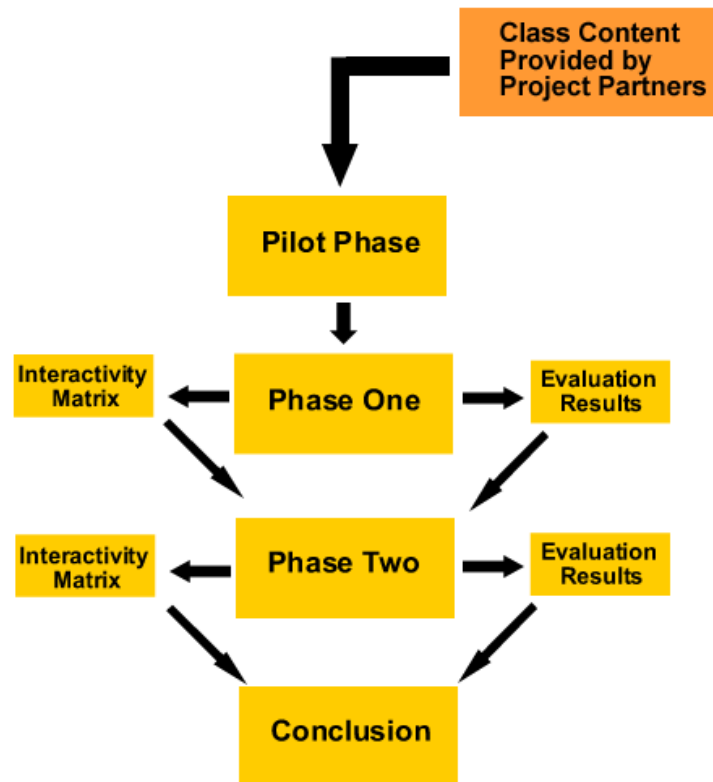
Figure 5.6 The Archiving of the DimDim Sessions



The archived material was reviewed and the interactions which took place during the class were recorded into an interactivity matrix. Copies of the archived classes are in appendix C. The interactivity matrix recorded a break down of the interactions that took place. The group wide interactions were general responses from the whole group of students and involved activities such as the use of a class poll or a simple yes or no question. The individual interactions were more detailed and involved the students offering their opinion on a subject. These individual contributions were made through the public chat or shared microphone feature on DimDim. By keeping a record of the quantity and type of interaction that took place, a comparison can be carried out between the phases of class delivery.

Figure 5.7 illustrates how the class content in the form of four virtual classes addressing areas of falls from height in the construction industry was delivered at WIT. The classes were first delivered using a pilot phase in order to test the technology. Phase one and two were delivered and the classes were analysed using an interactivity matrix to record the class interactions and an evaluation questionnaire. The comparison of the interactivity matrix and evaluation results for phase one and two allowed for conclusions to be drawn on the use of the e-learning framework as a whole. Figure 5.7 illustrates how the results from phase one fed into phase two, and how the results from phase two fed into the conclusions. This iterative cycle is the action research methodology outlined in the methodology chapter.

Figure 5.7 The Outline of the Delivery of Virtual Classes at WIT



The e-learning framework developed through this investigation sought to blend the asynchronous and synchronous communication with interactive content. The content for the virtual classes delivered at WIT was developed by the Minerva project partners

and the role of the instructor and the evaluation process was carried out at WIT and covered by this investigation. The evaluation results from the first phase resulted in significant changes to the role of the instructor. The changes that took place as part of the action research methodology and justification based on the evaluation results and interactivity matrix are presented in chapter six. The e-learning framework was designed using the Moodle LMS and DimDim as the asynchronous and synchronous communication systems to provide the types of interaction identified in the literature review. The role of the instructor was to use those communication channels to present the content and facilitate interaction in ways that targeted the dominant intelligences identified through the MIDAS questionnaire. The interaction that took place through the software systems were a key part in aiding students to move to higher level learning activities.

Chapter Six: Evaluation and Analysis of Case Study

The evaluation chapter looks at the evaluation questionnaire students were asked to complete after using the e-learning framework. The chapter also looks at the analysis of the changes in student's satisfaction which could be observed from the first to the second phase of the virtual classes. The aim of the evaluation was to rate students' satisfaction with the use of the technology and the role of the instructor. The evaluation also rates the presentation of content and the learning community experienced by the students. The amount and type of interactions that occurred during the class were recorded and presented in an interaction matrix. The combination of the students evaluation results and the interactivity matrix allow for comparisons to be drawn between phase one and phase two. This process was an important part of the action research methodology which allowed for the refinement of the framework. The findings of the evaluation along with the changes made from the first phase results are a key part of the investigations conclusion. The structure of the interactivity matrix and evaluation questionnaire used to evaluate the virtual classes are outlined in the following sections.

6.1 Interactivity Matrix

The interactivity matrix was used to record the interaction types that took place during the DimDim web meeting sessions. The details of each session were recorded with the length of time of the class, the number of students and the number of slides being presented. The interaction types were broken down into group wide and individual contributions. The group wide interactions were multiple choice questions and the use of class polls. The individual responses were divided into speaking through the shared microphone or using the text based public chat. From the recorded information for each class, two ratios were produced in order to allow comparison. The total duration of the class was divided by the total interactions to give an average number of minutes between each interaction. Then the total amount of interactions was divided by the class size to give the number of interactions per student per class. The number of posts made to the class forums was also recorded. The interactivity matrix results are averaged for phase one and two and presented in the chapter. The detailed results for each virtual class session delivered using the DimDim web meeting system are included in appendix G. The interactivity matrix results were presented with the evaluation questionnaire results. The questions asked in the evaluation questionnaire are outlined in the following section.

6.2 The Evaluation Questionnaire

As part of the action research methodology an evaluation process was designed to measure the level of student satisfaction. The purpose of this evaluation was to provide a mechanism to measure the student's satisfaction with the virtual class and use the information to improve the e-learning framework. The evaluation focused on the headings observed in figure 6.1. Each heading is a key factor in achieving learner satisfaction in a virtual class. The participants answered the evaluation questions by completing a Likert scale, rating a statement on the class from one to five or by answering with a Yes or No option. A copy of the questionnaire is available in appendix H. The evaluation questionnaire focused on the operational side of the e-learning framework by asking students to rate the operation of Moodle and DimDim along with the role of the instructor. The evaluation then asked students what they thought about the way the content was presented and the social interactions they experienced during the class. The focus of figure 6.1 is to illustrate that the functioning of Moodle and DimDim along with the role of the instructor supports the presentation of content and social interactions. A problem with technology or the instructor would directly impact on the way students access content and interact with the class.

Figure 6.1 The Elements to the Evaluation Questionnaire



The questions asked as part of the evaluation are presented in the following section. There are a number of questions on each section illustrated in figure 6.1 covering the functionality of Moodle and DimDim, the role of the instructor as well as the presentation of content and the learning community.

6.2.1 Moodle Features

Moodle was used to host and control the asynchronous educational material for the virtual class. The questionnaire asked students to rank their opinion on the following statements about the Moodle LMS.

- The operation of the website is stable
- I was able to navigate the website

6.2.2 DimDim Features

DimDim was used to host real-time collaborative web meetings with all the class participants. The purpose of the web meeting was to provide the group interaction and discussion that were absent from the more individual activities that took place using the Moodle LMS. The questionnaire asked the participants if they used key features for interaction during the class, as well as their satisfaction with the stability and ease of use of the system as a whole. The use of DimDim's feature by the class reflected on the instructor while the questions on the stability and ease of use measured the role technology. The students were asked to answer yes or no to the following questions;

- Did you use the class polls?
- Did you use the shared microphone?
- Did you use the chat features?

Students were asked to rank their opinion on the following statements;

- The clarity of audio was clear and understandable
- DimDim was easy to use and trouble free

6.2.3 Role of the Instructor

In terms of the role of the instructor the evaluation asked participants to rate their opinion on the following questions;

- To what degree did you feel you could interact with the instructor?
- How did you find the pace of the instruction?

The students were then asked about their opinion on how content was presented and the learning community they experienced.

6.2.4 The Virtual Class Content

The purpose of the virtual class content was to expose the learners to the content from a number of perspectives. Using multiple entry points allowed a range of intelligence types to access the content in a way that made sense to them. The questionnaire asked the students to rank their opinion of the following questions;

- The content was delivered visually through diagrams or pictures
- The content was delivered through a story or case study
- The content was clear and easy to understand.

6.2.5 Learning Community

In order to form a learning community students had to be able to interact with the instructor and share with the rest of the class. The questionnaire asked students to rate the following key interactions:

- The virtual class made it easy to share what you learned with the rest of the class
- The virtual class made it easy for you to interact with the instructor.

The evaluation questionnaire was completed by the students who participated in the virtual classes at WIT. The results of phase one concludes with the significant changes made to the e-learning framework as part of the action research methodology. The results from phase two demonstrate the effect of the changes made after phase one.

6.3 Phase One Delivery

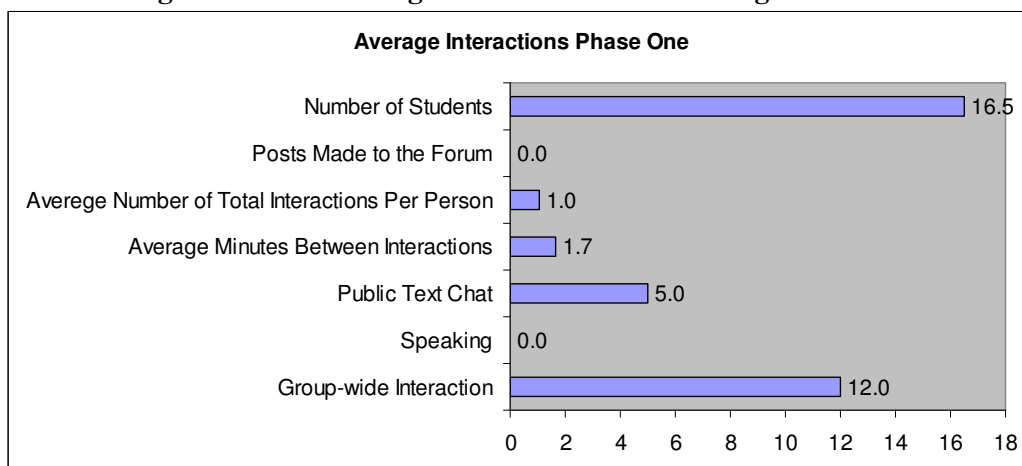
The first phase of the virtual class framework was presented to a group of 33 final year construction management students at WIT. The students were broken into two groups of sixteen and seventeen people and they completed two virtual classes.

Induction: The students were inducted on using the virtual class in a classroom using a data projector to explain the Moodle LMS and the use of the DimDim web meeting system. The students were issued with their user names and passwords on the day the virtual class was delivered.

Observations on the class Most of the interaction that took place during the class took place through group wide responses. Any individual responses that took place were using the public chat feature where the students typed their responses. There was an average of 17 total interactions during the class. There were some technical problems for some of the students logging onto the Moodle LMS. A number of students experienced problems with the audio quality of DimDim over slower internet connections.

The average interactions for each class given during phase one are presented in figure 6.2.

Figure 6.2 Average Class Interactions during Phase One



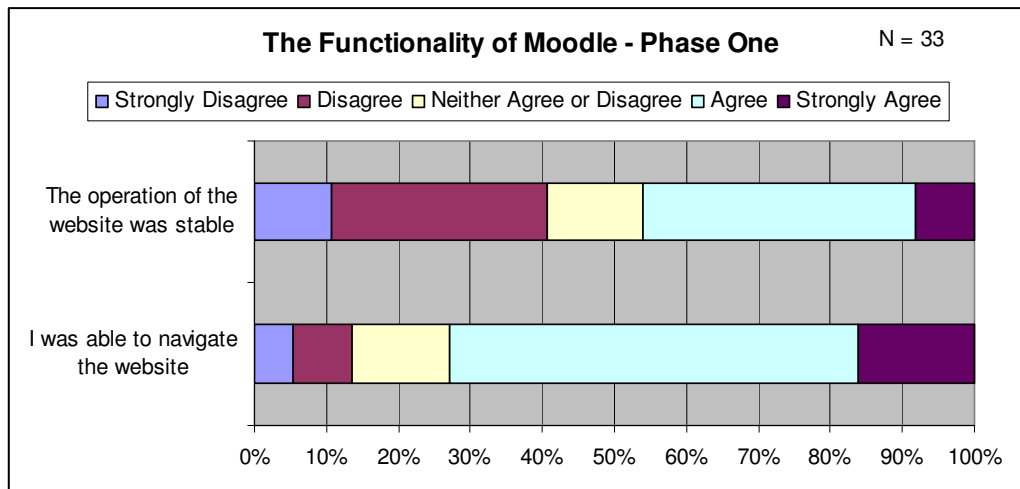
The average interaction matrix results are shown in figure 6.2. The majority of the interactions took place through group-wide interactions. There was a lower amount of public text chat and there was no speaking using the shared microphone. The results shown in figure 6.2 are combined with the evaluation question results in the following section in order to draw some conclusions from the first phase of virtual classes.

6.4 Phase One Evaluation Questionnaire Results

6.4.1 The Functionality of Moodle and DimDim

The results from the phase one results for the functionality of Moodle are shown in figure 6.3.

Figure 6.3 Phase 1 - The Functionality of Moodle



The following section describes the results illustrated in figure 6.3 and provides the comments made by students in table 6.1.

There was concern on the stability of the website as 40% of respondents expressed disagreement and strong disagreement in the stability of the website.

87% of respondents were neutral, in agreement or strong agreement in their ability to navigate the class website.

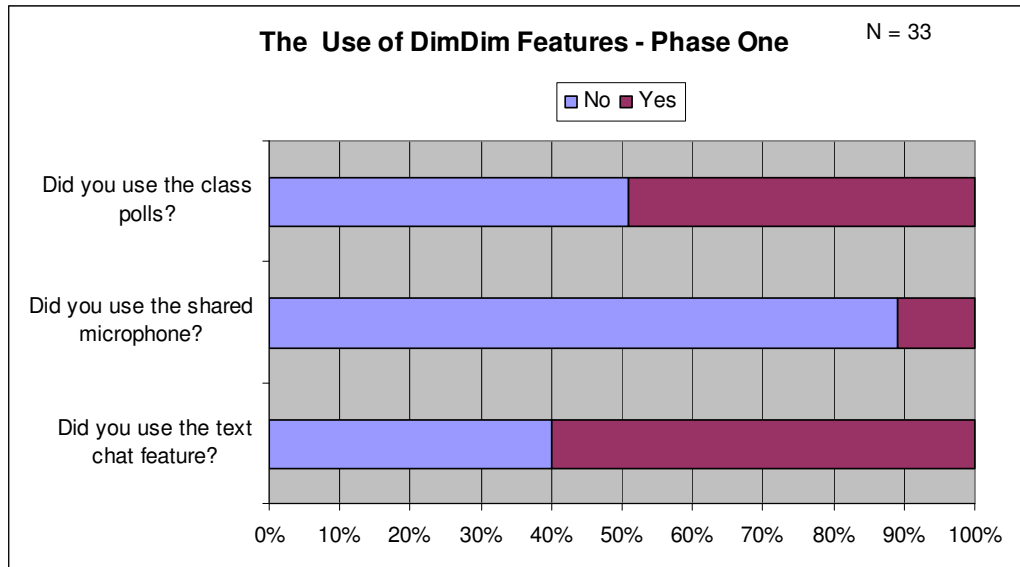
Table 6.1 Learner Comments on the Functionality of Moodle

<p><i>Very easy to follow the format.</i></p> <p><i>I found the use of the virtual class very useful.</i></p> <p><i>A useful aid for distance learning.</i></p> <p><i>It was easy to follow for someone with basic computer knowledge.</i></p>
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There were a number of minor technical issues with the username and passwords given to the students. This resulted in some students being unable to log on and have full access to the content. This explains the finding that 40% of participants reported the system as being unstable. The results for navigating the website show broad satisfaction with the functionality of the Moodle LMS used to present the class material. The learner comments reflected this with a number of comments saying the system was easy to use and useful as shown in table 6.1.

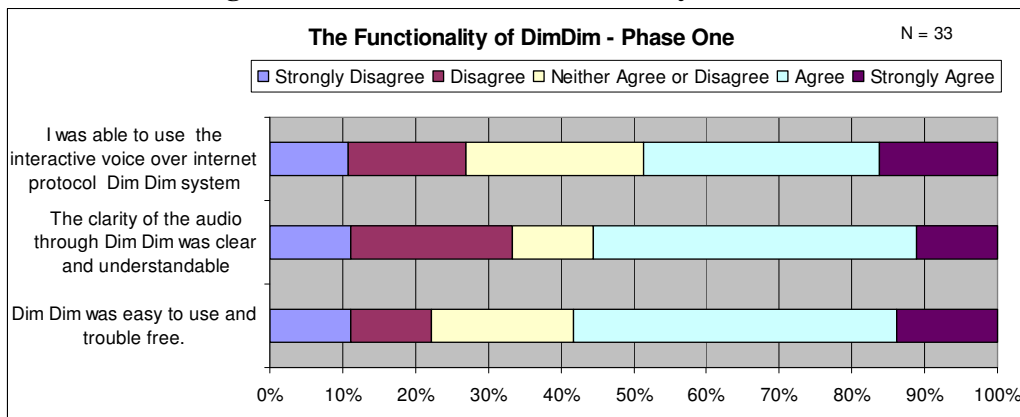
The evaluation results for the use of DimDim features are highlighted in figure 6.4 and figure 6.5 illustrates the results on the functionality of DimDim.

Figure 6.4 Phase One - Use of DimDim



There were problems with the use of DimDim features during the virtual class. The problems were highlighted by the fact that; 51% of the class did not use the class polls, 89% of the class did not use the microphone and 40% did not use the text chat feature. The problem with the use of DimDim features is also reflected in the interactivity matrix with no use being made of the shared microphone.

Figure 6.5 Phase One - Functionality of DimDim



The results illustrated in figure 6.4 and 6.5 are described in the following section and the students comments are outlined in table 6.2.

27% of respondents strongly disagree or disagree that they could use the interactive voice over internet protocol DimDim system and 24% express neutrality and 48% agree or strongly agree.

32% of respondents disagreed or strongly disagreed that the quality of the audio was clear and understandable. 68% of respondents found the audio quality acceptable.

56% of respondents were agreed and agreed strongly that the system was easy to use and stable. 20% expressed neutrality and 24% expressed disagreement or strong disagreement.

Table 6.2 Learner Comments on the Functionality of DimDim

<p><i>There were problems with the technology, which was unreliable.</i></p> <p><i>The length of time it took to set up DimDim and the echo in the presentation would be a cause of concern.</i></p> <p><i>The instructor's voice was a bit unclear at times.</i></p> <p><i>It is easy to use DimDim, but it is not trouble free as we did have some interference with the sound quality.</i></p>

The evaluation results show 27% of students were not able to use DimDim. The results indicate that there were problems with the way students were inducted to use DimDim. The evaluation also highlighted problems with the audio quality of DimDim as well as the use of the features by the instructor. 32% of the participants had problems with the clarity of the audio over the DimDim system. There was also a problem with the role of the instructor as the shared microphone, was not used during the class. There were issues with the audio and visual transmission due to broadband constraints, which was highlighted by the learner comments. The user comments in table 6.2 identify problems with the quality of audio over the DimDim system with comments such as *it is easy to use DimDim, but it is not trouble free as we did have some interference with the sound quality.*

The limitations of DimDim were made worse by the fact the instructor did not make full use of the DimDim features. Student responses indicated that 89% of students did not use the shared microphone, 51% did not use the thumbs up indicator and 40% did not use the text chat. The interactivity matrix results show that there was no use of the shared microphone and on average there were 5 interactions on the shared public chat.

An average of 12 interactions took place using group wide responses such as yes or no answers and use of the class poll. This highlights the role the instructor plays which is expanded further in the following section.

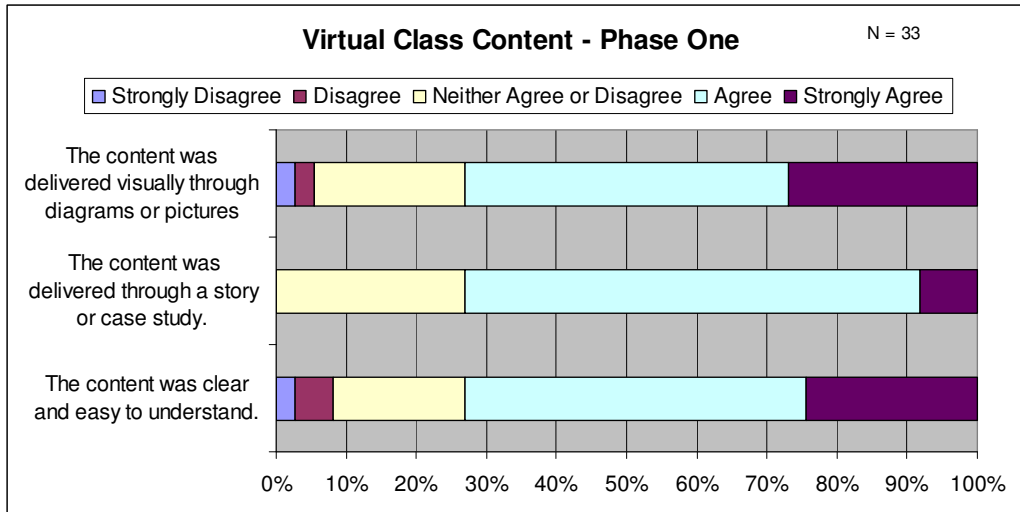
6.4.2 Phase One – Interaction with Instructor

The first phase indicates a varied amount of interaction between the students and the instructor during the virtual class. While 70% of the class reported the level of interaction with the instructor as being average or above average, 30% of the class felt the interaction with the class was below average. In terms of the pace of instruction during the class over 50% of students described the pace as perfect, 21% described the pace as slow and 29% described the pace as fast or very fast. The interactivity matrix highlights an average 1.7 minutes between all interaction types and the average amount of total interactions per student per class was one. As the majority of interaction took place using group wide interactions there was a low level of individualised interaction from the students.

The main issue for the instructor in the first phase of the virtual classes was the level of interaction with the class indicated in the evaluation results for using the microphone and chat feature of DimDim. The DimDim sessions involved a minimal amount of interaction with the students. This is reflected in the interaction matrix results as the majority of interactions did not involve individual responses from the students and each student produced an average of one interaction per class. The evaluation illustrates some satisfaction with the pace of instruction and the level of interactivity but the DimDim features such as shared microphone and class polls were not used by the majority of the class.

The evaluation results for the class content are presented in figure 6.6 and the student comments are in table 6.3.

Figure 6.6 Phase One - The Class Content



73% of respondents agreed or strongly agreed that the content delivered visually through diagrams and pictures. 21.5% of people expressed neutrality and 6% disagreed.

73% of respondents agreed or strongly agreed that case studies were used in presenting the content, while 27% expressed neutrality.

73% of respondents agreed or strongly agreed that the content was clear and easy to understand, 20% expressed neutrality and 7% disagree or strongly disagree.

Table 6.3 Learner Comments on Class Content

The class was very good and the scope is there to develop it.

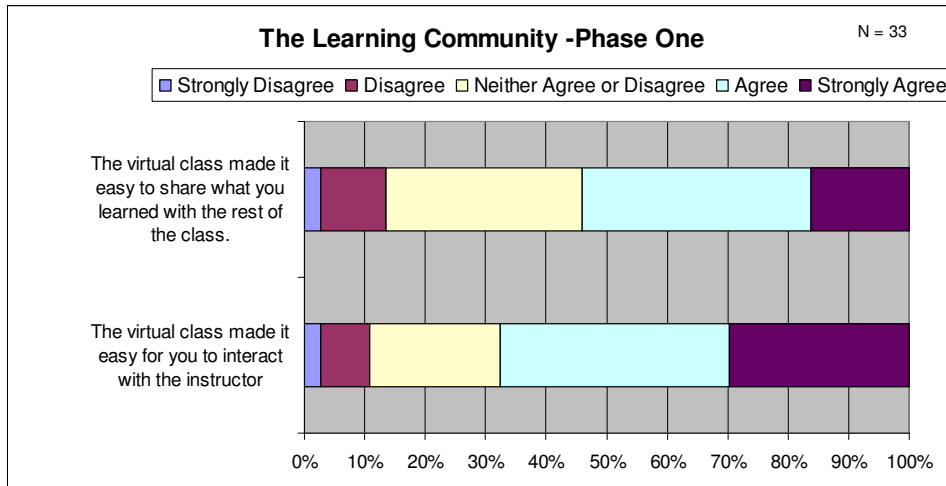
I suppose everybody having the motivation to use the website is the key.

The class was well done and well presented; it was clear and easy to follow.

The majority of the respondents expressed agreement with the use of visual and interactive presentation options and the fact that the class was clear and easy to understand. The student comments supported this with one comment stating that *the class was well presented, clear and easy to follow.*

The results of the students' evaluation of the learning community they experienced are illustrated in figure 6.7

Figure 6.7 Phase One – The Learning Community



The results illustrated in figure 6.7 are outlined and the student comments are highlighted in table 6.4.

54% of respondents expressed agreement or strong agreement in their ability to share what they had learned with the rest of the class. 32% of respondents expressed neutrality and 14% disagreed or strongly disagreed.

68% of respondents expressed agreement or strong agreement and 22% indicated neutrality in their ability to interact with the instructor. 11% disagreed or strongly disagreed.

Table 6.4 Learner Comments on the Learning Community

<i>Good service, easy to communicate with the class and lecturer</i>
<i>Good way of learning</i>
<i>Excellent learning experience - really enjoyed it</i>
<i>If only all lectures could be done over the web</i>
<i>There was not enough collaboration. The only person we heard was the instructor</i>

The students acknowledged greater satisfaction with their ability to interact with the instructor than their ability to share with the rest of the class; however satisfaction with both areas was not high with over 30% of the class stating disagreement or

neutrality. This can be attributed to a lack of interaction between the class and the instructor during the use of DimDim. This is illustrated by the comment that *there was not enough collaboration and the only person we heard was the instructor*.

As indicated in the interactivity matrix results, the majority of students did not engage in learning community activities such as discussion forums and DimDim interactions as there was an average of one interaction per student per class. The lower level of agreement and increased uncertainty in relation to the community building activities of sharing information and interacting with the rest of the class reflect this.

6.5 Lessons Learned From the First Phase

The first phase of the virtual class delivery experienced difficulties due to the induction process for DimDim, the technical performance of DimDim and the instructors' use of the system. The speed of some the students' broadband connection meant that they had difficulties taking part in the class. The instructor operated the class more as a broadcast than an interactive experience and there was minimal use made of the interactive features in DimDim. This is reflected in the interactivity matrix results with no use being made of the shared microphone. The majority of the interaction that did take place took place through group responses such as typing yes or no or using the mood indicator.

The problems associated with the instructors use of DimDim resulted in the students taking part in a limited amount of interactions. In order to improve the student experience for the second phase a number of changes were made to aspects of the e-learning framework. The changes were to focus on the role of the instructor as well as increase the types and quantity of interaction using the DimDim system and decrease the class size. The different aspects of the e-learning framework were changed as outlined in the following sub-sections;

6.5.1 The Functionality of Moodle

The results from evaluation on the functionality indicate a number of students found the system unstable with only 40% agreeing or strongly agreeing that the website as

stable. The majority of the class were able to navigate the website. The changes made to the use of Moodle for the second phase are as follows;

- The access details were issued to the group a week before the classes were held to allow any technical problems with access to be resolved.
- The navigation system between the virtual classes and the general layout of content on the pages was rearranged and made easier to navigate.

6.5.2 The Functionality of DimDim

The functionality of DimDim highlighted some major problems. 27% of the class were unable to use the system, 51% did not use class polls, 89% did not use the microphone and 40% did not use the text chat. There were also technical problems with 32% disagreeing with the clarity of audio being clear and understandable and 24% disagreeing with DimDim being easy to use and trouble free. In order to improve the use of DimDim for the second phase the following steps were taken:

- Greater effort was made in preparing the students for DimDim by giving them a live DimDim session in a computer lab where all the students could experiment with the feature and talk to the instructor who was in the room with them.
- All the students were instructed to purchase headsets for use with DimDim. In the first session some of the students only had headphones which meant they did not use the microphone features.
- A detailed guide was given to students as they were inducted in using DimDim. The guide allowed students to familiarise themselves with the system. A copy of the guide is in appendix B.

6.5.3 The Role of the Instructor

The evaluation results indicate 30% of the class felt the level of interaction with the instructor was low or very low. This corresponds with an average rate of an interaction every 1.7 minutes and an average one total interaction per class per student. As the interactivity matrix showed no use of the microphone and low levels of individualised interactions, the following steps were taken to ensure the level of interaction facilitated by the instructor improved for the second phase.

- A guide was put together by combining the content of the class with MI influenced activities in the form of a script for the instructor. The guide made use of Gauges events of learning and was adopted for each virtual class. A copy of the guides are in Appendix C.
- The instructor made a greater effort to make sure each member of the virtual class was engaged and interacted with DimDim's features.

6.5.4 The Class Content

In order to use multiple entry points in the class content the content was designed to be visual and use realistic case studies as well as being clear and easy to understand. The results from the content show over 70% agreement or strong agreement that content was presented visually, made use of case studies and was clear and easy to understand. In order to improve the content for the second phase steps taken were to widen the multiple entry point by giving the students more content presented in different ways. These steps involved:

- Giving students more time to access the class content.
- Providing more videos and diagrams relevant to the class content.
- Providing further links to external websites that gave further perspectives on the class focus.
- Making a greater effort to structure the forums through the use of leading questions to spark discussion based on the class content.

6.5.5 Learning Community

The results from the learning community indicated that 54% agreed that the virtual class allowed them to share what they learned with the rest of the class and 68% agreed the virtual class made it easy for them to interact with the instructor. From the interactivity matrix and student comments there were not enough community building activities during phase one. There were no posts made to the class forums and the majority of the class had minimal interaction using DimDim. In order to improve the potential for community building activities during the second phase the following steps was taken

- The DimDim sessions were held with smaller groups. The smaller groups were designed to encourage more interactions.

The use of DimDim during phase one experienced difficulties both technically and through the role of the instructor. From a technological point of view there were a number of issues using the web meeting system DimDim. The students who logged on using wireless broadband had difficulty taking part in the class due to the connection speed. When DimDim was used, the use of individual interaction features were minimal, with the shared microphone feature not being used at all. In terms to the asynchronous communication there were no posts made to the class forum.

The changes made to the framework based on the first phase evaluation results, focused on the instructors operation of the DimDim web meeting system. The first phase results indicated student satisfaction with the content presentation and the second phase sought to build on the content and enable more interactions. The groups of the second phase were much smaller, with an average of 5 people per group. The classes started interactions through the class forums and then built on the forum posts to interactions within DimDim. The results of the second phase evaluation are outlined in the following section.

6.6 Phase Two

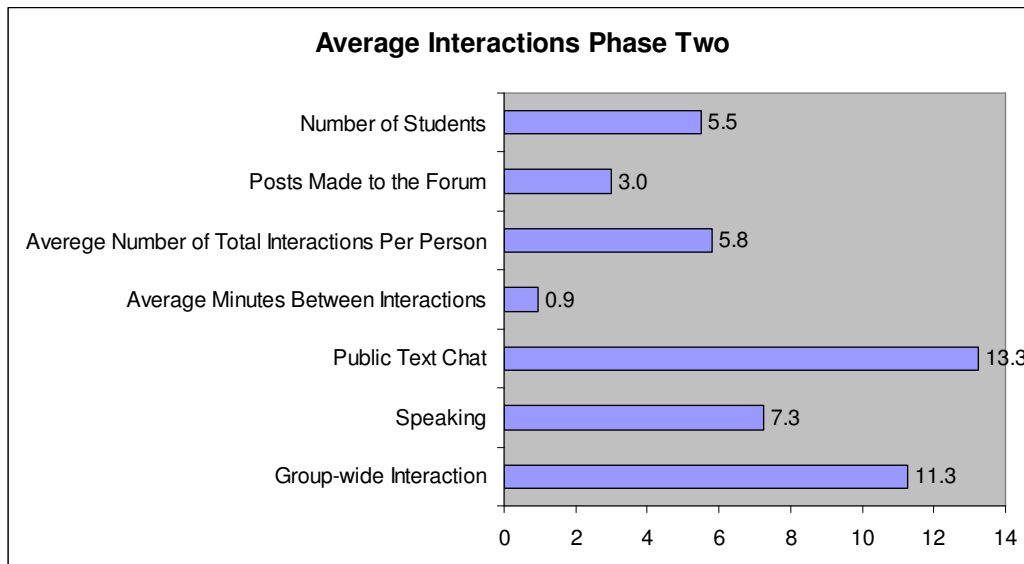
For the second phase delivery, the e-learning framework was revised and delivered to a group of twenty two students at WIT. The group were members of a part time master program designed for professional people who work in the construction industry. The class was broken into groups and completed four virtual classes.

Induction: The induction for using the virtual class was given in a computer lab where the students had access to the virtual class and could experiment with the features as it was shown on the data projector. The group were given their user name and passwords a week before any classes took place, to allow people to familiarise themselves with the content and technology. Everybody was given a DimDim guide to use during the virtual class.

Observation on the Class: The DimDim system worked as planned and extensive use was made of the shared microphone to add to the class interaction. The audio

quality during the session still caused problems, however there was a good mix of group and individual interactions. As all the students had access to broadband the class was delivered to everybody in their home. The average interaction results from the four classes in phase two are highlighted in figure 6.8. As illustrated in figure 6.8, the average class size was 5.5 students and averages of 3 posts were made to the class forums. The average number of interactions per person was 5.8 and the number of minutes between interactions was 0.9. The channels of interaction on average were public text chat with 13.3 interactions, speaking with 7.3 interactions and group-wide responses with 11.3. The average of total interactions per students was 5.8.

Figure 6.8 Average Interactions Phase Two



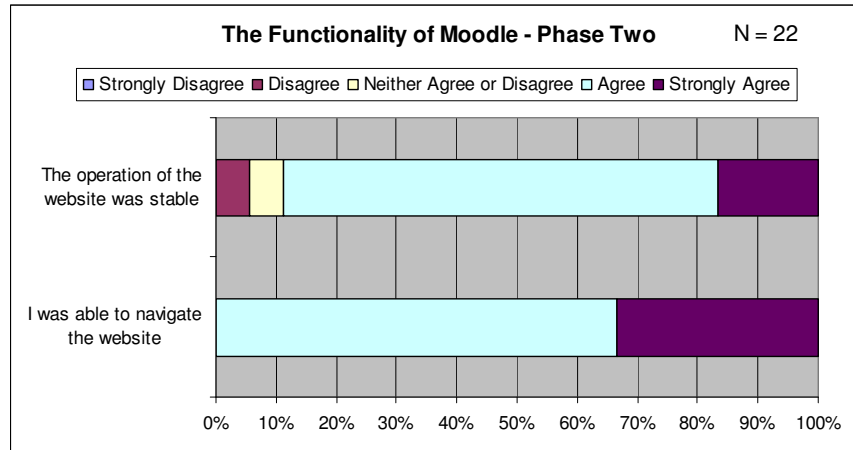
The evaluation questionnaire results for phase two of the virtual classes are presented in the following section. The questions that the students answered are the same as in phase one to allow comparison between phase one and two.

6.7 The Second Phase Evaluation Results

6.7.1 The Functionality of Moodle and DimDim

The evaluation results start with the results for the functionality of Moodle. The results are illustrated in figure 6.9 and student comments are shown in table 6.5.

Figure 6.9 Phase Two – The Functionality of Moodle



89% of respondents agreed or strongly agreed that the operation of the website was stable. 6% expressed neutrality and 6% found the system unstable.

100% of respondents agreed or strongly agreed that they could navigate the website.

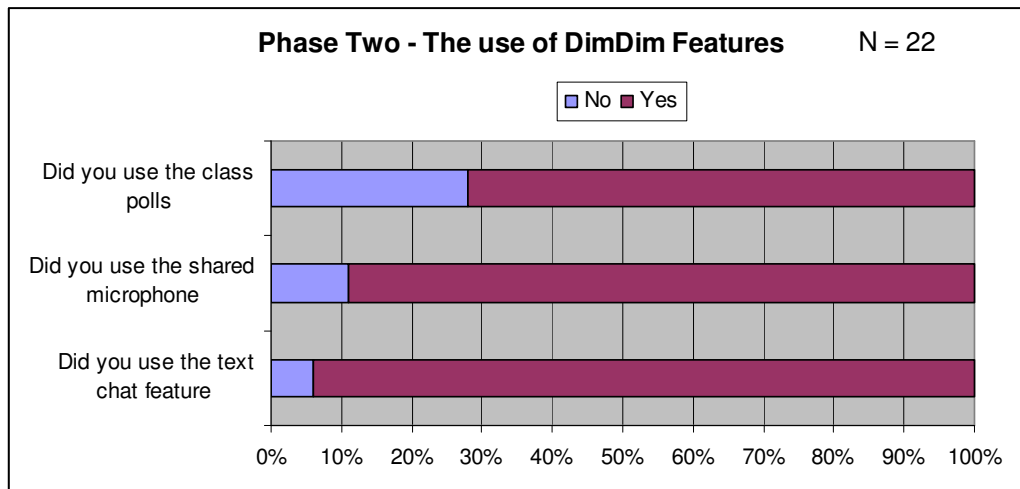
Table 6.5 Comments on the Functionality of Moodle

The content was interesting and easy to use.
The website worked well for delivery of the information.
I think the website works very well and is fairly easy to understand.

The second phase highlights an increase in the satisfaction levels of the Moodle interfaces functionality. The stability of the system is much improved from the first phase, with 89% of students agreeing or strongly agreeing that it was stable. 90% of respondents agreed or strongly agreed that the Moodle LMS was easy to use and 100% agreed or strongly agreed that they were able to navigate the website.

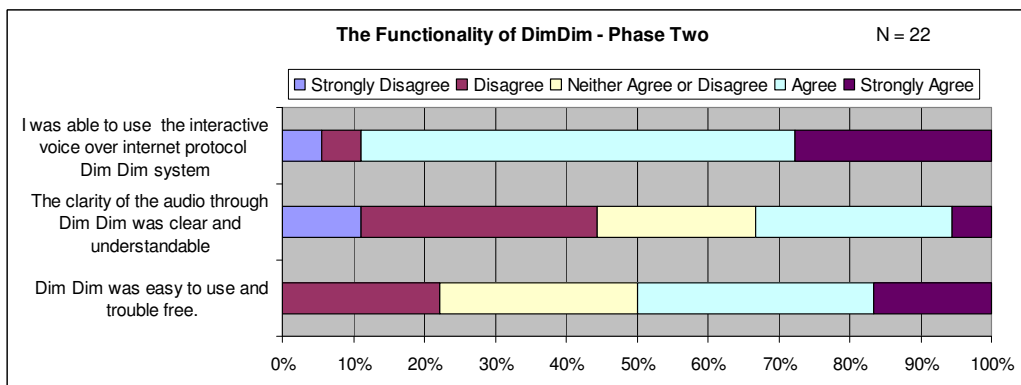
The results from the questions of the use of DimDim and the functionality of DimDim are illustrated in figure 6.10 and 6.11.

Figure 6.10 Phase Two – The Use of DimDim



When asked about the use of DimDim’s features 72% used the class polls, 89% used the shared microphone and 95% used the text that feature. The response to the questions on the functionality of DimDim are illustrated in figure 6.11 and student comments are highlighted in table 6.6.

Figure 6.11 Phase Two – The Functionality of DimDim



12% of respondents disagreed or strongly disagreed with being able to use the interactive voice over internet protocol DimDim and 88% agreed or strongly agreed. 34% of respondents agreed or strongly agreed that audio through DimDim was clear and easy to understand, 22% were uncertain and 44% disagreed or strongly disagreed. 17% agreed strongly, 33% agreed, 28% were uncertain and 22% disagreed that DimDim was easy to use and trouble free.

Table 6.6 Comments on the Functionality of DimDim

I had cable broadband installed in order to be able to participate, but the transmission of the lecturer's voice broke down after a period of time and I found myself concentrating on listening to the "echo" which was transmitted continuously. As this was the first class some minor issues were experienced at the start, but all in all I thought it was a good learning experience. I did have problems with the sound breaking up at times however but this may have been due to my own computers operation.

The majority of the interactive features of DimDim such as text chat, microphone sharing and class polls were used by the students. The interactivity matrix for the second phase highlights that there was an average of 13.3 interactions with public chat features, 11.3 interactions using the group-wide responses and 7.3 interaction using the shared microphone. During the second phase there were still limitations of broadband speed experienced by most of the students. This was reflected in the low rating given to the audio quality by the students with only 50% agreeing or strongly agreeing that DimDim was easy to use and trouble free. Furthermore 45% of the students disagreed or strongly disagreed that the audio through DimDim was clear and understandable.

The majority of the class were able to use DimDim. This indicates that the induction to using DimDim was successful. Technical problem related to the limitations of broadband speed caused high levels of neutrality suggesting that the students were able to use DimDim but were not fully satisfied with its stability. This is backed up by the students comments in table 6.6 which point out some technical issues with the operation of DimDim. Despite the continued technical issues, the results of the second phase show an improvement in terms of the instructors use of DimDim. The interactivity matrix results show a large increase in the quantity and type of interactions initiated by the instructor with the total interactions per student being 5.8.

6.7.2 Phase Two – The Interaction with Instructor

The second phase of the virtual class demonstrates a substantial increase in the level of interaction the students had with the instructor. This is largely due to the decreased

group sizes and the increased effort made by the instructor to engage the students. 95% of the students felt the interaction with the instructor was average or above average. The students almost unanimously agree that the pace of the virtual class was perfect, with 89% of the class describing the pace of instruction as perfect. The average amount of time between total interactions during the classes was 0.9 minutes and the average amount of interactions per person was 5.8. The increase in interaction levels effected students' satisfaction levels with the role of the instructor. Compared to the first phase results, the second phase results from the evaluation questionnaire and the interactivity matrix support the use of the instructor guide and the smaller groups of students. Some of the comments made by the students are included in table 6.7. The comments reflect positively on the instructor and emphasise the importance of the instructor role in the class delivery.

Table 6.7 Learner Comments on the Role of the Instructor

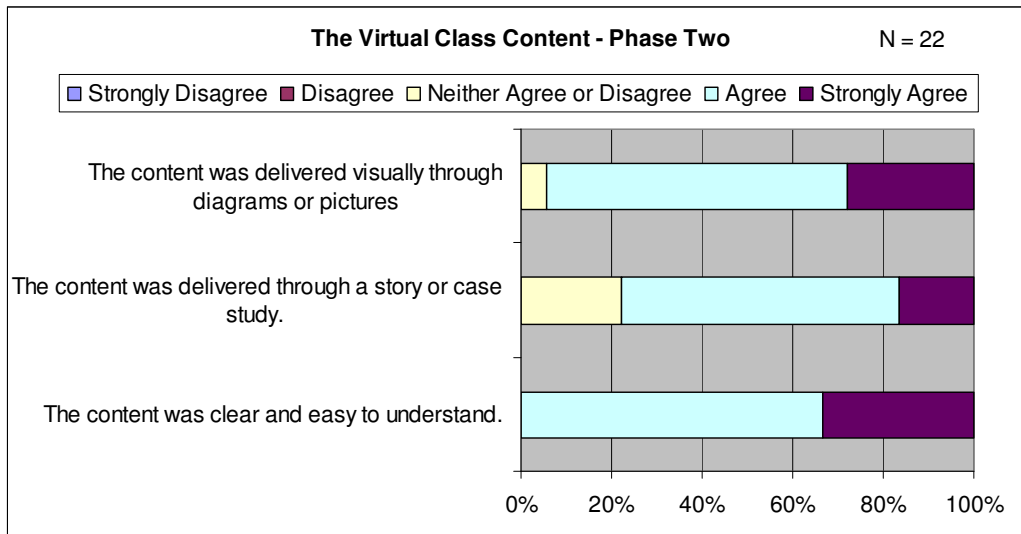
<p><i>I felt it was run very well. The instructor gave everybody a chance to speak and interacted with everyone.</i></p> <p><i>The role of the instructor is vital to manage the class and share the microphone.</i></p> <p><i>I felt that interaction with the instructor was enough. The style of the presentation was very natural and encouraged participation even though my own microphone did not work properly and I ended up using the text chat. The presenter tried to get my feed back, and give others time to interact.</i></p>

There were on going technical problems with the quality of audio through DimDim which are reflected in the learner comments. One comment refers to the fact that their microphone did not work, but that they could still interact with the class through the text chat. In the second phase of the class delivery, the instructor was more successful in combining the pace of instruction with the level of interaction.

6.7.3 Class Content and the Learning Community

Figure 6.12 illustrates the evaluation results for the class content delivered through the virtual class and table 6.8 contains some student comments.

Figure 6.12 Phase Two – The Virtual Class Content



The results shown in figure 6.12 are outlined in the following section and some of the students comments are given in table 6.10.

95% of respondents agreed or strongly agreed that content was delivered visually.

78% of respondents agreed or strongly agreed that the content was delivered using case studies. 22% expressed uncertainty to case studies being used.

100% of respondents agreed or strongly agreed that the class was clear and easy to understand.

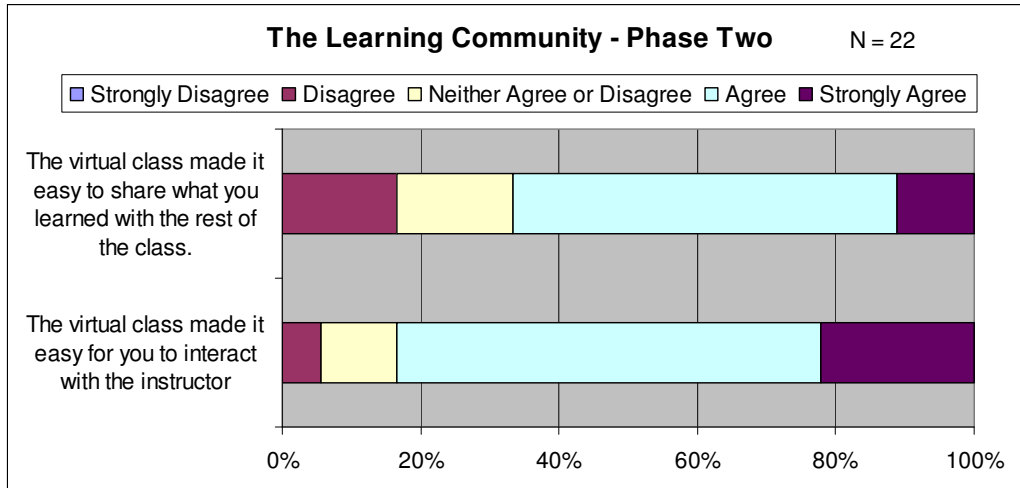
Table 6.8 Learner Comment on the Virtual Class Content

The case studies and videos work a lot better than pages of text.
The forums and web chat is also extremely effective as it facilitates learning from other peoples real life on site experiences.

The second phase shows a clear increase in agreement with content being delivered visually, using case studies and being clear and easy to understand. The changes made to the classes during the second phase in terms of using videos and more images are reflected in the student comment of: *the case studies and video work a lot better than pages of text.*

The results for the questions on the learning community are presented in figure 6.13 and the students comments are in table 6.9.

Figure 6.13 Phase Two – The Learning Community



67% of respondents agreed or strongly agreed, 17% expressed neutrality and 17% expressed disagreement in their ability to share what they learned.

83% of respondents agreed or strongly agreed that they could easily interact with the instructor. 11% expressed uncertainty and only 6% disagreed.

Table 6.9 Learner Comments on the Learning Community

We had very limited audio and were unable to make contributions verbally; we did most of our communication by typing which was really good as you could see other people's comments and feedback.

The time delay over the connection made it difficult to interact. In a normal classroom environment it is much easier to share an opinion without having to wait for the time delay.

When everyone could use the microphone then it was at its best. It was good to hear some of the lads giving their examples on safety in the workplace. You can't really get the same experience if they are typing it out.

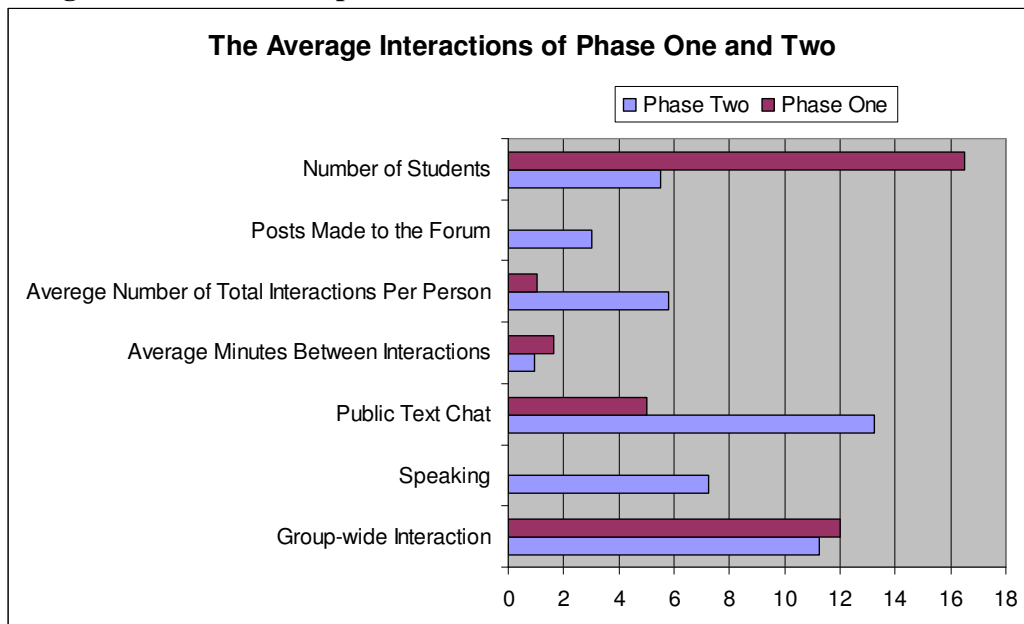
There was a mixed result in the ability to form a learning community using the virtual class. The technological limitations with DimDim and broadband speeds interfered with the real time interactions between the class participants. This is reflected in a student comment of the time delay over the connection made it difficult to interact.

The smaller groups of people using the DimDim system were more suitable as the amount of total interaction per person increased from 1 in the first phase to 5.8 in the second phase. The largest increase in satisfaction from the learning community was the area of interaction between class participants and the instructor but the problems with the audio quality over DimDim is a recurrent problem reported in the student comments.

6.8 Lessons Learned from the Second Phase

The second phase of the virtual classes showed an improvement on the first phase in terms of the class interaction rate. During the second phase the average time between class interactions 0.9 minutes. In the first phase the average time between interactions was 1.7 minutes. The increase in interactions affected the use of the class forums as the second phase had an average of 3 contributions made to the forums. In comparison, the first phase had no posts made to the class forums. The changes in interactions from phase one to phase two are illustrated in figure 6.14.

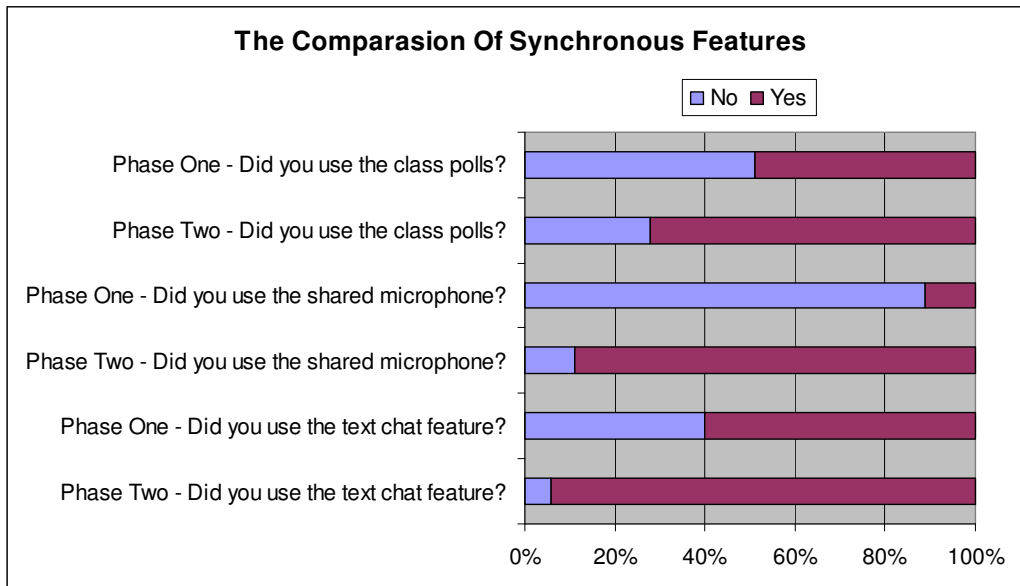
Figure 6.14 The Comparison of Interactions in Phase One and Phase Two



The key changes from phase one to phase two are the reduction in class sizes and the increase in the interaction of public text chat, speaking and group-wide responses. The largest change was the average interactions per person per class, which went from 1 in

phase one to 5.8 in phase two. There were significant technical difficulties with the quality and reliability of the DimDim system largely due to broadband speeds. While these difficulties were present through out the first and second phase of the class deliveries, the smaller class sizes and role of the instructor during the second phase increased the interaction and participation rates. The changes in the use of DimDim features are illustrated in figure 6.15. Students reported a shift in the use of DimDim features from phase one to phase two. Identifying yes to the use of DimDim features shifted from 49% to 72% in using the class polls, 11% to 89% in using the shared microphone and 60% to 95% in using the text chat feature.

Figure 6.15 The Comparison of the Synchronous Features.



The interactivity matrix results and the use of synchronous communication demonstrate the large increase in interactivity that took place in phase two compared to phase one. Table 6.10 compares the mean scores on the questionnaire results for Moodle, DimDim, the class content and the learning community between phase one and two. The mean score is for phase one and two allows for comparisons to be drawn between phase one and two and conclusions to be made on the effects of the changes made between phase one and two.

Table 6.10 A Comparison of the Mean Scores

Section of the Questionnaire	The Questions	Phase One	Phase Two
Moodle	I was able to navigate the website	3.7	4.33
	The operation of the website was stable	3.03	4
DimDim	I was able to use the interactive voice over internet protocol DimDim system	3.27	4
	DimDim was easy to use and trouble free.	4.3	4.44
	The clarity of the audio through DimDim was clear and understandable	4.14	3.83
Content	The content was delivered visually through diagrams or pictures	3.92	4.22
	The content was delivered through a story or case study.	3.81	3.94
	The content was clear and easy to understand.	3.86	4.33
Learning Community	The virtual class made it easy to interact with other students	3.62	3.39
	The virtual class made it easy for you to interact with the instructor	3.3	3.89

In completing the evaluation questionnaire, the students were asked to complete a Likert scale of five increments with 1 being the least positive and 5 being the most positive. Table 6.10 highlighted the effect of the action research refinements made between phase one and phase two. An increase in the mean score from phase one to phase two indicates an improvement in student satisfaction, while a decrease in mean score indicates a reduction in student satisfaction.

The functionality of Moodle in the second phase witnessed an increase in mean score of 3.7 to 4.33 for students' ability to navigate the website. The mean score for the stability of the website increased from 3.03 to 4. The increases in mean score from phase one to phase two support the provision of a week to allow students to access the website and the focus on improving the website by making it easier to navigate.

The changes made in the approach to using DimDim represented the most important improvement between the first and second phase. A detailed guide was given to students to explain the features of DimDim. The use of the guide to improve the induction process resulted in an increase in mean score from 3.27 to 4 for the statement *I was able to use the interactive voice over protocol DimDim system*. The technical aspect of DimDim caused problems during phase one and phase two. The statement *DimDim was easy to use and trouble free* resulted in a small increase in mean score from 4.3 to 4.44 and the statement *the clarity of the audio through DimDim was clear and understandable* decreased in mean score from 4.14 to 3.83.

The quality of the internet connection available to students was the cause of the technical problem experienced during phase one and two. The results demonstrate the effectiveness in using the detailed DimDim guide during the induction but also highlights the on going issues with audio quality and satiability over slower internet connections.

The students identified a high level of satisfaction with content being presented as case studies and being interactive, as well as being accessible and understandable. The satisfaction levels with the class content improved from the first phase. The mean score for *the content was delivered visually through diagrams or pictures* improved from 3.92 to 4.22. The mean score for *the content was delivered through a story or case study* increased from 3.81 to 3.94 and the mean score for *the content was clear and easy to understand* increased from 3.86 to 4.33. The use of embedded videos and links to external websites as well as the linking of content to the forums during the second phase produced an increase in student satisfaction with the class content.

There was mixed results in the student's satisfaction levels with the ability to create a learning community. The biggest increase was with the level students felt they could interact with the instructor, the level students felt they could interact with other students reduced from the first phase to the second phase. *The virtual class made it easy to interact with other students* highlighted a decrease in mean score from 3.62 to 3.39. *The virtual class made it easy for you to interact with the instructor* produced an increase in mean score from 3.3 to 3.89. The fact the virtual classes were held over approximately a one hour period, meant the learning community had limited time to develop. This explains the reduction in the student to student interaction score from phase one to phase two. Some of the comments made by student reflected the potential the class offered to form a community over time. The increase in the mean score for the students ability to interact with the instructor and the large increase in the quantity and variety on interactions from the interactivity matrix in figure 6.14 demonstrate the improvement from phase one to phase two. The key improvements that resulted in an increase in community building activities involved using smaller groups of students and designing an instructors guide to prompt interactions.

The role of the instructor received a large increase in student satisfaction from phase one to phase two. During phase one 50% of students identified the pace of instruction as perfect and in the second phase that increased to 89%. 70% of student described the interaction with the instructor as being average or above average in the first phase which increased to 95% for the second phase. The interactivity matrix in figure 6.14 demonstrates the total interactions per student increase from 1 in the first phase to 5.8 in the second phase. The increase in instructor satisfaction levels combined with the increased amount of class interaction demonstrates how the instructors role changed from phase one to phase two. The use of the instructors guide which blended technical, social and content relevant information increased the students satisfaction with the class content, the use of technology during the class and the role of the instructor in facilitating interactions.

6.9 Summary

The first phase of the virtual classes used the Moodle LMS to present the class content visually and though the use of case studies in a way that was clear and easy to understand. The use of the synchronous system DimDim however was unsuccessful in generating sufficient social interaction to allow students to engage in community building activities. The failure was in part technological and in part down to the role of the instructor. The effective operation of Moodle and DimDim supported by the instructor was key to the creation of a learning environment. The problems associated with DimDim and the use of DimDim by the instructor during the first phase of the virtual classes impacted on the social interaction during the class and this was reflected in the evaluation results.

The evaluation results for the second phase produced a clear improvement on the first phase. This was due to the following changes made to the e-learning framework.

- The instructor followed clear instructional guidelines that promoted personalised interaction by using the class forums to link the class content and with the DimDim sessions. The instructor sought to maximise the potential of both the asynchronous - Moodle and synchronous – DimDim systems to create and sustain group discussions.

- A guide for using DimDim was given to the students before hand to improve the induction process as some of the students had been using it less effectively during in phase one
- A greater range of perspectives were added to the class content by providing videos and links to relevant external websites. This helped to create talking points to further expand the group discussion.

In conclusion the second phase expanded on the first one by dealing with some of the problems that were attached to the use of DimDim and the role of the instructor. The differences in the student groups used in phase one and two limited the amount of comparison that could be drawn between the phases, however some comparison could be drawn as to the role of the instructor and the use of technology. While there were still problems with the quality and reliability of synchronous activities due to broadband speeds, there were more successful interactions which lead to an increase in student satisfaction. As the synchronous interactions were held in a single session on DimDim lasting approximately one hour, and the asynchronous interactions took place over one week through Moodle, there were limitations to the degree to which a learning community could be developed. The evaluation results for the second phase show a increase in the community building activities of synchronous and asynchronous interactions which can lead to the creation a strong learning community which over time. MI theory did aid in the provision of content that was accessible to a group of people with varied intelligence profiles. It also has the potential to create an inclusive learning community that facilitates and encourages students through targeting their dominant intelligence areas.

Chapter Seven: Discussion

The aim of the investigation was to create an e-learning framework which incorporated MI theory and to pilot the framework by delivering health and safety training to construction students. The integration of MI theory involved presenting the content in a number of ways and the use of an MI profiling system on a sample of the target group. The MI profiling results were used to identify collective MI strengths among construction managers and target those strengths through virtual classes. The methodology for the investigation was an action research case study, which used iterative cycles of the e-learning framework to refine the use of MI principles in an e-learning environment. The virtual classes were delivered at WIT and a student evaluation questionnaire and interactivity matrix were used refine the e-learning framework and draw conclusions from the results.

The literature review looked at the technological facets available to the e-learning framework. Moodle and DimDim were the open source and cost effective solutions for the asynchronous and synchronous communications required for a learning experience. The virtual classes were run in two phases at WIT and analysed in two ways. Firstly the classes were recorded and archived for students to view at a later date, the archived footage was reviewed and the quantity and types of interactions were recorded. Secondly the students were asked to complete an evaluation questionnaire which asked their opinion on the use of technology during the class as well as their learning experience. The combination of the interaction and the evaluation results over the two phases of delivery gave a picture of the effectiveness of the framework as a whole and allowed conclusions to be drawn as to the instructor's role in the process. The chapter concludes with a summary of key findings from the investigation and an outline of how an instructor could use MI theory in an e-learning environment.

7.1 Multiple Intelligence

Reigeluth (1999) commented that the influence of information technology and the development of educational design have shifted the focus of education. Technology in education reduces the burden of providing information and focuses the attention on how people learn (Sanchez and Llera, 2006). Howard Gardner and the theory of MI has been influential in the shift from a narrow definition of intelligence to a wider

definition of what intelligence is and how it is created (Smith, 2008). The theory of MI has been widely used in classroom based education and this investigation sought to apply elements of MI theory within an e-learning environment.

Bloom's taxonomy of cognitive objectives represents an alignment of the three learning theories of behaviourism, cognitivism and constructivism which enables students through incremental steps to use higher level thinking skills (Mödritscher, 2006). An online environment places responsibility on the individual student and requires large amounts of self motivation (Eom et al., 2006). The use of MI theory as a conceptual guide allows the e-learning framework to focus on how people learn and how to adopt e-learning tools to create and support a learning environment (Freund and Piotrowski, 2003).

7.1.1 Health and Safety Training in the Construction Industry

In order to give training within the context of the construction industry, the content targeted construction managers. The review of training within the construction industry identified the need to increase the quantity and quality of staff training to meet financial, legal and competitiveness constraints (Lin and Mills, 2001). One of the main issues that require increased training is the area of health and safety. The investigation targeted this need for health and safety training in the construction industry by delivering falls from height virtual classes.

The design and delivery of the content was guided by the results of the MI profiling of a sample group of construction managers. The MIDAS system is an MI profiling questionnaire designed to measure the MI profile of individual students. A group of construction managers were asked to complete the questionnaire which produced an average MI profile for the group. This average score was analysed and the results were used to influence the design of the content and the role of the instructor during the classes. The results from the MI profiling identified the dominant intelligence areas as being, visual / spatial and logical / mathematical with a high level of spatial problem solving. The dominant intelligence areas identified by the MIDAS were used in the design of the class content. Due to the time constraints of the investigation the results from the group of construction managers were transferred to the construction

students. The differences in groups students which were under graduates in the first phase and post graduates in the second phases was also a limitation of the investigation. The difference in students between phase one and two reduced the amount of comparison that could be made between the two phases.

The content was designed to make use of visual elements and case studies. A 3D model of a construction site was used to present the falls from height in a way that targeted spatial problems solving. From the first phase results, there was agreement with the content being presented visually and through the use of case studies. The majority of the class found the content clear and easy to understand. The interactivity matrix for phase one indicates that there were no posts made to the class forum during the duration of the class. In order to increase the interactivity during the classes in phase two there was an increase in the interactive content on Moodle. This was achieved through the use of embedded videos, links to external websites and the use of a number of leading questions on the class forums to start discussions. The results in phase two highlighted an increase in satisfaction levels and greater use of the forums. The use of visual material and realistic case studies were successful in creating engaging content. The increase in interactivity during the second phase was demonstrated by greater student involvement.

7.2 Virtual Classes

In order to achieve the blend of individual self study and group collaboration using both synchronous and asynchronous communication identified by Romiszowski (2004), the Moodle LMS and DimDim web meeting system were used. Bower (2007) identified stability and ease of use as the key requirements of technology used in education. An evaluation questionnaire asked the students to rate the operation of Moodle and DimDim and the role of the instructor, as well as the social interactions that took place.

7.2.1 The Moodle LMS

The function of the Moodle LMS was to provide a stable and easy to use system to deliver class content and provide tools for asynchronous collaboration. The first phase satisfaction results show a number of participants reporting the operation of the

system as unstable. This was largely due to problems with the administration of passwords which meant that the students could not log into the LMS as planned. This was a mistake by the instructor that was discovered during the induction and was rectified before the class started. For phase two of the classes the passwords were administered correctly and the students were given seven days to familiarise themselves with the LMS. The satisfaction ratings on the operation of Moodle in the second phase demonstrated broad satisfaction with the stability and ability to navigate the LMS. This supports the comments of Cole and Foster (2007) who identified Moodle as being an efficient and easy to use LMS that could facilitate the asynchronous communications during a virtual class.

7.2.2 The DimDim Web Meeting System

The DimDim web meeting system was selected to offer synchronous audio, video, text chat and presentation sharing during a virtual class. The features offered by the web meeting system were identified as an important part of creating the real time interactions that maintain students motivation and create a social learning experience (Bower, 2007).

During the first phase the satisfaction levels for the functionality of DimDim highlighted problems. The majority of the class did not use the thumbs up indicator and the shared microphone, and not all used the text chat features. Of those that did use DimDim's features, over 30% of the class did not think the audio was clear and understandable or that DimDim was easy to use and trouble free. The interactivity matrix indicates that no interactions took place by the students using the shared microphone and the majority of the interaction was group wide with a small number of students interacting individually.

The second phase results were an improvement with all of DimDim features being used by the students. There were ongoing problems with the clarity of audio delivered over the DimDim system. As some of the students had poor quality internet connections, the interference was a distraction to the class. DimDim did not provide the synchronous communications to its full potential due to poor quality internet connection available to the class participants. Despite the ongoing audio problems of DimDim throughout the investigation, a number of students commented on its

potential to host virtual classes. A key requirement for the use of DimDim was a good quality broadband connection. Wexler (2007) identified the requirement of a high quality internet connection for using web meeting systems. During the investigation a number of students used wireless broadband which did not provide the quality of connection needed to use DimDim fully.

7.2.3 The Role of the Instructor

Tham and Werner (2005) identified the role of the online instructor as fulfilling technical, pedagogical and social roles. The balanced use of these roles by the instructor was identified as one of the key factors in the successful deployment of the e-learning framework. During this investigation the instructor was required to present content using MI influenced principles through the DimDim web meeting in a way that encouraged students to interact.

The results from the first phase evaluation questionnaire indicated a low level of interactivity between the instructor and the class. The interactivity matrix indicates that there was an interaction with the class on average every 1.5 minutes and there was one interaction per student per class. Of those interactions the majority were group wide in the form of mood indicators and text chat. The low level of individual interaction and the fact that there were no posts made to the forums during the first phase suggested passive involvement by the students. Low levels of interaction and collaborative activities have been associated with lower user satisfaction and learning outcomes (Eom et al., 2006).

In order to allow the instructor to increase the interaction and the role of individual students during the class there were two main changes in the second phase. Firstly the classes were made smaller, the first phase had two groups of 16 – 17 students and the second phase had 4 groups of 5 – 7 students. Secondly the instructor had a guide with recommended interaction activities which could be carried out with the class content. This guide was based on Gagnes 'Events of Learning', identified in the literature review and guided the instructor in a step by step way. The guide also allowed the instructor to fulfil the required social, pedagogical and technical roles required.

Instructor immediacy refers to the connectedness between the students and the instructor and is an important part of creating a learning community in an online environment (Melrose and Bergeron, 2006). The results from the second phase showed a clear improvement in both the pace of instruction and the level of interaction. The increase in interaction along with improved satisfaction with the role of the instructor demonstrates an increase in the level of instructor immediacy.

7.2.4 The Learning Community

Palloff and Pratt (2005) identified the creation of a learning community as one of the key aspects to creating a successful virtual class. In order to create that community regular interaction is required between the instructor and the group of students (Davis and Wong, 2007). The creation of a community is a key step in facilitating students in moving from lower to higher level learning activities in an online environment (Sword and Leggott, 2007). Wenger (2004) identified the need for interaction and Hutchins (2003) identified instructor immediacy over a sustained period of time in order to allow a strong learning community to develop. As the virtual classes took place over one session the degree to which a learning community could form was limited. The investigation took the evidence of interaction during the virtual class and the level of instructor immediacy reported by the students as a measure of community building activities.

The evaluation questions on the learning community asked students if they could share what they learned with the rest of the class and if the class made it easy for them to interact with other students. From the first phase results, over half the class agreed or strongly agreed but the rest of the class expressed uncertainty or disagreement. The interactivity matrix indicated there were no posts made to the forum and most of the interactions in DimDim were made through group wide interactions. The students were passive in their participation in the class and this did not result in interactions that could lead to a learning community. In planning for the second phase of the class delivery it was clear that the social interactions during the class had to be improved. In order to achieve this, the following steps were taken:

- Students were given a week to familiarise themselves and use the class forums.

- The DimDim sessions were held with smaller groups of people.
- A greater effort was made by the instructor to have two way communication.

The second phase illustrated a clear improvement in the satisfaction levels in the social aspect of the virtual class. Due to the fact that the class did not take place over a longer period of time meant the social aspect was limited. However the changes made based on the first phase evaluation results did make a difference in the second phase. The large increase in all of the interaction types observed in the interactivity matrix for the second phase supports this conclusion. The increases in interaction and instructor immediacy are important community building activities. Based on the literature review and the results of this investigation the lessons learned from the research are presented in the following section.

7.3 Lessons Learned from the Investigation

The design of the e-learning framework used for this investigation was based on an alignment of e-learning technology and MI influenced educational theory. The e-learning framework was defined as the use of synchronous and asynchronous communication channels to allow a learning community to develop. This involved the interactions between the instructor, the content and the group of students. The key focus of this investigation was the role of the instructor in the e-learning framework.

Based on this investigation a number of conclusions can be drawn.

1. MI profiling was a useful tool in the development and operation of the content for an e-learning environment. The MIDAS results provided a group of dominant intelligence strengths which were a useful guide to designing content which made sense to students within the context of the construction industry. The MIDAS system allowed for the identification of the strengths in intrapersonal, visual / spatial, interpersonal, verbal / linguistic and logical / mathematical intelligences, even though the instructor was disconnected from the students in an online environment. Using the MIDAS results in combination with the multiple entry points allowed for students to have access to the class content through a number of perspectives.

2. A comprehensive induction and familiarisation period is required to ensure all students are comfortable with using e-learning technology. During the second phase of delivery, students were given a guide to using DimDim and a period of one week to familiarise themselves with the technology. These step increased student satisfaction with the stability and ease of use of the technology.
3. Based on the deployment of the first phase of the virtual class an instructor's guide was created. This guide facilitated the instructor in balancing the roles of using technology, creating social interactions and delivering the class content.
4. A high quality broadband connection is necessary in order to use synchronous web meeting systems. The varying quality of broadband connections experienced by students proved problematic in both phases.
5. The use of multiple entry points with the presentation of class content, allowed each individual learner to engage using their intelligence strengths.
6. Using social interactions to drive the group learning is a particular challenge in an e-learning environment. The blend of asynchronous and synchronous communication such as forums and web meeting systems like DimDim faced both technical and motivational challenges. This challenge proved to be a bigger issue than initially anticipated at the beginning of the investigation. The investigation found that the instructor having a clear plan that tied the content with the synchronous and asynchronous communication improved the students' rate of interaction in the class.

Phase one provided satisfaction with the way content was presented on the LMS, but there was very little group interactions through the forums or the DimDim web meeting system. Phase two illustrated an improvement in the satisfaction with the presentation of content and there was a marked improvement in the interaction levels of both the web forums and DimDim. This improvement was due to smaller group sizes and the instructor getting a response from the students through the forums first and then building on that response through the DimDim web meeting system.

One important factor in the increase in student interactions in the second phase was the role the instructor played in turning the students satisfaction with class content into interaction through class forums and through DimDim. The instructor used a step by step guide in operating the DimDim sessions to blend content with MI influenced activities. By focusing on encouraging forum contributions and building on them during the DimDim session, the interaction and use of DimDim features increased in the second phase. The process of building a learning community that has a large amount of interaction requires a period of time to build up. In the first phase the students did not make use of the forums and that was reflected through little use of the DimDim features. The effective use of a web meeting system like DimDim benefits from students being fully familiar with the class content and having carried out some learning activities on their own through class forums. During the second phase the group of students were smaller which resulted in over five times the amount of interaction per student. The use of DimDim clearly benefited from better leadership from the instructor and smaller class sizes.

With using e-learning technology there is a clear barrier between providing content on the web and having a social interaction with a group about that content. The use of MI principles within the e-learning framework contributed to overcoming that barrier. By making an effort to present content that appeals to students, and then drawing them into a personalised interaction increased student satisfaction with the learning experience. MI theory however is not a one size fits all approach and needs careful application. Kornhaber (2001) pointed to the value of MI theory in offering a conceptual influence in designing an educational approach. The observations and findings of this investigation would support this. The use of MI theory can be used to define an educational focus that is guided by the dominant intelligence areas of a group, the nature of the content being covered and the availability of resources.

The improvement in the second phase was a combination of the conceptual focus offered by MI theory and the improved role of the instructor. Figure 7.1 illustrate how MI theory can provide an educational focus and the role of the instructor can increase interaction within that focus.

Figure 7.1 The Educational Focus for Using MI theory

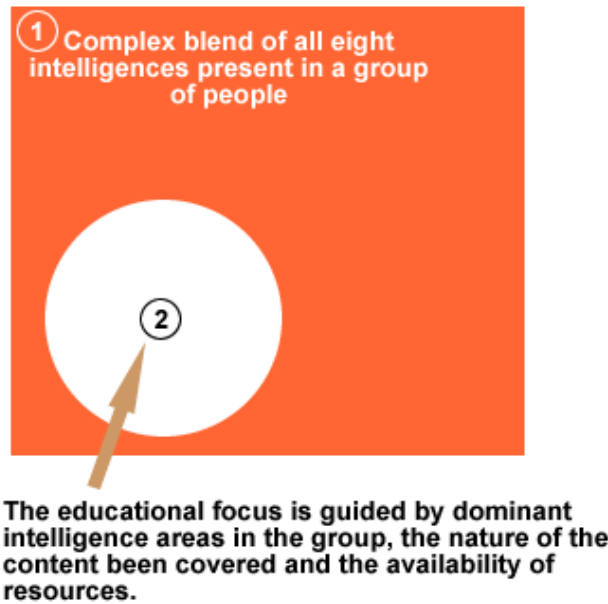


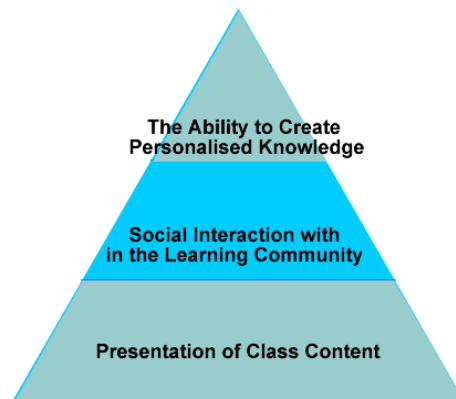
Figure 7.1 illustrates how MI principles can be used to give educational focus. The outer square area represents the total eight intelligences which are present to varying degrees in all groups of people. By using an MI profiling system to identify the dominant intelligence areas and target those intelligences in ways relevant to the content and available resources, a focus can be given to the virtual class. The selection of an educational focus, which allows a group of students to use their strongest intelligence areas flexibly, is an ongoing process which requires subjective analysis from the instructor and interaction with the group of students. The combination of targeting dominant intelligences on one hand and using a number of interactions types on the other is the key to the use of MI theory within e-learning. The following section outlines the key findings of this investigation and presents some guidelines for the use of MI in an e-learning framework.

7.4 Guidelines for an Instructor in Using MI theory in E-learning.

Based on the findings of this research, the role of the instructor in using MI with e-learning has three key stages. These stages deal with the areas of presentation of content, the creation of a learning community and facilitating each student in creating individualised knowledge. An MI profiling system such as MIDAS can be used to

identify the dominant intelligences areas in a group of people. Those dominant intelligences can be used to give focus to the content presentation options, the practices that guide the learning community and the individual performances student undertake as they personalise knowledge. Figure 7.2 illustrates these as the steps a student takes in the process of gaining skills and creating knowledge.

Figure 7.2 Illustration of the Steps to Using MI Theory in an E-Learning Framework



The class content should be presented in a way that allows multiple perspectives. The multiple entry points identified by Gardner (1993) and used in this investigation are outlined in table 7.1. Some examples are given as to how each entry point can be used to present class content.

Table 7.1 The Multiple Entry Points

Entry Points	Multiple Perspectives
Aesthetic	Photos, videos, illustrations, music
Existential	Blogs, wikis, personal internet research
Quantitative	Downloadable documents containing fact sheets, statistics and government reports
Narrational	Case studies and newspaper articles from a personal point of view.
Social	Collaborations via email and web forums, the use of web meeting systems.
Kinaesthetic	Natural activity that requires physical movement. Downloadable podcasts for use while jogging or driving.

Source: Acar et al. (2008)

Table 7.2 outlines some activities associated with the eight intelligences which allow students to interact with the class. The use of multiple practices, allows students to interact in a way that matches their MI profile. As students' access content and take part in a learning community in a way that makes sense to their personal MI profile, students are in a position to start to develop skills and knowledge. The use of multiple

performances allows students to create outputs from their education process. The combination of multiple practices and performances are a key part of creating a learning community that facilitates students in achieving higher level learning activities. Table 7.2 gives some examples of activities that involve practices and performances identified in the literature review.

Table 7.2 Multiple Practices and Performances

	Multiple Practices	Multiple Performances
Logical	Questions and polls	Electronic document submission.
Linguistic	Text and aural responses to instructors questions	The use of narration in a document or the production of a pod cast.
Intrapersonal	Use of emoticons. The use of reflective problem solving exercises	Regular updates to a blog or learning log over a period of time.
Interpersonal	Break out sessions using a web meeting system to involve text and spoken contributions.	Collaborative work which could be presented in a document or recorded as a podcast.
Natural	Problem solving exercises that involve natural phenomena, such as the weather or natural materials.	A field log of natural phenomena over a period of time.
Kinesthetic	The use of emotions during the web meeting system	A portfolio of items which required physical activity.
Visual	Reference to pictures and videos.	A portfolio of mind maps, flowcharts and other diagrammatic material.
Musical	The use of musical material to enforce key points in the class content.	The use of music to produce a podcast.

Source: Madden (2007)

The multiple performances involve the personalised presentation of what the learners achieved. The use of practice and performance that involve students MI profile allows the higher level learning activities identified by Churches (2008) to be achieved. Due to the time limitations of this investigation this is an area which was not explored to its full potential. This is an area that could be the basis of further research.

This investigation used the MI profiling system MIDAS to guide the process of creating an educational focus of the virtual classes. The evaluation then looked at the level of interaction which took place within that educational focus. As this investigation is a case study with the classes taking place over one session, the students did not have enough time to create the learning community required to move into higher levels of learning. It is clear in the second phase of delivery that even after one session, the group made further steps towards the higher order learning activities of application and analysis through increased group interactions. Many of the comments from the students indicated that they could see the potential for the system

over a longer period of time. In conclusion the use of MI influenced principles have a role to play in the conceptual use of e-learning. The human issues of motivation and ability to engage across different intelligence types and skill levels are often overlooked when using technology in education. The use of MI theory must be paired with a practical plan to ensure that enough interactions take place during the virtual class to allow a learning community to establish. The use of the instructors' guide to bring together the content, MI principles and interactions during the second phase of this investigation resulted in a clear increase in student satisfaction and engagement.

Chapter Eight: Conclusions and Recommendations

The conclusion and recommendations section of this investigation revisits the aim, objectives and research questions posed in the introduction chapter. It looks at the conclusions drawn from the completion of this investigation, makes recommendations for future research and comments on the limitations of the investigation. The discussion chapter identified the value of MI theory as a conceptual guide to creating an e-learning framework as shown from the research findings. Based on the findings of this investigation a list of lessons learned were identified. Delivering a virtual class requires a great deal of focus from the instructor to ensure the social, technical and educational roles are met. Based on these roles a guideline for using MI theory in an e-learning environment was outlined.

8.1 Research Aim and Objectives

Chapter One outlined the research aim and objectives that guided the investigation. The aim of the research was to create an e-learning framework which incorporated MI theory and pilot the framework by delivering health and safety training to construction students. The research aim was framed through the use of two research questions.

The research questions were;

- Can MI profiling be used to guide the instructional role and content development of an e-learning framework?
- When the e-learning framework is piloted with Irish construction students, how do they evaluate the areas of: the use of technology, the learning community, the presentation of content and the role of the instructor?

In overall terms this research found that MI profiling is effective in determining the dominant intelligence areas in a group of construction managers. The pilot of the framework through two phases underpinned the research findings in terms of the use of technology, role of the instructor as well as the content and the learning community.

The following objectives were used to guide the investigation:

1. Conduct a literature review on MI theory and its application to e-learning with a focus to health and safety training in construction.

2. Identify the key requirements for the selection of technology for the e-learning framework.
3. Apply a multiple intelligence profiling system to the target group of construction managers.
4. Design virtual classes which target falls from heights in the construction industry.
5. Deliver two phases of virtual classes to construction focused students as part of an action research methodology.
6. Conduct an evaluation system for participants so as to enable analysis of the use of technology, the presentation of content and learning interactions within the e-learning framework.
7. Based on the analysis of the investigation - produce a guideline for the instructor to use MI theory through e-learning technology.

In order to complete the investigations objectives, four virtual classes were developed based on a literature review of e-learning technology and the dominant intelligences areas identified through the MIDAS questionnaire. The MIDAS questionnaire was completed by construction managers and provided focus in terms of designing the class content on falls from height on construction sites. The content was delivered in two phases to two different groups of construction industry focused students. The delivery of the virtual classes allowed an action research methodology to evaluate and refine the design and delivery of the classes. An evaluation questionnaire was used to refine the virtual classes between the first and second phase identify the effects that those changes had. The issues identified from the first phase where addressed through changes to the virtual class delivery in the second phase. The second phase evaluation reflected on those changes and produced the major conclusions of the investigation. The results from the second phase show a clear improvement in student satisfaction with the class content and role of the instructor as well as an increase in overall class interaction. The major conclusions are outlined in the following section.

8.2 Summary of Major Conclusions

Based on the literature review and an analysis of the evaluation results from the virtual classes delivered at WIT, the following conclusions can be drawn:

1. The use of the MI profiling system MIDAS was a useful tool in identifying the dominant intelligence areas in a sample group of construction managers in an online environment.
2. The instructor plays a key role in the technical operation of a virtual class, facilitation of synchronous and asynchronous communications and the presentation of class content. The use of MI principles can aid the instructor in the challenges of presenting content and managing social interactions in a learning community.
3. A comprehensive induction process is an important part of an e-learning framework. The DimDim guide, created as part of this investigation, improved the level of interaction by class participants. The class sizes were reduced from phase one to two. The reduction in class sizes also increased the level of class interaction.
4. The web meeting system DimDim, used during the investigation, experienced some instability. The investigation demonstrated the importance of a high quality broadband connection in using web meeting systems. The quality of broadband available to a number of participants limited the functionality of the web meeting system.

This research was of a developmental nature and used technology and MI theory in order to create an innovative framework for e-learning in the construction industry. The use of an action research methodology meant that the focus on this research was to solve practical problems associated with the use of e-learning and MI theory and then reflect on the wider application to areas of wider focus. The developmental nature of the research meant that there were a number of limitations that effected the investigation.

8.3 Limitations

Some of the limitations which affected this investigation were as follows:

1. The students did not have sufficient time to use the e-learning framework. The students completed the classes in one session and for many of the

students, the use of the systems was a new experience. Even with an induction process in using the technology, some students were still not fully proficient. A structured induction process addressing the key features of the technology in greater detail would have allowed all of the students to familiarise themselves with the systems and focus on the learning process.

2. The investigation used undergraduate students during the first phase and post graduate students during the second phase. The use of different group of students meant that there were limitations to the degree of comparison between phase one and phase two. The use of exclusively post graduate or undergraduate students would have increased the degree of comparison. The use of a control group would have given allowed the learning effectiveness of the use of MI theory to be measured.
3. The action research methodology produced results that were focused primarily on problem solving. This limitation meant that the investigations results are not highly transferable to other situations. Future research could focus on quantitative research techniques to produce more transferable results.
4. The virtual class content could have focused more on the activities that required input from the students. The key to student interaction from the investigation was having the students comment on various aspects of the class content in the forums and then developing these comments through the DimDim web meeting system.
5. Due to the constraints of the investigation, the sample sizes used to identify the dominant intelligence areas among construction managers and deploy the virtual classes were small. Larger sample sizes could have given a more representative picture.
6. Due to time constraints, the students who completed the virtual classes, did not complete the MIDAS survey. The individualised nature of the MIDAS results can have a powerful effect on how students create their own learning

strategies. Making the MIDAS questionnaire more central to the class would have enabled MI theory to have more of a positive effect on the students.

7. During phase one the instructor could have focused more on facilitating class interactions. The use of different instructors between phase one and two reduced the degree of comparison that could be made on the role of the instructor.

8.4 Recommendations

Based on the findings of this investigation the following areas could be explored through further research.

1. Tools such as MIDAS have the potential to allow students to identify their own intelligence areas and develop personal learning strategies. Future research could look at how students could use MIDAS to identify and develop their own intelligence strengths as part of self directed learning.
2. The use of MI in education results in a wider range of learning activities and methods of assessment. Further research could be carried out on the identification of appropriate methods of assessment in an educational environment that uses MI theory.
3. The literature review identified the importance of an active learning community in an e-learning environment. The use of emerging technology in building online communities is a rapidly changing area and has application in creating learning communities. Further research could be carried out on the roles of emerging technology in creating active and inclusive online communities.
4. This investigation outlined the area of health and safety training as an area that could be targeted through online education. There are a range of other areas within the construction sector which could be targeted through e-learning. Future research could focus on the identification of these additional areas.

5. The higher level learning activities outlined in Bloom's taxonomy indicate that students should create learning outputs. The literature review identified online methods of creating learning outputs such as blogs, Wiki pages and podcasts. Further research could be carried out on the identification of methods students could use in order to create learning outputs that correspond with MI principles.
6. The investigation produced a guideline for an instructor's use of MI with e-learning. The guideline recommended that MI theory could be used in three distinct stages in the educational process. MI can be integrated in terms of presenting the class content, facilitating community building activities and allowing students to create learning outputs. Due to the limitations of this research these guidelines were not fully evaluated. Further research could evaluate these guidelines through measuring the learning effectiveness experienced by the students.

The investigation was successful in using an MI profiling system to profile a sample group of construction managers and use the dominant intelligence areas identified to design an e-learning framework. The e-learning framework was deployed using an action research methodology in two phases, which then allowed for conclusions to be drawn from the investigation. The evaluation process identified the role of the instructor, the level of class interactions and the stability of technology as key aspects of the e-learning framework. Changes to the role of the instructor, size of the class and use of technology showed a clear improvement in class interactions and student satisfaction from phase one to phase two.

Based on the results and observations made on the completion of this investigation, a set of guidelines were produced on how an instructor could use MI theory within an e-learning environment. These guidelines involved presenting class content to students in a number of ways to give them access to multiple perspectives of a topic. The social interaction within the learning community should allow students to interact in a number of ways that can best suit their MI profile. The last stage involves giving students a method to express what they have gained as a personal learning output. MI

theory has a valuable role to play in the selection and use of new forms of technology in education. By using MI as a conceptual guide, technology can be selected that focuses on empowering students according to their intelligences area.

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***Appendix A MIDAS Questions and
Sample Result***

**Adult - intrapersonal**

- Qn98. Do you have a clear sense of who you are and what you want out of life?
- Very little
 - A little
 - Usually
 - Most of the time
 - Almost all of the time
 - I don't know
- Qn99. Are you aware of your feelings and able to control your moods?
- Every once in a while
 - Sometimes
 - Most of the time
 - Almost all of the time
 - Always
 - I don't know
- Qn100. Do you plan and work hard toward personal goals like at school, at work or at home?
- Rarely
 - Sometimes
 - Usually
 - Almost all the time
 - All the time
 - I don't know
- Qn101. Do you 'know your own mind' and do well at making important personal decisions such as choosing classes, changing jobs or moving?
- No or every once in a while
 - Sometimes
 - Usually
 - Almost all the time
 - All the time
 - I don't know
- Qn102. Are you happy with the work you choose because it matches your skills, interests and personality?
- No or rarely
 - Sometimes
 - Usually
 - Almost all the time
 - All the time

- I don't know or does not apply yet

Qn103. Do you generally know what you are good at (or not good at) doing and try to improve your skills?

- Every once in a while
- Sometimes
- Usually
- Almost all the time
- All the time
- I don't know

Qn104. Do you get very angry when you fail or are frustrated?

- Almost all the time
- Sometimes
- Every once in a while
- Rarely
- Almost never
- I don't know

Qn105. Have you ever had interest in 'self improvement'? For instance, do you attend classes to learn new skills or read 'self-help' books or magazines?

- No
- A little
- Sometimes
- Often
- Almost always
- I don't know

Qn106. Have you ever been able to find unique or unusual ways to solve personal problems or achieve your goals?

- Once or twice
- Every once in a while
- Sometimes
- Often
- All the time
- I don't know

Next

**Adult - kinesthetic**

- Qn15. In school, did you generally enjoy sports or gym class more than other school classes?
- Not At All
 - A little
 - About the same
 - Enjoy sports more
 - Enjoy sports much more
 - I don't know
- Qn16. As a teenager, how often did you play sports or other physical activities?
- Every once in a while
 - Sometimes
 - Often
 - Almost always
 - All the time
 - I don't know or does not apply
- Qn17. Did you ever perform in a school play or take lessons in acting or dancing?
- Never
 - Maybe once
 - A couple of times
 - Often
 - Almost all the time
 - I don't know
- Qn18. Do you or other people (like a coach) think that you are coordinated, graceful or a good athlete?
- No
 - Maybe a little
 - About average
 - Better than average
 - Superior
 - I don't know
- Qn19. Did you ever take lessons or have someone teach you a sport such as bowling, karate, golf, etc.?
- No
 - Rarely
 - Sometimes
 - Often
 - Nearly all the time

- I don't know

Qn20. Have you ever joined teams to play a sport?

- Never
- Rarely
- Sometimes
- Often
- Almost all the time
- I don't know

Qn21. As an adult, do you often do physical work or exercise?

- Rarely
- Sometimes
- Often
- Almost all the time
- All the time
- I don't know. Does not apply

Qn22. Are you good with your hands at things like card shuffling, magic tricks or juggling?

- Not very good
- Fair
- Good
- Very good
- Excellent
- I don't know

Qn23. Are you good at doing precise work with your hands such as sewing, making models, tying flies, typing or have good handwriting?

- Not at all
- Fairly good
- Good
- Very good
- Excellent
- I don't know

Qn24. Do you enjoy working with your hands on projects such as mechanics, building things, preparing fancy food or sculpture?

- Never or rarely
- Sometimes
- Often
- Almost all the time
- All the time
- I don't know. No opportunity

Qn25. Are you good at using your body or face to imitate people such as teachers, friends, or family?

- Not at all
- A little bit
- Fair
- Good
- Very good
- I don't know

Qn26. Are you a good dancer, cheerleader or gymnast?

- Not at all
- Fairly good
- Good
- Very good
- Excellent
- I don't know

Qn27. Do you learn better by having something explained to you or by doing it yourself?

- Always better by explanation
- Sometimes better by explanation
- No difference
- Usually better by doing it
- Always better by doing it
- I don't know

Next

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**Adult - linguistic**

Qn60. You enjoy telling stories or talking about favorite movies or books?

- Not at all
- Rarely
- Sometimes
- Often
- Almost all the time
- I'm not sure

Qn61. Do you ever play with the sounds of words like making up jingles, or rhymes? For example, do you give things or people funny sounding nicknames?

- Never
- Rarely
- Sometimes
- Often
- All the time
- I don't know

Qn62. Do you use colorful words or phrases when talking?

- No
- Rarely
- Sometimes
- Often
- All the time
- I don't know

Qn63. Have you ever written a story, poetry or words to songs?

- Never
- Maybe once or twice
- Occasionally
- Often
- Almost all the time
- I don't know

Qn64. Are you a convincing speaker?

- Not at all
- Every once in a while
- Sometimes
- Often
- Almost all the time
- I don't know

Qn65. How are you at bargaining or making a deal with people?

- Not very good
- Fair
- Pretty good
- Good
- Excellent
- I don't know

Qn66. Can you talk people into doing things your way when you want to?

- Not at all
- Every once in a while
- Sometimes
- Often
- Almost all the time
- I'm not sure

Qn67. Do you ever do public speaking or give talks to groups?

- Very rarely or never
- Every once in a while
- Sometimes
- Often
- Almost all the time
- I don't know.

Qn68. How are you at managing or supervising people?

- Never do or not good at all
- Fair
- Good
- Very good
- Excellent
- I don't know.

Qn69. Do you have interest for talking about things like the news, family matters, religion or sports, etc.?

- A little
- Some interest
- Average interest
- More than average
- A great deal
- I don't know

Qn70. When others disagree are you able to easily say what you think or feel?

- Rarely
- Every once in a while
- Sometimes
- Often
- All the time

- I don't know

Qn71. Do you enjoy looking up words in dictionaries, or arguing with others about "the right word" to use?

- Never or rarely
- Every once in a while
- Sometimes
- Often
- Very often
- I don't know

Qn72. Are you often the one asked to "do the talking" by family or friends because you are good at it?

- Very rarely or never
- Rarely
- Sometimes
- Often
- Almost all the time
- I don't know

Qn73. Have you ever been good at imitating the way other people talk?

- Not really
- Fairly good
- Pretty good
- Good
- Very good
- I don't know

Qn74. Have you ever been good at writing reports for school or work?

- Not really. Never do any.
- Pretty good
- Good
- Very good
- Superior
- I don't know

Qn75. Can you write a good letter?

- No or fair
- Pretty good
- Good
- Very good
- Excellent
- I don't know

Qn76. Do you like to read or do well in English classes?

- A little
- Sometimes
- Usually

- Often
- All the time
- I don't know

Qn77. Do you write notes or make lists as reminders of things to do?

- Rarely or never
- Every once in a while
- Sometimes
- Often
- Almost all the time
- I don't know

Qn78. Do you have a large vocabulary?

- Not really
- Less than average
- About average
- Above average
- Superior
- I don't know

Qn79. Do you have skill for choosing the right words and speaking clearly?

- Not at all or rarely
- Sometimes
- Usually
- Most of the time
- Almost always
- I don't know

Next

**Adult - logicMath**

Qn28. As a child, did you easily learn math such as addition, multiplication and fractions?

- Not at all
- It was fairly hard
- Pretty easy
- Very easy
- Learned much quicker than all the kids
- I don't know

Qn29. In school, did you ever have extra interest or skill in math?

- Very little or none
- Maybe a little
- Some
- More than average
- A lot
- I don't know

Qn30. How did you do in advanced math classes such as algebra or calculus?

- Didn't take any
- Not very well
- Fair (C's)
- Well (B's)
- Excellent (A's)
- I don't know or does not apply yet

Qn31. Have you ever had interest in studying science or solving scientific problems?

- No
- A little
- Average
- More than average
- A great deal
- I don't know

Qn32. Are you good at playing chess or checkers?

- No
- Fairly good
- Good
- Very good
- Excellent
- I don't know

Qn33. Are you good at playing cards or solving strategy or puzzle-type games?

- Not at all
- A little
- About average
- Better than average
- Excellent
- I don't know

Qn34. Do you often play games such as Scrabble or crossword puzzles?

- Very rarely or never
- Every once in a while
- Sometimes
- Often
- All the time
- I don't know. No opportunity

Qn35. Do you have a good system for balancing a checkbook or figuring a budget?

- Not at all
- Fairly good
- Good
- Very good
- An excellent system
- I don't know or does not apply

Qn36. Do you have a good memory for numbers such as telephone numbers or addresses?

- Not very good
- Fair
- Good
- Very good
- Superior
- I don't know

Qn37. How are you at figuring numbers in your head?

- Can not do it
- Not very good
- Fair
- Good
- Excellent
- I don't know

Qn38. Are you a curious person who likes to figure out WHY or HOW things work?

- Every once in a while
- Sometimes

- Often
- Almost all the time
- All the time
- I don't know

Qn39. Are you good at inventing 'systems' for solving long or complicated problems? For example, betting at the race track or organizing your home or life?

- Not very good
- Fair
- Good
- Better than average
- Excellent
- I don't know

Qn40. Are you curious about nature like fish, animals, plants or the stars and planets?

- Rarely
- Sometimes
- Often
- Almost all the time
- All the time
- I don't know

Qn41. Have you ever liked to collect things and learn all there is to know about a certain subject such as antiques, horses, baseball, etc.?

- Not at all
- A little
- Sometimes
- Often
- Almost all the time
- I don't know

Qn42. Are you good at jobs or projects where you have to use math a lot or get things organized?

- Not good at all
- Fairly good
- Good
- Very good
- Excellent
- I don't know. No opportunity

Qn43. Outside of school, have you ever enjoyed working with numbers like figuring baseball averages, gas mileage, budgets, etc?

- Not at all
- Every once in a while
- Sometimes
- Often
- Almost all the time

- I don't know

Qn44. Do you use good common sense for planning social activities, making home repairs, or solving mechanical problems?

- Sometimes
- Usually
- Often
- Almost all the time
- All the time
- I don't know

Next

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**Adult - musical**

Qn1. As a child, did you have a strong liking for music or music classes?

- A little
- Sometimes
- Usually
- Often
- All the time
- I don't Know

Qn2. Did you ever learn to play an instrument?

- No
- A little
- Fair
- Good
- Excellent
- I don't know

Qn3. Can you sing 'in tune'?

- A little bit
- Fair
- Well
- Very well
- Excellent
- I don't know

Qn4. Do you have a good voice for singing with other people in harmony?

- A little bit
- Fair
- Good
- Very good
- Excellent
- I don't know

Qn5. As an adult, did you ever play an instrument, play with a band or sing with a group?

- Never
- Every once in a while
- Sometimes
- Often
- Almost all of the time
- I don't know. Does not apply.

Qn6. Do you spend a lot of time listening to music?

- Every once in a while
- Sometimes
- Often
- Almost all the time
- All the time
- I don't know

Qn7. Do you ever make up songs or write music?

- Never
- Once or twice
- Every once in a while
- Sometimes
- Often
- I don't know

Qn8. Do you ever drum your fingers, whistle or sing to yourself?

- Every once in a while
- Sometimes
- Often
- Almost All the time
- All the time
- I don't know

Qn9. Do you often have favorite tunes on your mind?

- Every once in a while
- Sometimes
- Often
- Almost all the time
- All the time
- I don't know

Qn10. Do you often like to talk about music?

- Never
- Every once in a while
- Sometimes
- Often
- Nearly all the time
- I don't know

Qn11. Do you have a good sense of rhythm?

- Fair
- Pretty good
- Good
- Very good
- Excellent
- I don't know

Qn12. Do you have a strong liking for the SOUND of certain instruments or musical groups?

- Every once in a while
- Sometimes
- Often
- Almost all the time
- All the time
- I don't know

Qn13. Do you think you have a lot of musical talent or skill that was never fully brought out?

- No
- Some
- A fair amount
- A good amount
- A great deal
- I don't know

Qn14. Do you often have music on while you work, study or relax?

- Every once in a while
- Sometimes
- Usually
- Almost always
- Always
- I don't know

Next

**Adult - naturalist**

Qn107. Have you ever raised pets or other animals?

- Never or Rarely
- Every once in a while
- Sometimes
- Often
- All the time
- I don't know. No opportunity.

Qn108. Is it easy for you to understand and care for an animal?

- Not at all
- Maybe a little
- Fairly easy
- Quite easy
- Very easy
- I don't know

Qn109. Have you ever done any pet training, hunting or studied wildlife?

- No
- A little
- Sometimes
- Quite a bit
- A great deal
- I don't know. No opportunity.

Qn110. Are you good at working with farm animals or thought about being a veterinarian or naturalist?

- Not at all
- A little
- Some
- Quite a bit
- Very much so
- I don't know

Qn111. Do you easily understand differences between animals such as personalities, traits or habits?

- Not at all
- A little
- Fairly easy
- Quite easy
- Very easy
- I don't know

Qn112. Are you good at recognizing breeds of pets or kinds of animals?

- Not at all
- A little
- Somewhat
- Quite good
- Very good
- I don't know

Qn113. Are you good at observing and learning about nature, for example, types of clouds, weather patterns, animal or plant life?

- Never
- A little
- Some
- Quite a bit
- A great deal
- I don't know

Qn114. Are you good at growing plants or raising a garden?

- Not at all
- A little
- Somewhat
- Quite a bit
- Very good
- I don't know.

Qn115. Can you identify or understand the differences between types of plants?

- Not at all
- A little
- Somewhat
- Most of the time, yes
- All the time
- I don't know

Qn116. Are you fascinated by natural energy systems such as chemistry, electricity, engines, physics or geology?

- No
- A little
- Somewhat
- Quite a bit
- A great deal
- I don't know

Qn117. Do you have a concern for nature and do things like recycling, camping, hiking or bird watching?

- No
- A little
- Some

- A lot
- A great deal
- I don't know

Qn118. Have you taken photographs of nature or written stories or done artwork?

- No
- A little
- Some
- A lot
- A great deal
- I don't know

Qn119. Is spending time with nature an important part of your life?

- Not really
- A little
- Somewhat
- Quite a bit
- Very much so
- I don't know

Next

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**Adult - spatial**

Qn45. As a child, did you often build things out of blocks or boxes; play with jacks, marbles or jump rope?

- Never or rarely
- Sometimes
- Often
- Almost all the time
- All the time
- I don't know

As a teenager or adult, how well could you do any of these:

Qn46. mechanical drawing, hair styling, woodworking, art projects, auto body, or mechanics?

- Didn't take any
- Fair
- Good. (C's)
- Very good. (B's)
- Excellent. (A's)
- I don't know

Qn47. How well can you 'design' things such as arranging or decorating rooms, craft projects, building furniture or machines?

- Never do
- Fair
- Pretty good
- Good
- Excellent
- I don't know

Qn48. Can you parallel park a car on your first try?

- Rarely or do not drive
- Sometimes
- Often
- Almost all the time
- All the time
- I don't know. No opportunity

Qn49. Are you good at finding your way around new buildings or city streets?

- Not at all
- Fairly good
- Good
- Very good
- Excellent

- I don't know

Qn50. Are you good at using a road map to find your way around?

- Not at all
- Fairly good
- Good
- Very good
- Excellent at map reading
- I don't know

Qn51. Are you good at fixing 'things' like cars, lamps, furniture, or machines?

- Not at all
- Not very good
- Fair
- Good
- Excellent
- I don't know

Qn52. How easily can you put things together like toys, puzzles, or electronic equipment?

- Not at all
- It is hard
- It is fairly easy
- It is easy
- It is very easy
- I don't know

Qn53. Have you ever made your own plans or patterns for projects such as sewing, carpentry, crafts, woodworking, etc?

- Never
- Maybe once
- Every once in a while
- Sometimes
- Often
- I don't know

Qn54. Have you ever drawn or painted pictures?

- Rarely or never
- Every once in a while
- sometimes
- Often
- Almost all the time
- I don't know. No opportunity

Qn55. Do you have a good sense of design for decorating, landscaping or working with flowers?

- Not very good
- Fair
- Good
- Very good
- Excellent
- I don't know

Qn56. Do you have a good sense of direction when in a strange place?

- Not at all
- Fairly good
- Good
- Very good
- Superior
- I don't know

Qn57. Are you good at playing pool, darts, riflery, archery, bowling, etc.?

- Not at all
- A little
- Fair
- Better than average
- Excellent
- I don't know

Qn58. Do you often draw a picture or sketch to give directions or explain an idea?

- Never
- Rarely
- Sometimes
- Often
- All the time
- I don't know

Qn59. Are you creative and like to invent or experiment with unique designs, clothes or projects?

- Very little or not at all
- A little
- Somewhat
- Often
- Almost all the time
- I'm don't know

Next

**Adult - interpersonal**

Qn80. Have you had friendships that have lasted for a long time?

- One or two
- More than a couple
- Quite a few
- A lot
- A great many long lasting friendships
- I don't know

Qn81. Are you good at making peace at home, at work or among friends?

- Fair
- Pretty good
- Good
- Very good
- Excellent
- I don't know

Qn82. Are you ever a 'leader' for doing things at school, among friends or at work?

- Rarely
- Every once in a while
- Sometimes
- Often
- Almost always
- I don't know

Qn83. In school, were you usually part of a particular group or crowd?

- Rarely
- Every once in a while
- Sometimes
- Most of the time
- Almost all the time
- I don't know

Qn84. Do you easily understand the feelings, wishes or needs of other people?

- Sometimes
- Usually
- Often
- Almost always
- Always
- I don't know

Qn85. Do you ever offer to 'help' other people such as the sick, the elderly or friends?

- Sometimes
- Usually
- Often
- Very often
- Always
- I don't know

Qn86. Do friends or family members ever come to you to talk over personal troubles or to ask for advice?

- Every once in a while
- Sometimes
- Often
- Almost All the time
- All the time
- I don't know

Qn87. Are you a good judge of 'character'?

- Every once in a while
- Sometimes
- Usually
- Almost always
- Always
- I don't know

Qn88. Do you usually know how to make people feel comfortable and at ease?

- Every once in a while
- Sometimes
- Usually
- Almost always
- Always
- I don't know

Qn89. Do you generally take the good advice of friends?

- Every once in a while
- Sometimes
- Usually
- Often
- Almost always
- I don't know

Qn90. Are you generally at ease around (men or women) your own age?

- Rarely
- Sometimes
- Usually
- Almost all the time

- Always
- I don't know

Qn91. Are you good at understanding your (girlfriend's or wife's) (boyfriend's or husband's) ideas and feelings?

- Every once in a while
- Sometimes
- Usually
- Almost all the time
- All the time
- I don't know. Does not apply.

Qn92. Are you an easy person for people to get to know?

- Not at all
- Pretty hard
- Fairly easy
- Easy
- Very easy
- I don't know

Qn93. Do you have a hard time coping with children?

- Usually have a hard time.
- Sometimes it is hard
- Usually easy
- Almost always easy
- Always very easy
- I don't know

Qn94. Have you ever had interest in teaching, coaching or counseling?

- Very little or none
- A little interest
- Some interest
- A lot of interest
- A great deal of interest
- I don't know or doesn't apply

Qn95. Can you do well when working with the public in jobs such as sales, receptionist, promoter, police, or waiter?

- Fair
- Fairly well
- Well
- Very well
- Excellent
- I don't know. Does not apply.

Qn96. Do you prefer working alone or with a group of people?

- Always alone
- Usually alone

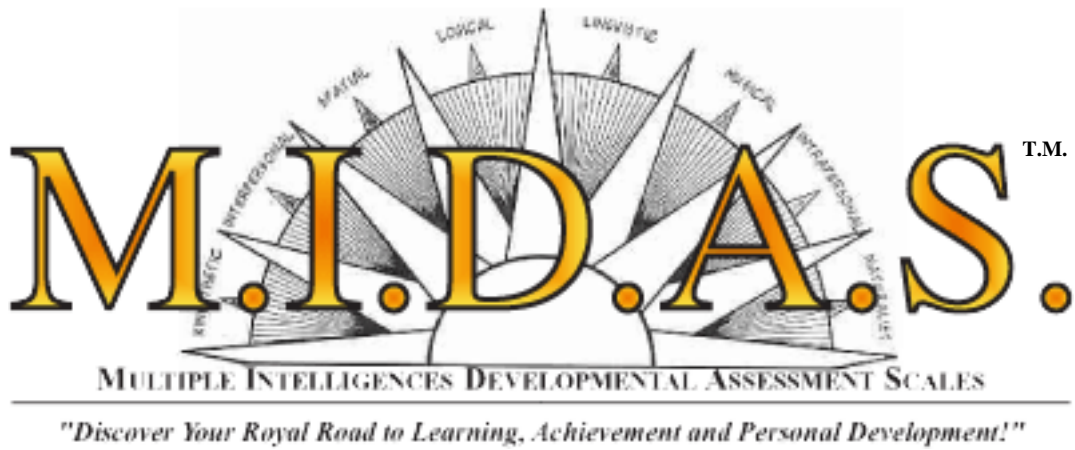
- No preference
- Usually with a group
- Always with a group
- I don't know

Qn97. Are you able to come up with unique or imaginative ways to solve problems between people or settle arguments?

- Maybe once or twice
- Every once in a while
- Sometimes
- Often
- All the time
- I don't know

Next

Copyright © 1999-2004 The MIDAS. All rights reserved.



Name: M. Carney **ID Number:** 3616 **Code:**
Birth Date: **Education:** **Sex:**

These main scales represent your multiple intelligences profile as reported by you. You should review and verify this profile via reflection, discussion and in comparison with other information

Main Scales

Linguistic	*****
Interpersonal	*****
Intrapersonal	*****
Logical-Mathematical	*****
Spatial	*****
Musical	*****
Kinesthetic	*****
Naturalist	*****

The following Profile represents your intellectual style. These scales indicate if you tend to be more social, practical or inventive in your problem solving abilities.

Style Scales

Leadership	*****
General Logic	*****
Innovative	*****

Processed 11-04-2009

Percent answered items = 100%

The MIDAS subscales are ranked below in the left column from the highest at the top to the lowest at the bottom. The shaded top group represents skills that you identified as strengths. Areas that are least well developed are in the shaded area at the bottom.

	Specific Skill	Main Scale
High	Everyday Problem-Solving	Logical-Mathematical
	Plant Care	Naturalist
	Spatial Problem-Solving	Intrapersonal
	Effectiveness	Intrapersonal
	Science	Naturalist
	Communication	Leadership
	Animals	Naturalist
	Expressive	Linguistic
	School Math	Logical-Mathematical
	Spatial Awareness	Spatial
	Personal Knowledge	Intrapersonal
	Rhetorical	Linguistic
	Appreciation	Musical
	Vocal	Musical
	Sensitivity	Interpersonal
	Persuasion	Interpersonal
	Working with People	Interpersonal
	Dexterity	Kinesthetic
	Calculations	Intrapersonal
	Management	Leadership
	Art Design	Spatial
	Social	Leadership
	Written / Reading	Linguistic
	Working with Objects	Spatial
	Athletic	Kinesthetic
	Everyday Math	Logical-Mathematical
	Instrument	Musical
	Composer	Musical
Low	Logic Games	Logical-Mathematical

The following are percentage scores based on the total number of completed items for the main scales and subscales. This profile should be carefully verified before assuming the validity of these scores. Approximate category ranks will assist interpretation.

All Scales	Score	Category
Linguistic	71 (High)	
Expressive		75 (High)
Rhetorical		72 (High)
Written / Reading		63 (High)
Interpersonal	68 (High)	
Persuasion		67 (High)
Sensitivity		68 (High)
Working with People		67 (High)
Intrapersonal	75 (High)	
Personal Knowledge		75 (High)
Calculations		65 (High)
Spatial Problem-Solving		80 (Very High)
Effectiveness		80 (Very High)
Logical-Mathematical	55 (Moderate)	
School Math		75 (High)
Logic Games		25 (Low)
Everyday Math		55 (Moderate)
Everyday Problem-Solving		83 (Very High)
Spatial	69 (High)	
Spatial Awareness		75 (High)
Art Design		65 (High)
Working with Objects		63 (High)
Musical	64 (High)	
Appreciation		71 (High)
Instrument		50 (Moderate)
Vocal		69 (High)
Composer		50 (Moderate)
Kinesthetic	63 (High)	
Athletic		58 (Moderate)
Dexterity		67 (High)
Naturalist	81 (Very High)	
Science		80 (Very High)
Animals		79 (High)
Plant Care		81 (Very High)
Leadership	72 (High)	
Communication		80 (Very High)
Management		65 (High)
Social		65 (High)
General Logic	62 (High)	
Innovative	75 (High)	

Appendix B Case Study

3 Forget Inflation - Prof Hans-Werner Sinn

FFH01: Setting

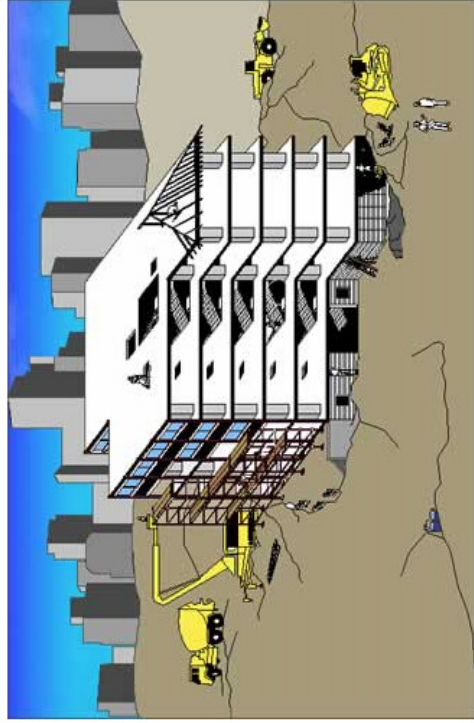
VirtualClassesCentre
HEALTH & SAFETY IN CONSTRUCTION
 Minerva Project 228895-CP-1-2006-14E

Jump to...

Case study

Setting

Mason construction are 10 months into a major office block development. They have recently appointed Bill O'Hare as the new construction manager. The previous manager was let go because of a series of on-site accidents which had led to the project incurring a lot of extra cost and being delayed considerably. Bill has a lot of experience in the building trade where he began as a general labourer and there are few activities in which Bill has not been involved at one stage or another, from pipe-laying to block laying. However, this is his first big project and he is anxious to ensure that it is not delayed or negatively affected by any issues relating to health and safety. Every afternoon, Bill walks through the site searching for any health and safety concerns and this afternoon he has asked you to accompany him to identify anything on the site you might consider as a hazard.



***Appendix C CD ROM with Archive
and 3D model***

Appendix D DimDim guide

How to guide to using Dimdim

Presenters Guide

*To deliver Virtual Classes
as part of the Minerva project*



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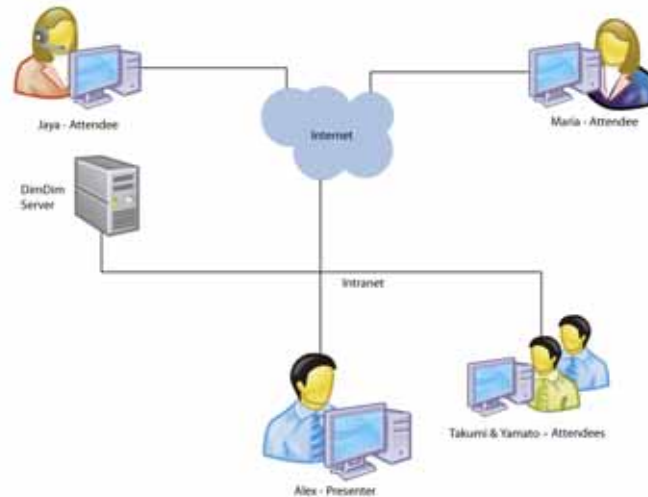
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Requirements

Overview



Presenter

Shares presentation, application or other resource.
Required to have microphone and /or webcam.
Can control user access / features / interaction.

Attendee / user

Sees & hears the presentation.
Can interact with presenter, other attendees by chat areas when / if allowed.

Supported platforms

Presenter:

Windows Internet Explorer 6.0 (with flash) on Windows 2000 or higher
Latest Adobe flash player installed www.adobe.com

Attendees:

Windows Internet Explorer 6.0 or Firefox 1.5 (both browsers with flash) on
Windows 2000 or higher
Latest Adobe flash player installed www.adobe.com

Logging in for the Presenter

Go to <http://www.dimdim.com/>

Select



Sign in using your Username and password:

A light blue sign-in form titled "Sign in to dimdim". It contains two input fields labeled "Username" and "Password", a "login" button, and a link for "Forgot my password".

Some browser checks will be performed, and on the first use may take longer than subsequent uses.



Meeting Settings

Some settings can only be set up at this stage of the meeting so it may be worth your while to take some time to initially look over these settings and understand what they do.



General

Meeting Room: this is the default username.

Meeting Name/ Meeting Key / Meeting Room this can be the name of the Virtual Class. It is useful when you have more than one meeting or want to schedule a number of meetings

Meeting Agenda: Can be used to give a descriptor of the Meeting / Virtual Class. It is useful when you have more than one meeting or want to schedule a number of meetings.

Attendees: Attendees can be invited by email address if you wish but it is not essential. Alternatively they can log on using a Meeting Name or Meeting Key.

Schedule: If you schedule a meeting you have an option of a once only, weekly or monthly

Schedule Meeting

General Options Features

Meeting Room: fmcnamee@cpdcollege.com

Meeting Name: Health & Saftey VC

Meeting Agenda: Meeting today will cover part one of the VC programme - Falling from Heights

Attendees:

Meeting: Start Now Schedule

Repeat Option: Once Only

Start Date: February 21, 2008

End Date: February 21, 2008

Start Time: 4 20 PM

Timezone: GMT Dublin, Edinburgh

Schedule Cancel

A list of meetings will then come up in your upcoming meetings schedule



Options A set of defaults that need to be checked prior to the meeting. The most important here are:



Time: if you suspect you will be longer than 2 hours to change the default. Maximum time is 5 hours.

Participants: If you think there will be more than 20 participants to change it accordingly, maximum number of participants is 500.

Attendee Mics: Max possible number of Mics is 3 but you may have more control with 1 attendee mic.

Features



Features are the most important thing to check before the meeting commences as they cannot be changed once a meeting is started.

AudioVideo: Attendees can hear and see video, the video can be turned off if there is a loss of quality with the sound. Other options are audio only or none.

Private Chat: Attendees and or presenter can chat to each other privately. Options available enable / disable.

Public Chat: Everyone can see what everyone else has written. Options available enable / disable.

Publisher: Enables the presenter to put up slides / websites etc. Options available enable / disable.

Whiteboard: An interactive space for writing. All attendees and presenter can write and correct each others drawing / text. Options available enable / disable.

Main Screen

Home tab



The above screen shows the general layout of the presenter's initial log in screen. Upcoming meetings are available to view, reschedule and delete.

The My Meetings tab



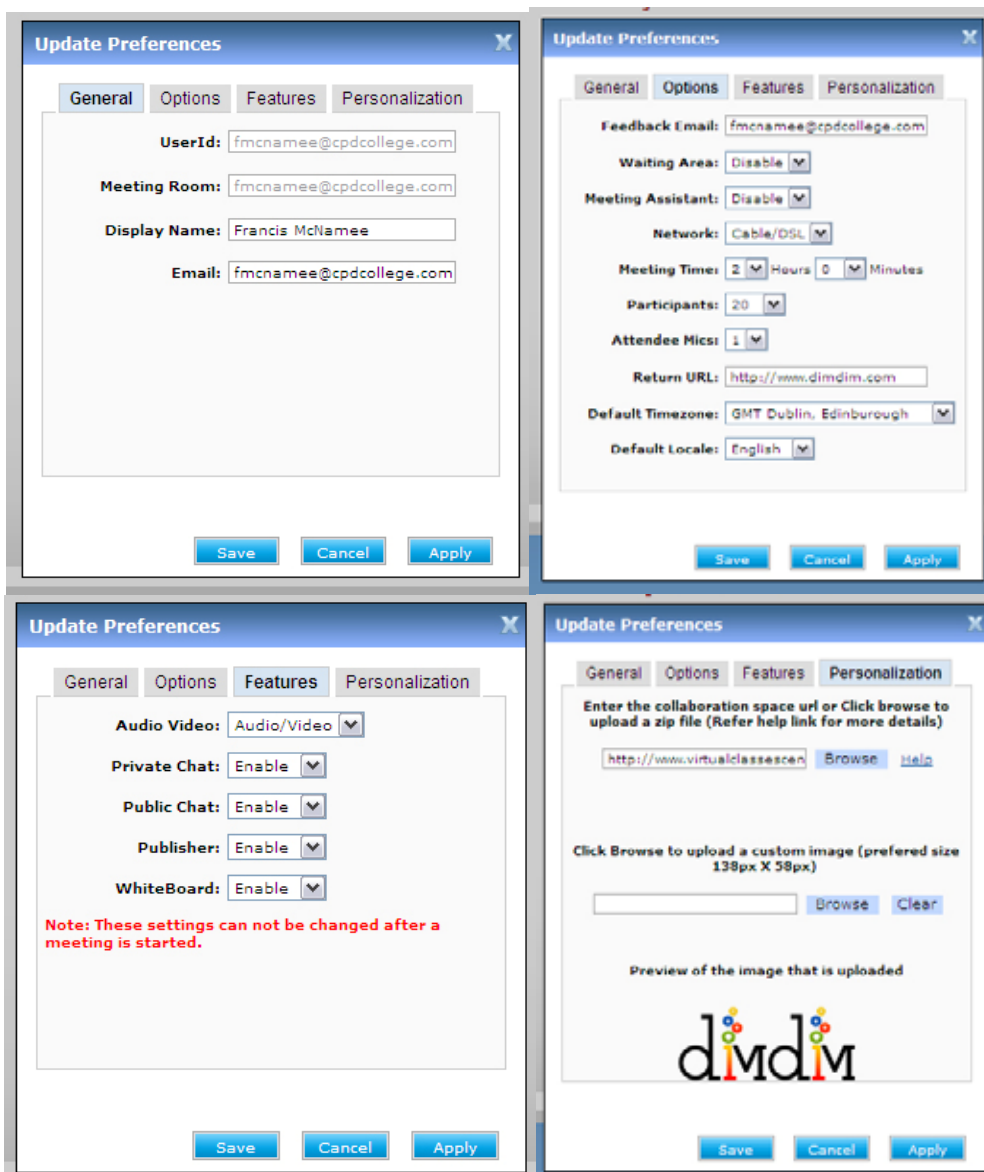
Lets you organise your scheduled meetings and search through past meetings as well as scheduled meetings.

Preferences



In the top right hand corner there is a preferences hyperlink which will enable you to change and update the preferences of any prescheduled meeting. It will also change your personal preferences, similar to the default preferences that have been set up previously.

Here is a view of the tabs and the changes you can make:



Presenters view

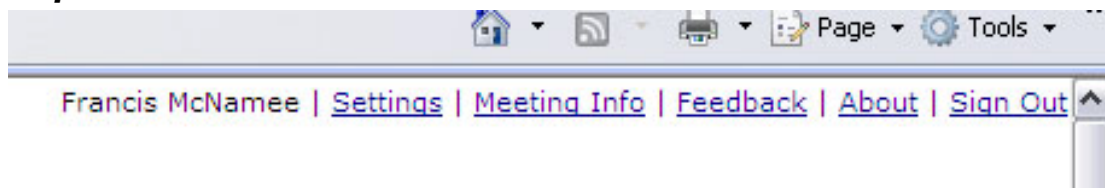


This is the general presenters view, to start a class from this screen go to host meeting:-

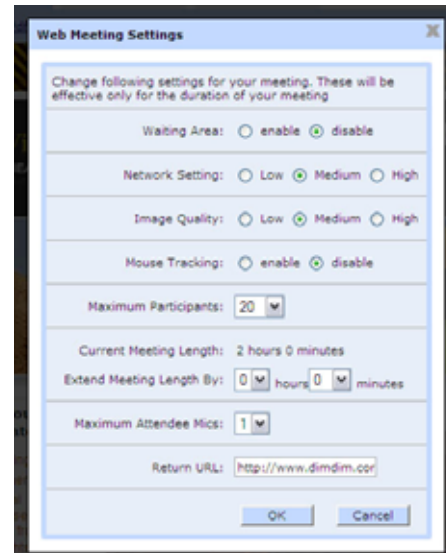


Presenters View

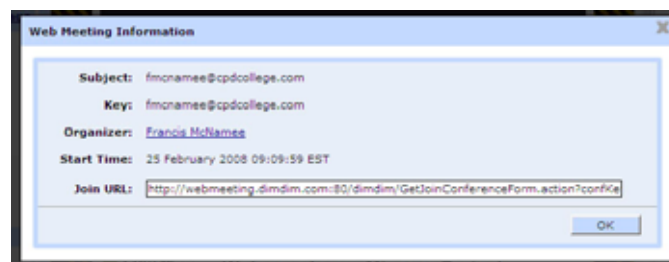
Top menu



Settings: settings can be changed for the duration of the meeting. **Mouse Tracking** is important to have enabled here as it will let you point things out on screen during a presentation.



Meeting info:



Feedback: Can be sent back to the meeting presenter.



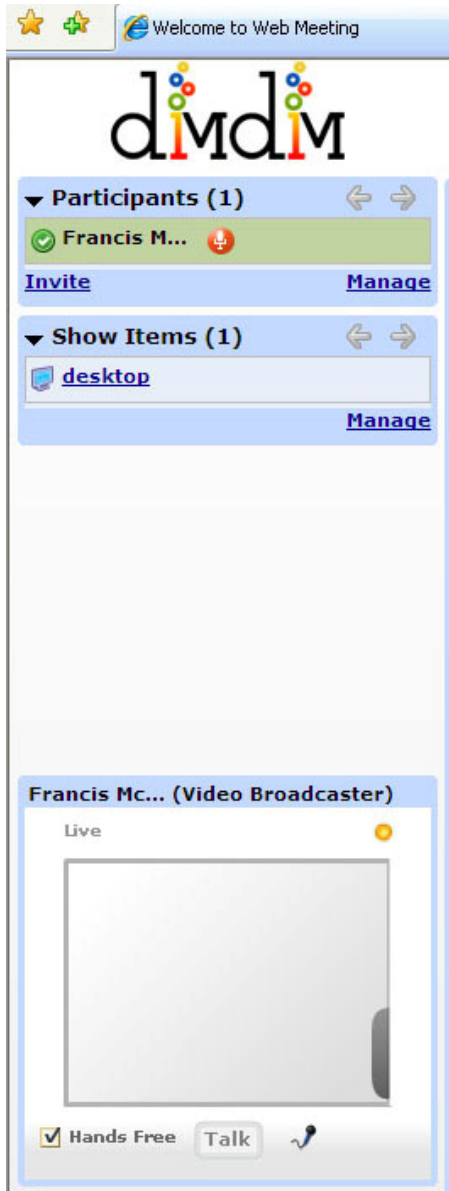
About

Dimdim Version in use.



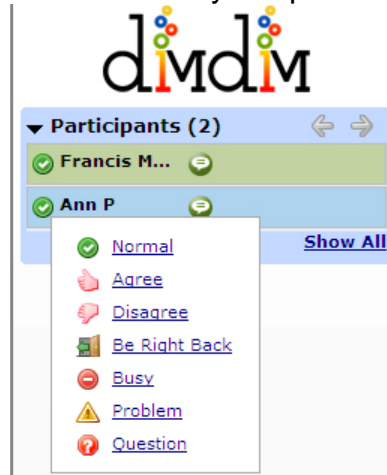
Sign out: Try to sign out after each meeting as the sound may still broadcast!!

Side menu:

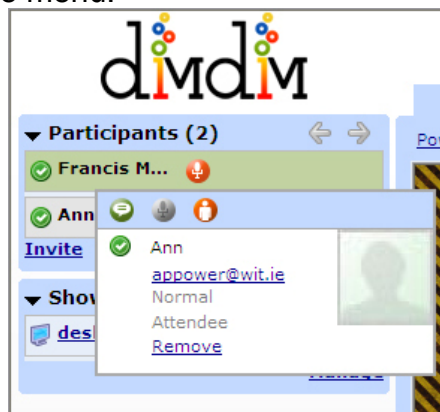


Participants: Lists the participants attending the presentation. The red microphone symbol shows the people who are eligible to talk.

The green check default symbol hides a number of different moods. The green speech bubble can be used for private chat only if this is enabled by the presenter.

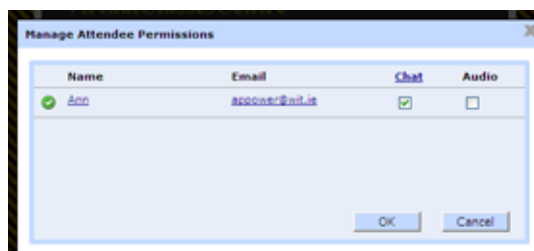


Participants can be polled by left clicking on the green tick and show the thumbs up or they can be removed from the session by hovering over the user name to get the remove menu.



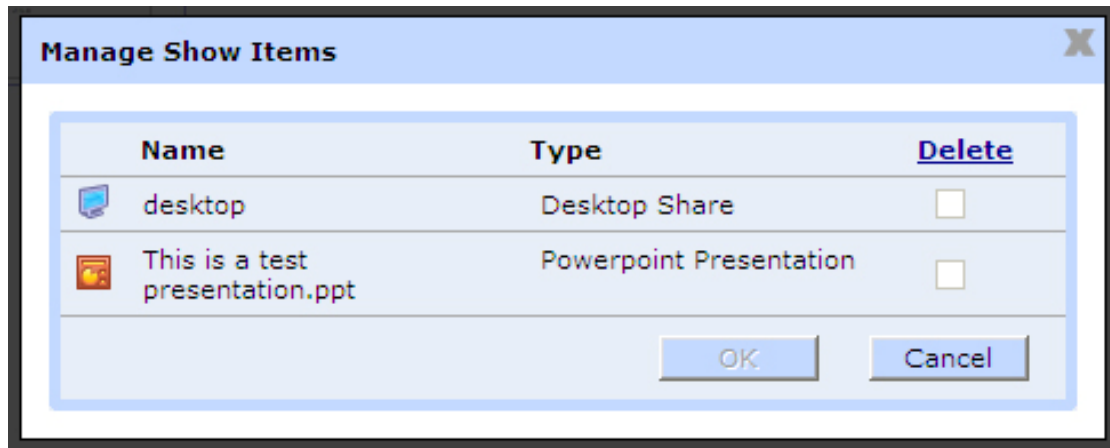
Invite: Additional participants can be invited while within a meeting.

Manage: Only available on the presenters screen audio and chat can be enabled /disabled in a pop up screen:



Show items

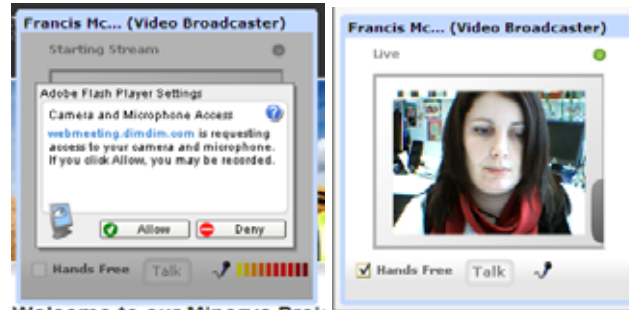
Shows the items that you have uploaded. Manage is only available on the presenters screen and lets you delete items you may have uploaded.



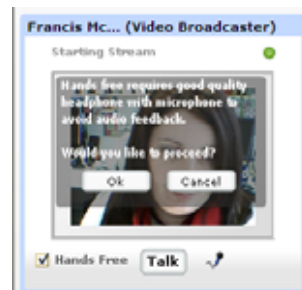
Video broadcaster

Launch

To launch the video broadcaster, tick allow, to enable the flash properties. This includes sound as well as video.

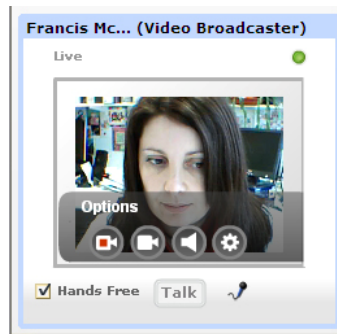


Make sure hands free is ticked

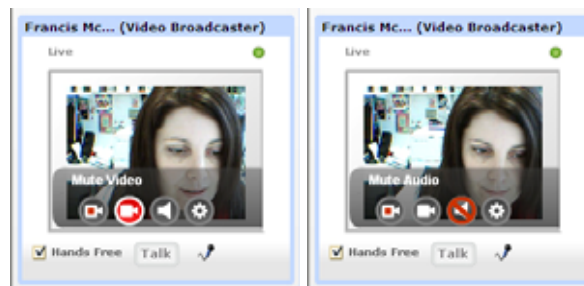


Options

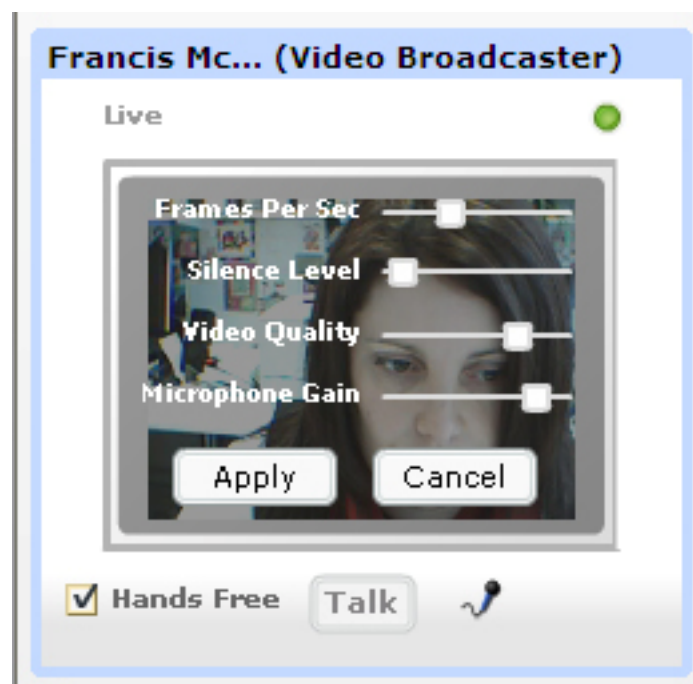
Hover over the grey bar at the right hand side of the picture to get the options



When the Video is live a green dot appears in the top right hand corner of the window. You have the option to **mute video** and **mute audio**:



Settings These can be changed to enhance or reduce the quality of the video broadcast. These can be particularly useful. It is best to freeze the video when there is a conflict between the changing of the PowerPoint slides and the broadcast of video.



Top tabs

The tabs to the left are presenter's tools and the clock on the right shows how long the meeting is in place. The assistant will guide you through uploading the presentations step by step

Upload:



Screen



Whiteboard



You can lock the white board during a meeting if you want to emphasise a point or unlock it to engage the students.

Chat with all: Text box where you can write to all participants at once, maximum amount of text you can type is around 130 words or 13 lines of standard text.

Emoticons: Hover over the blue emoticon text and you can add different icons to your text.



Full Screen



Full Screen can be used when the text is too small to read or if you don't need to see the participants. May be of more use to the Attendees. Can also be an alternative when the PowerPoint presentation is not visible, or freezes on a slide.

Uploading

Points to note

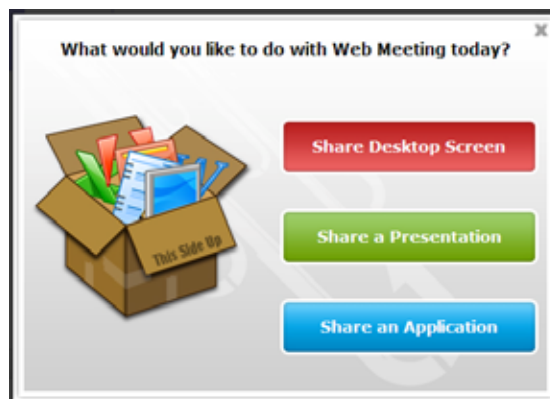
Presentations work best.

Web pages like the Minerva project page in the background can be viewed and URL's can be followed but each attendee can navigate away from the page so that everyone may be viewing the same URL. Using another window for WebPages is better and can be tabbed between.

How to upload

Assistant on the top tab

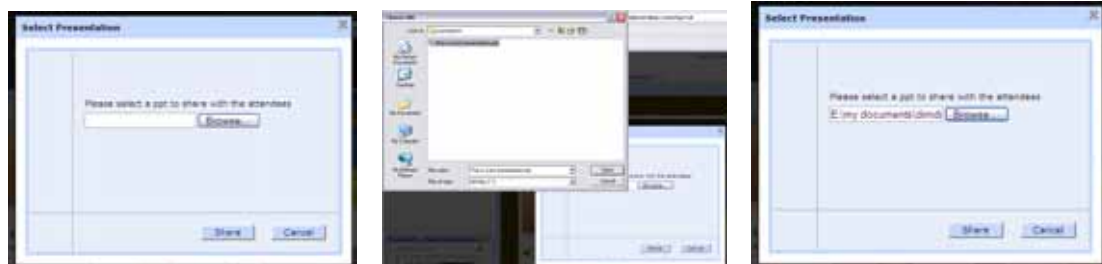
The assistant will guide you through step by step through the process.



Or you can use the **Upload** top tab

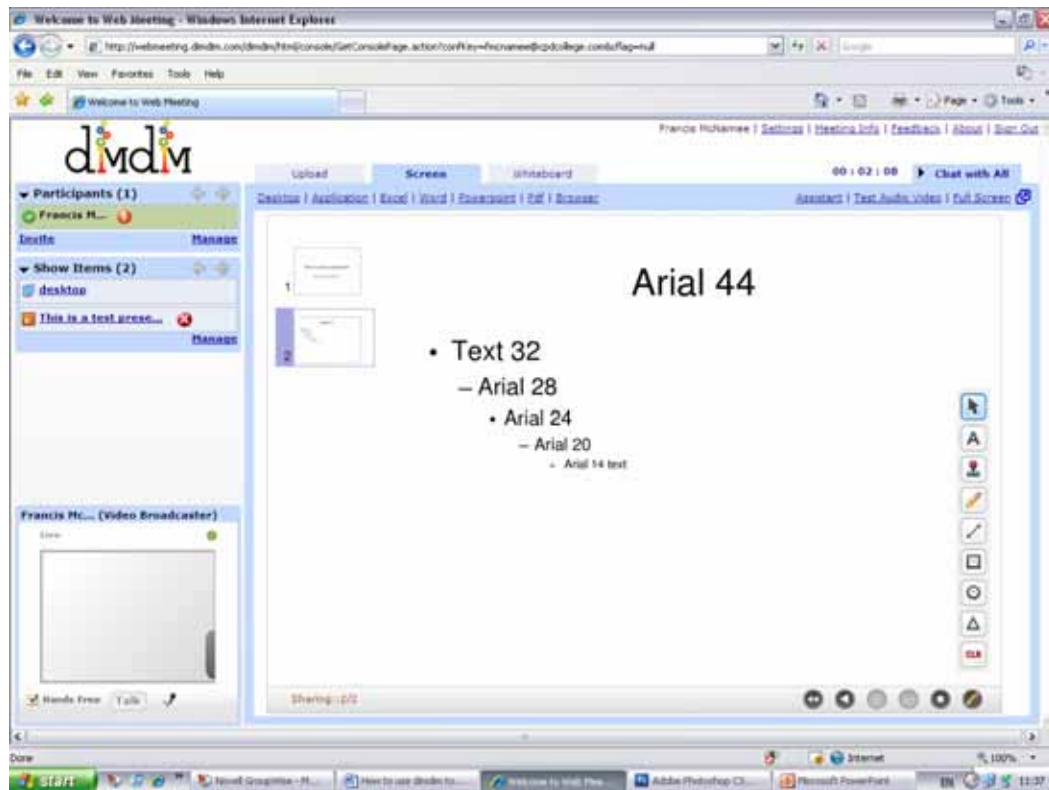


PowerPoint



Browse to your presentation and select **share**.

The presentation should appear in the main body of the window as well as in your show items section.



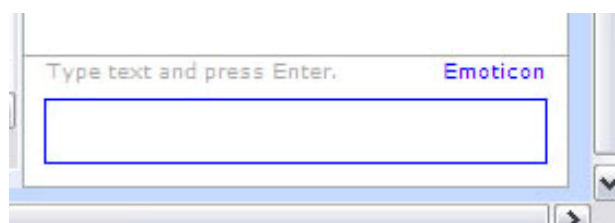
Guidelines for Dimdim presentations

- Try to keep presentation file size small
- No coloured backgrounds
- Pictures should be at 72 dpi
- Veranda text works best for people with learning difficulties
- Be aware –especially with text- the size of the final presentation will depend on screen size. A screen 1152 x 864 (17" flat screen) will give a viewable area 585 x 534.
- No different styles of text as its confusing to the viewer
- Pictures should be placed in the centre of slide where possible
- No sounds or animation effects

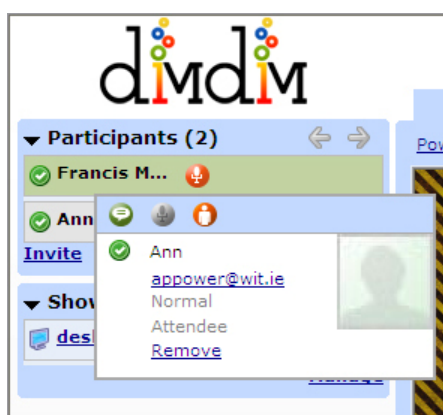
Engaging Students

Public Chat:

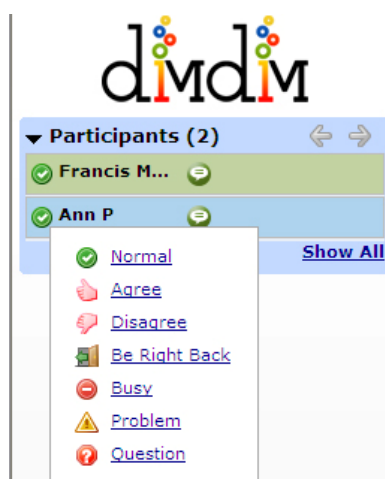
The most obvious way to interact is with the text box in the bottom right hand corner.



Passing the microphone: You can enable a microphone with a maximum of 3 to any attendees at any time, by hovering over their name, click the greyed out microphone to enable.



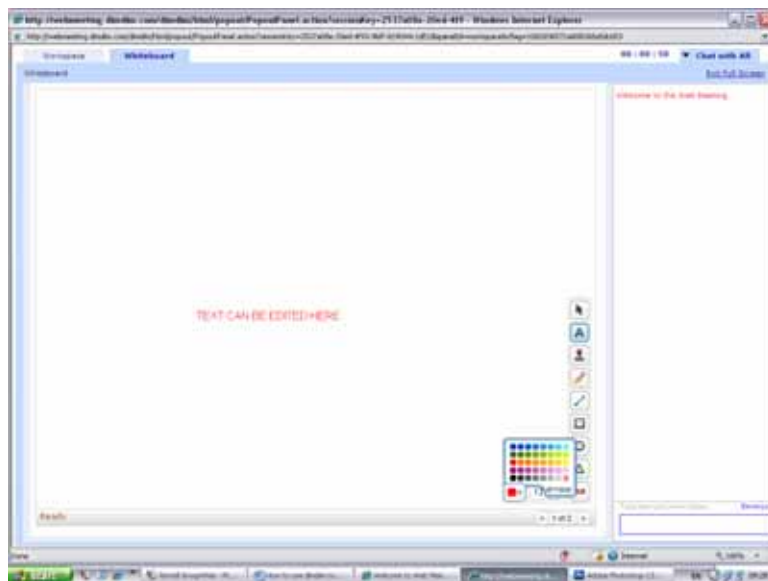
Moods can be used to poll, agree, disagree, be right back, busy, problem, question. Default mood is Normal. To see Moods, click the green tick of normal mood.



White board,

Text can be editable in the white board by everyone, if there are a number of people editing a piece of text at the same time, suggest each attendee use a

different colour for their text. You can lock the white board during a meeting if you want to emphasise a point or unlock it to engage the students.



Clearing items

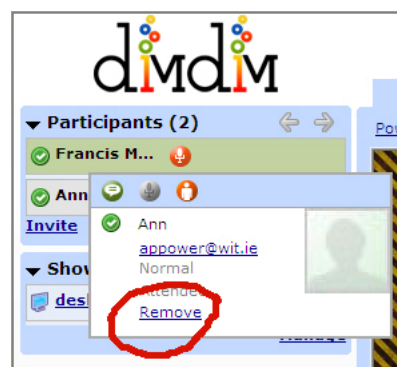
When the whiteboard gets too messy or you just need to start a new discussion you can use the CLR button.

Emoticons: hover over the blue emoticon text and you can add different icons to your text.



Removing people

Participants can be removed from the session by hovering over the user name to get the remove menu



Attendees

It is important for the presenter to understand the attendees logging in process and see what the attendees can see.

Joining a meeting

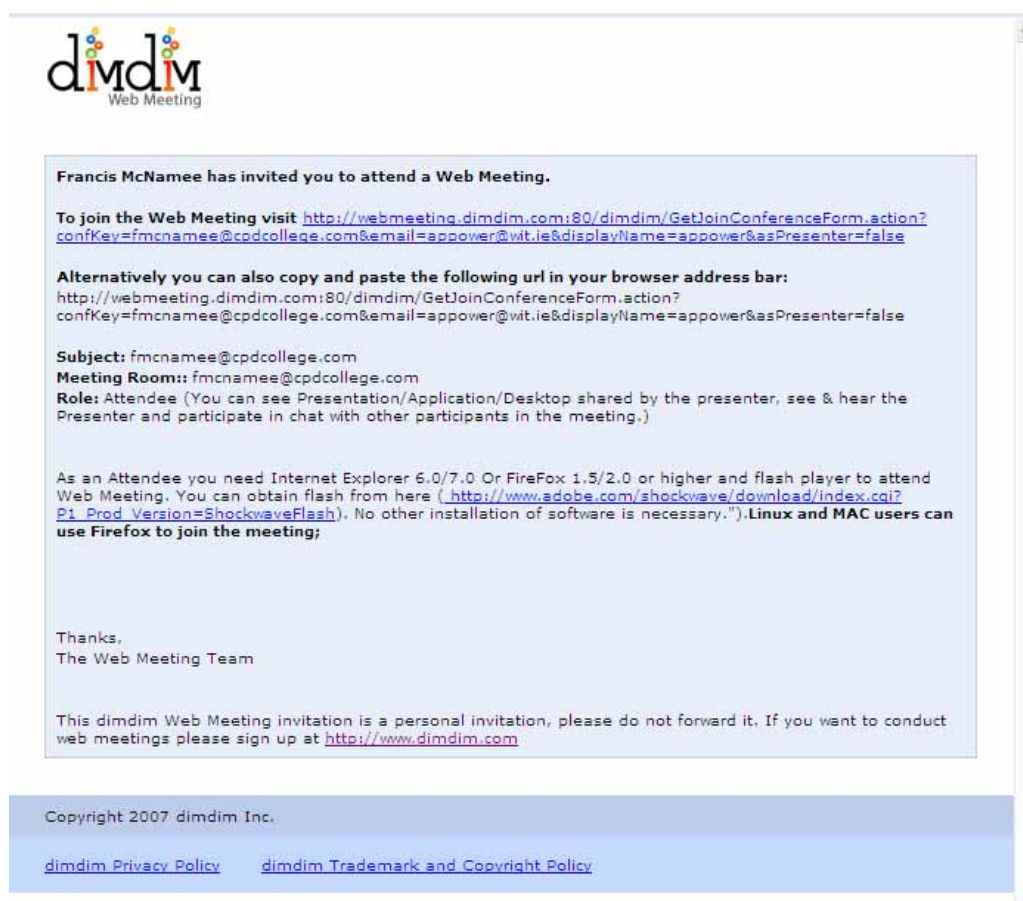
There are 2 ways to join a meeting:

Meeting key

This is when the Presenter gives the attendee the meeting key or meeting name and they log in directly from the Dimdim website.

Email invitation

Attendees can be invited by email and follow the hyperlink directly from the email. An email invitation looks like:



The image shows a screenshot of an email invitation from dimdim. At the top left is the dimdim logo with the text "Web Meeting" below it. The main body of the email is a light blue box containing the following text:

Francis McNamee has invited you to attend a Web Meeting.

To join the Web Meeting visit <http://webmeeting.dimdim.com:80/dimdim/GetJoinConferenceForm.action?confKey=fmcnamee@cpdcollege.com&email=appower@wit.ie&displayName=appower&asPresenter=false>

Alternatively you can also copy and paste the following url in your browser address bar:
<http://webmeeting.dimdim.com:80/dimdim/GetJoinConferenceForm.action?confKey=fmcnamee@cpdcollege.com&email=appower@wit.ie&displayName=appower&asPresenter=false>

Subject: fmcnamee@cpdcollege.com
Meeting Room:: fmcnamee@cpdcollege.com

Role: Attendee (You can see Presentation/Application/Desktop shared by the presenter, see & hear the Presenter and participate in chat with other participants in the meeting.)

As an Attendee you need Internet Explorer 6.0/7.0 Or FireFox 1.5/2.0 or higher and flash player to attend Web Meeting. You can obtain flash from here (http://www.adobe.com/shockwave/download/index.cgi?P1_Prod_Version=ShockwaveFlash), No other installation of software is necessary. **Linux and MAC users can use Firefox to join the meeting;**

Thanks,
The Web Meeting Team

This dimdim Web Meeting invitation is a personal invitation, please do not forward it. If you want to conduct web meetings please sign up at <http://www.dimdim.com>

At the bottom of the email, there is a blue footer bar containing the following text:

Copyright 2007 dimdim Inc.
[dimdim Privacy Policy](#) [dimdim Trademark and Copyright Policy](#)

Attendee Login in direct from the website

Go to <http://www.dimdim.com/>
Select



Sign in using your Email address, the name you want to appear as a participant and the **Meeting Room** given to you by the Presenter.

A dialog box titled "Attend Meeting" with a close button (X) in the top right corner. It contains three input fields: "Email:", "Display Name:", and "Meeting Room:". At the bottom right, there are two buttons: "Join" and "Cancel".

Some browser checks will be performed, and on the first use this may take longer than subsequent uses.



Attendee Login in from Invitation



The screenshot shows an email invitation from dimdim. The header includes the dimdim logo and the text "Francis McNamee has invited you to attend a Web Meeting." The main body of the email contains the following information:

- To join the Web Meeting visit:** <http://webmeeting-dimdim.com:80/dimdim/GetJoinConferenceForm.action?confKey=fmcnamee@cpdcollege.com&email=apponer@vit.ie&displayname=apponer&asPresenter=false>
- Alternatively you can also copy and paste the following url in your browser address bar:** <http://webmeeting-dimdim.com:80/dimdim/GetJoinConferenceForm.action?confKey=fmcnamee@cpdcollege.com&email=apponer@vit.ie&displayname=apponer&asPresenter=false>
- Subject:** fmcnamee@cpdcollege.com
- Meeting Room:** fmcnamee@cpdcollege.com
- Role:** Attendee (You can see Presentation/Application/Desktop shared by the presenter, see & hear the Presenter and participate in chat with other participants in the meeting.)

Below this information, there is a section for system requirements: "As an Attendee you need Internet Explorer 5.0/7.0 Or FireFox 1.5/2.0 or higher and flash player to attend Web Meeting. You can obtain flash from here (http://www.adobe.com/shockwave/flash/get/index.cgi?_q=Spot+version+Shockwave+flash). No other installation of software is necessary." It also notes: "Linux and MAC users can use Firefox to join the meeting!"

The email concludes with "Thanks, The Web Meeting Team" and a footer that reads "This dimdim Web Meeting invitation is a personal invitation, please do not forward it. If you want to conduct web meetings please sign up at <http://www.dimdim.com>". At the bottom, there is a copyright notice for 2007 dimdim Inc. and links to "dimdim Privacy Policy" and "dimdim Trademark and Copyright Policy".

Click the join hyperlink which will automatically fill out your Email address, username and meeting key and click **join**.

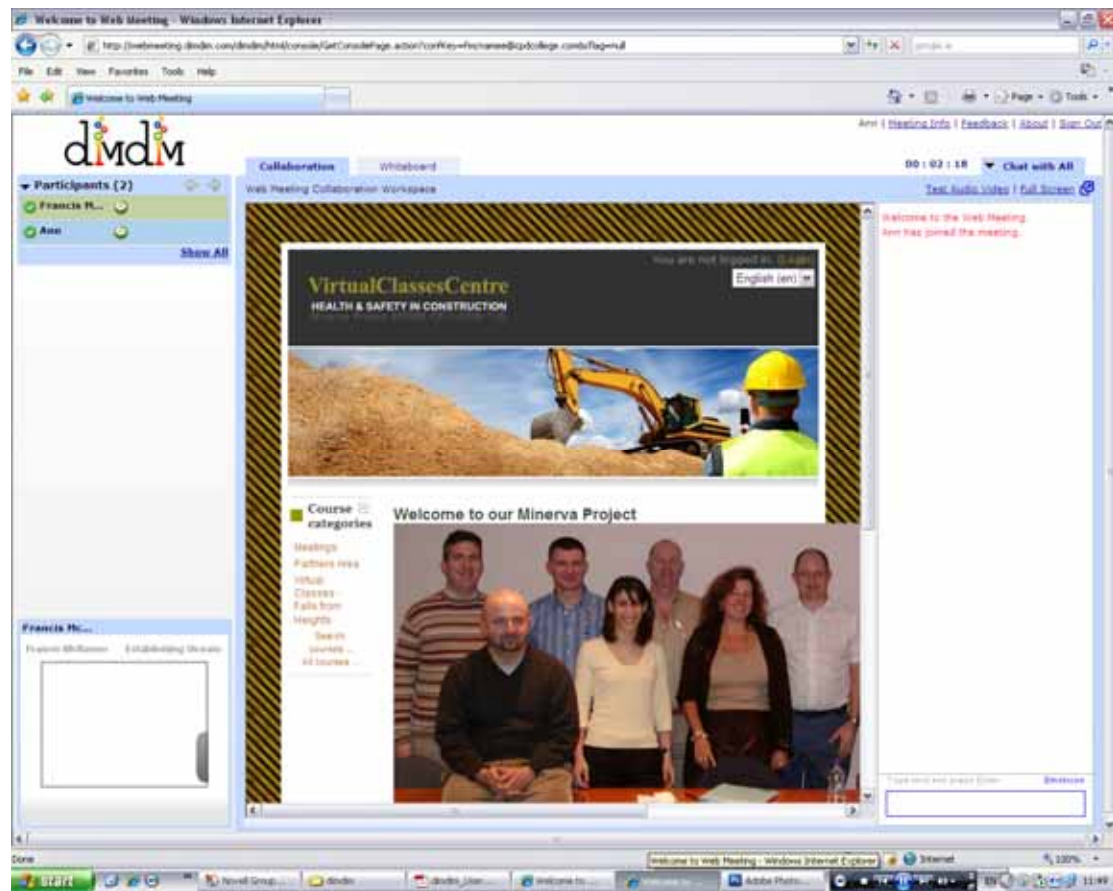


The screenshot shows a web browser window displaying the dimdim "Join Meeting" page. The browser's address bar shows the URL: <http://webmeeting-dimdim.com:80/dimdim/JoinMeetingForm.action?confKey=fmcnamee@cpdcollege.com&email=apponer@vit.ie&displayname=apponer&asPresenter=false>. The page features the dimdim logo and a "Join Meeting" form with the following fields:

- Email:**
- Name:**
- Meeting Key:**

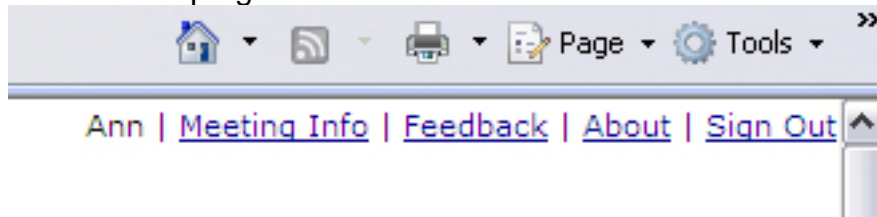
A "Join" button is located below the form. To the left of the form, there is a "Start a Web Meeting" section with instructions on how to use the service. The browser's taskbar at the bottom shows several open applications, including Internet Explorer, and the system clock indicates the time is 12:28 on 11/21.

Attendees view

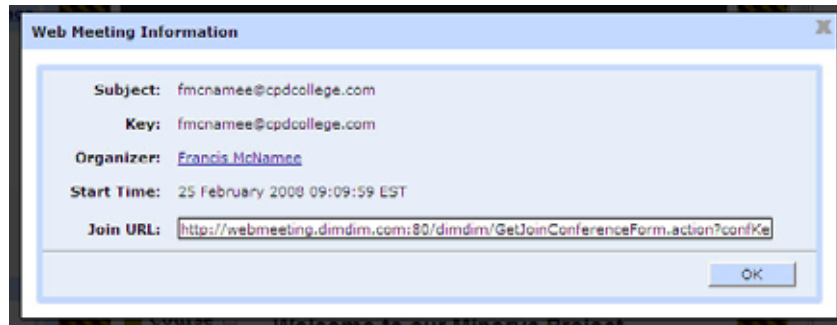


Top Menu

Users menu in the top right hand corner:



Meeting info:



Feedback: Can be sent back to the meeting presenter.

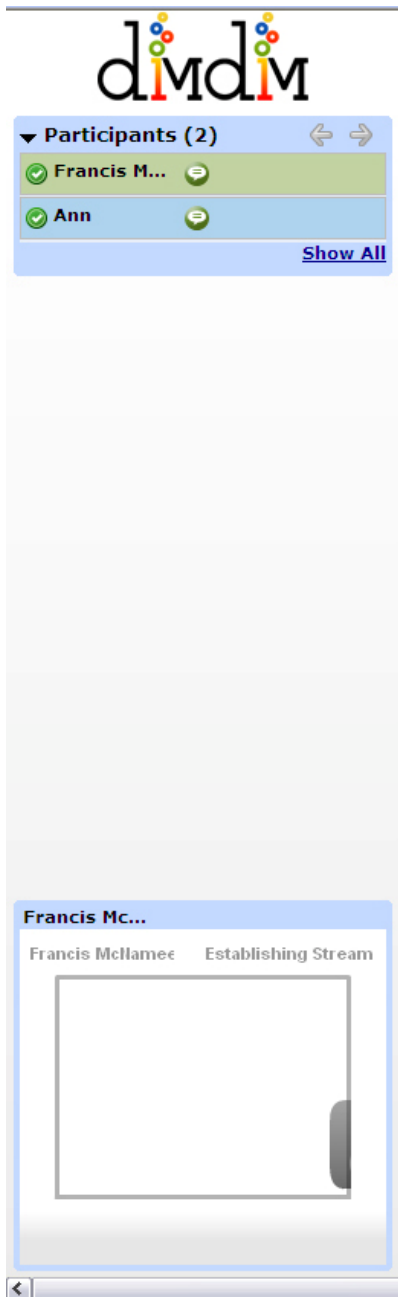


About Dimdim Version in use.



Sign out: Sign out after each meeting.

Side menu:

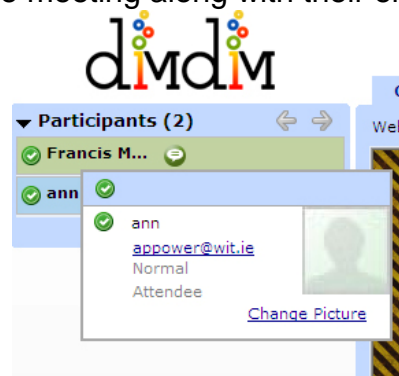


Participants: Lists the participants attending the presentation. The red microphone symbol shows the people who are eligible to talk. The green check default symbol hides a number of different moods. The green speech bubble can be used for **private chat** only if this is enabled by the presenter.



Participants can join in polls by left clicking on the green tick and show the thumbs up, agree, disagree etc.

Show all will show all the participants currently attending the meeting along with their email address.



Hovering over the participants name will give you the details of the user. Participants can upload their own picture.



Top tabs

The clock on the right shows how long the meeting is in place.

Collaboration



Whiteboard

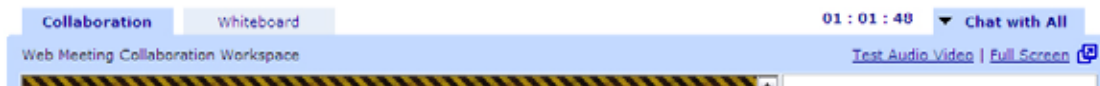


Chat with all: Text box where you can write to all participants at once, maximum amount of text you can type is around 130 words or 13 lines of standard text.

Emoticons: Hover over the blue emoticon text and you can add different icons to your text.



Full Screen



Full Screen can be used when the text is too small to read or if you don't need to see the participants. Can also be of help when the PowerPoint presentation is not visible, or freezes on a slide.

When things go wrong

Crashing PC

If your computer crashes, it is possible to still hear the sound even though your internet browser is not open. It is best to sign in again. You may need to use a different email address as Dimdim may still acknowledge your original log in.

Logging in again

If for some reason you need to log in again and your original log in details are still held by the Meeting Room. You may need to use a different email address as Dimdim may still acknowledge your original log in.

Using full screen

If you cannot see any presentation, or your screen is frozen on a slide. It may refresh if you go to full screen mode.

Presenters easy steps to logging in

1. Go to <http://www.dimdim.com/>
2. Select Host Meeting



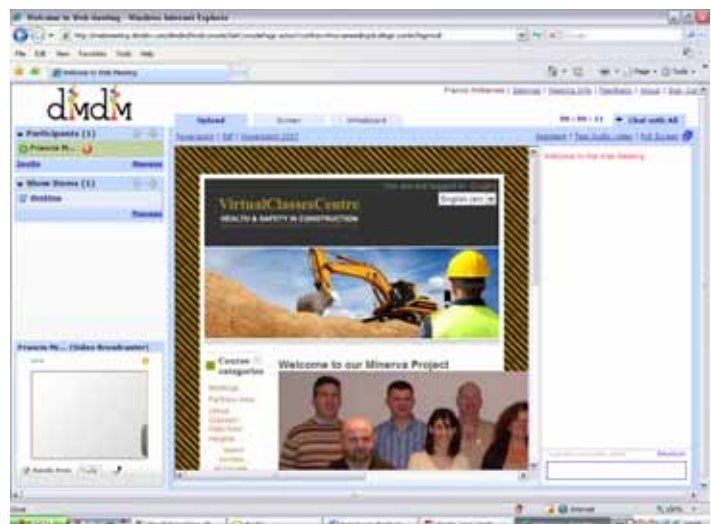
3. Sign in using your Username and password:

A light blue login form titled "Sign in to dimdim". It contains two input fields: "Username" and "Password". Below the fields is a grey "login" button. A link labeled "Forgot my password" is located at the bottom left of the form.

4. Select Submit:

A "Host Meeting" configuration window with tabs for "General", "Options", and "Features". The "General" tab is active, showing fields for "Meeting Room" (fmcnamee@cpdcollege.com), "Meeting Name" (fmcnamee@cpdcollege.com), "Meeting Agenda" (with a text area for "Enter a meeting agenda"), and "Attendees" (with a text area for "Enter a list of emails separated by '|')". At the bottom, there are radio buttons for "Start Now" (selected) and "Schedule". A red circle highlights the "Submit" button at the bottom right.

5. You should be able to view the Dimdim presenter's screen:



Attendees easy steps to logging in

Joining from a email invitation

Follow the hyperlink from the email in your inbox and click **Join**

Joining from the Internet with a Meeting key

1. Go to <http://www.dimdim.com/>
2. Select Attend Meeting

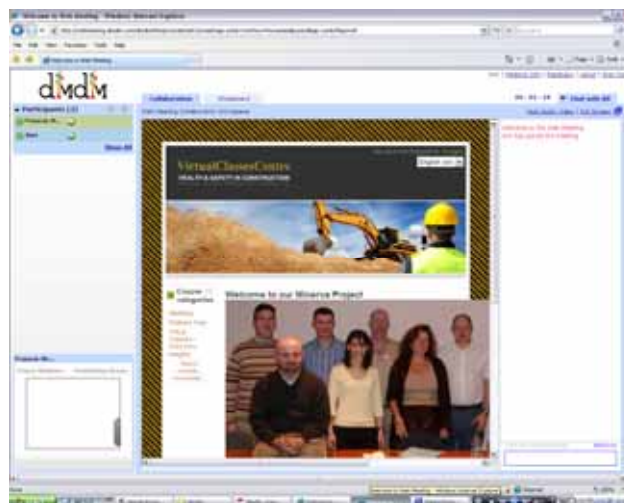


3. Sign in using your Email address, name and Meeting Room / Key:

A screenshot of a web browser window showing a login form titled "Attend Meeting". The form has three input fields: "Email:", "Display Name:", and "Meeting Room:". At the bottom right of the form are two buttons: "Join" and "Cancel".

4. Select Join

5. You should be able to view the Dimdim Attendee's screen:



Appendix E Instructors Guides

E 1. The Instructors Guide

The instruction design used to drive the instruction given through the virtual class was aimed at arranging the content resources and delivery methods offered by construction health and safety training and virtual classes in a way to make use of multiple intelligence principles. The role of the instructor was to make use technology to create a learning environment that was tailored to individual learners yet also fostered a community that the learners could feel part of.

The Content

The content of the virtual classes was target to the health and safety training needs of construction professionals. As the overwhelming cause of death and injury on a construction site are falls from height the class content target this area. The class content was developed by industry experts and was designed using principles identified form MI theory. The content used as much visual and context relevant material as possible. As the number of different ways to present information on a website is limited a detailed instructor guide was prepared to guide the actual delivery of the class. The instructor guide was designed for use through out the synchronous class and matched the learning objects and content of the class with examples of multiple presentation and perspective options. The guide for the instructors was tailored for each virtual class and is outlined in the following sections. The virtual class titles are as follows:

Table E.1 – Instructor Guide for the Hazards of Falls from Height Class

Event	Explanation	Content	Intelligence Tapped
Pre Work		Ask the students if they have completed the pre test.	

Gain Attention	Engage the Learner and Create Interest	Use some visual material and statistics to gain the students attention.	Experiential Entry Point
Inform Learner of Learning Objective	Tell the Learner what they are going to be able to do.	Describe the main hazards of working at heights <ul style="list-style-type: none"> • <i>From stairs or steps</i> • <i>Through existing floor openings</i> • <i>From ladders</i> • <i>Through roof coverings or roof openings</i> • <i>From roof/floor edges</i> • <i>From scaffolds</i> • <i>From staging or platforms</i> • <i>From building girders or other structural members</i> • <i>While jumping to a lower level</i> • <i>From ground level</i> 	Intrapersonal
Stimulate Recall of	Retrieve items from prior	Crystallise what we are talking about.	Foundational Entry Point

Learning	learning that may need to be incorporated into the newly learned capability	<p>Recall standard meaning and definition of key terms:</p> <p>A hazard is anything that can cause harm, such as chemicals, electricity and working from ladders</p> <p>The risk is the chance, high or low, that somebody could be harmed by these and other hazards, together with an indication of how serious the harm could be.</p>	
Present Stimuli	Display or communicate the elements involved in the performance of the objective	Refer to the case study in the class content where hazards are presented in the environment of a construction site.	Narrative Entry Point Spatial
Guide Learning	Provide hints, prompts, questions or a story that suggests a line of thought.	<p>Talk in some detail on each of the following hazards;</p> <ul style="list-style-type: none"> • <i>From stairs or steps</i> • <i>Through existing floor openings</i> 	Spatial (<i>Described used the core graphic</i>)

		<ul style="list-style-type: none"> • <i>From ladders</i> • <i>Through roof coverings or roof openings</i> • <i>From roof/floor edges</i> • <i>From scaffolds</i> • <i>From staging or platforms</i> • <i>From building girders or other structural members</i> • <i>While jumping to a lower level</i> • <i>From ground level</i> 	
Elicit Performance	Get learners to show that they know how to do a task, even if in limited circumstances or to a limited range.	Ask some general questions on the hazards of falls from height. Possibly ask some direct questions to people based on their pre class activities.	Interpersonal
Provide Feedback	Tell the learner about the degree of correctness of	Inform the learner if they were right or wrong, always responding to a learner's response.	Personalisation

	their performance		
Assess Performance	Get the learner to show how to do the task, through repetition of the performance(to ensure reliability) and under the same conditions (to ensure validity)	Ask the class to identify any hazards that were not identified in the class material.	Interpersonal
Enhance retention and Transfer	Provide for practice opportunities over time that incorporate variety.	Ask the students to work on further development on the case study and class work to be contributed to post class work	Experiential
Post Work		Direct the Students to complete the post test and the Evaluation	

Table E.2 – Instructor Guide for the Consequences of Falls from Height

Event	Explanation	Content	Intelligence Tapped
Pre Work		Ask the students if they have completed the pre test.	

Gain Attention	Engage the Learner and Create Interest	Highlight that falls from height are the largest cause of death in the construction industry.	Experiential entry point
Inform Learner of Learning Objective	Tell the Learner what they are going to be able to do.	The learners will be able to describe the consequences of falls from heights	Intrapersonal
Stimulate Recall of Learning	Retrieve items from prior learning that may need to be incorporated into the newly learned capability	Crystallise what we are talking about. The main consequences of falls from height are: <ul style="list-style-type: none"> • Death • Injury • Financial • Social Cost 	
Present Stimuli	Display or communicate the elements involved in the performance of the objective	Present the case study of Phil who had a life changing accident	narrative entry point
Guide Learning	Provide hints, prompts, questions or a story that suggests a line of thought.	Bring out the consequences as seen in Phil's story.	
Elicit Performance	Get learners to show that they	Ask the learners if they have any personal	interpersonal

	know how to do a task, even if in limited circumstances or to a limited range.	experience of an accident on a construction site and what the consequences were.	
Provide Feed Back	Tell the learner about the degree of correctness of their performance		Individualisation
Assess Performance	Get the learner to show how to do the task, through repetition of the performance(to ensure reliability) and under the same conditions (to ensure validity)		intrapersonal
Enhance retention and Transfer	Provide for practice opportunities over time that incorporate variety.		
Post Work		Direct the Students to complete the post test and the Evaluation	

Table E.3 – The Instructor Guide for the Preventative Measures for Falls from Height

Event	Explanation	Content	Intelligence Tapped
Pre Work			
Gain Attention	Engage the Learner and Create Interest	present learners with a graph of the amount of accidents that take place be low head height. The answer is 60% - get students to use the white board features to circle the percentages before you give the answer.	logical / mathematical – visual Bodily intelligence – using actions
Inform Learner of Learning Objective	Tell the Learner what they are going to be able to do.	Using risk assessments and preventative measures to 1. stop accidents happening and 2. reduce the harm caused when they do happen.	
Stimulate Recall of Learning	Retrieve items from prior learning that may need to be incorporated into the newly learned capability	Crystallise what we are talking about. The points are <ul style="list-style-type: none"> • Risk assessments through out project life cycle • Stopping accidents before they happen • Reducing the impact of accidents if they do happen 	intrapersonal

Present Stimuli	Display or communicate the elements involved in the performance of the objective	<p>Discuss the things that cause falls</p> <ul style="list-style-type: none"> • task related factors • environmental factors • personal factors <p>ask students of their experiences</p>	interpersonal
Guide Learning	Provide hints, prompts, questions or a story that suggests a line of thought.	<p>Go through;</p> <p>Accident prevention</p> <ul style="list-style-type: none"> • edge protection • protection of openings • safe access • use fall protection • use of ppe <p>fall injury reduction</p> <ul style="list-style-type: none"> • restraint systems • fall arrest • catch platforms • scaffolds • safety nets • safety mesh 	interpersonal narration entry point, possible give some personal examples of these systems.
Elicit Performance	Get learners to show that they know how to do a task, even if in	Ask the learners if they have any personal experience of issues in regard to preventative systems and	

	limited circumstances or to a limited range.	what the consequences were. Possibly ask about experience of renovation projects or fire proofing an old building where preventative measures are not straight forward.	
Provide Feed Back	Tell the learner about the degree of correctness of their performance	ask students about effective safety methods their companies use such as method statements and safe plans of action ect.	interpersonal
Assess Performance	Get the learner to show how to do the task, through repetition of the performance(to ensure reliability) and under the same conditions (to ensure validity)		
Enhance retention and Transfer	Provide for practice opportunities over time that incorporate variety.		
Post Work			


Table E.4 – The Instructor Guide for the Use of Mobile Elevated Work Platforms (MEWP)

Event	Explanation	Content	Intelligence Tapped
Pre Work			
Gain Attention	Engage the Learner and Create Interest	MEWP – are often used to remove the need for ladders – but people often use them without knowing how to use them or inappropriate use. Example – being outside the basket or driving over uneven ground.	Experiential entry point
Inform Learner of Learning Objective	Tell the Learner what they are going to be able to do.	the learners will be able to describe the different types of MEWP and be familiar with the hazards they represent.	Intrapersonal
Stimulate Recall of Learning	Retrieve items from prior learning that may need to be incorporated into the newly learned capability	look at the following types of equipment and be aware of their characteristics and dangers : <ul style="list-style-type: none"> • scissor lifts • telescopic booms • articulated telescopic booms 	
Present Stimuli	Display or communicate the elements involved in the performance of	Begin to go through the points about using a MEWP. Ask students if they have any experience in using one.	Narrative entry point

	the objective		
Guide Learning	Provide hints, prompts, questions or a story that suggests a line of thought.	Describe what should be done before work is started on a MEWP . <ul style="list-style-type: none"> • plan work • be fully competent with the machine • inspect the machine and look for the inspection report date • know where the emergency stop system is located. • Make sure work cradle is complete • check the condition of the ground you will cover with the MEWP 	visual / spatial Pictures of the equipment
Elicit Performance	Get learners to show that they know how to do a task, even if in limited circumstances or to a limited range.	Ask the learners if they have any personal experience of an accident on a MEWP and what the consequences were.	Interpersonal
Provide Feedback	Tell the learner about the degree of correctness of their performance		Individualisation

Assess Performance	Get the learner to show how to do the task, through repetition of the performance(to ensure reliability) and under the same conditions (to ensure validity)		Intrapersonal
Enhance retention and Transfer	Provide for practice opportunities over time that incorporate variety.		
Post Work			

Appendix F Class Content




Virtual Class

Hazards of working at heights


John Wall/Frank McNamee

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14




Learning Outcome

At the end of this class participants will be able to describe the hazards of working at heights.




VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14



Question

From 1996 to 2006 what percentage of fatalities on UK construction sites were caused by falls from heights?

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14



Question

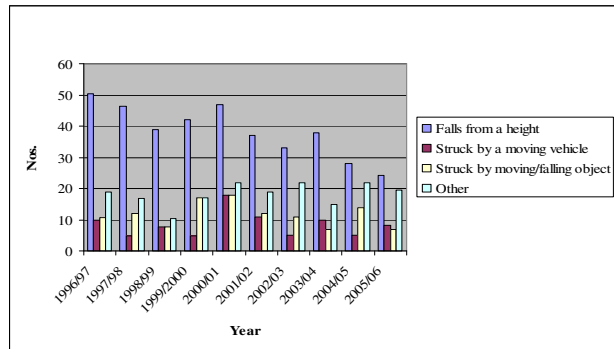
From 1996 to 2006 what percentage of fatalities on UK construction sites were caused by falls from heights?

Answer: 54%

Source: UK Health and safety commission, report on statistics of workplace fatalities and injuries - construction

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14

Statistics – Construction accidents in the UK



VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14

1932 Construction of Rockefeller Centre



VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14

Culture and attitudes

Empire state building completed 1931 - 5 deaths.



Hoover dam constructed between 1931 and 1935 – 96 deaths.



VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14

Definitions

A **hazard** is anything that can cause harm, such as chemicals, electricity, working from ladders, an open drawer etc (1) (2)

The **risk** is the chance, high or low, that somebody could be harmed by these and other hazards, together with an indication of how serious the harm could be (2)

Work at height means - (a) work in any place, including a place at or below ground level; (b) obtaining access to or egress from such place while at work, except by a staircase in a permanent workplace (3)



1. HSE-Health and Safety Executive (2006) Leaflet: Five Steps to Risk Assessment. <http://www.hse.gov.uk>, (Accessed 22-Apr-07).
2. Malta Occupational Health and Safety Authority (2006) Code of Practice for the Construction Industry – Consultation Document. Malta.
3. Work at Height Regulations (2005).
4. HSE-Health and Safety Executive (2007) Work at height: The basics. 'Height Aware' campaign. Information sheet No.1, www.hse.gov.uk/falls (Accessed 22-Apr-07).

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14

Hazards of working at heights

Categories of hazards - falls:

- From stairs or steps
- Through existing floor openings
- From ladders
- Through roof coverings or roof openings
- From roof/floor edges
- From scaffolds
- From staging or platforms
- From building girders or other structural members
- While jumping to a lower level
- From ground level

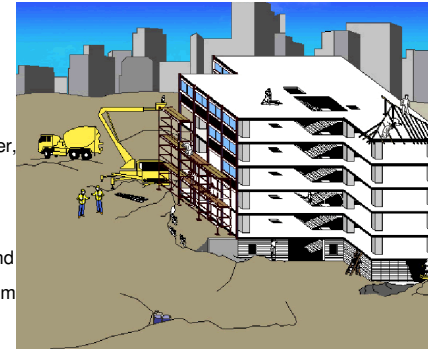


VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Miravva Project 228995-CP-1-2006-14

Case Study

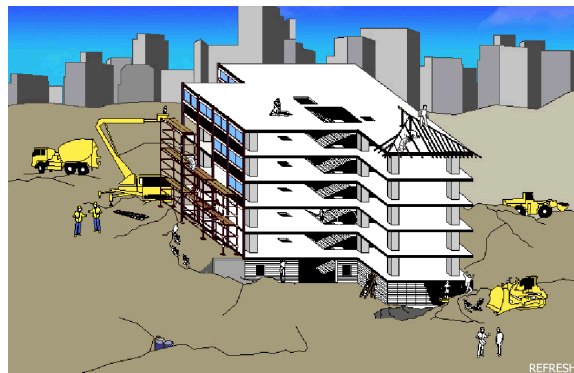
Setting

- Mason construction are 10 months into a major office block development.
- Recently appointed Bill O'Hare as the new construction manager.
- The previous manager was let go because of a series of on-site accidents.
- Bill has a lot of experience, however, this is his first big project and he is anxious to ensure that it is not delayed by any issues relating to health and safety.
- Every afternoon, Bill walks through the site searching for any health and safety concerns and this afternoon he has asked you to accompany him to identify anything on the site you might consider as a hazard.



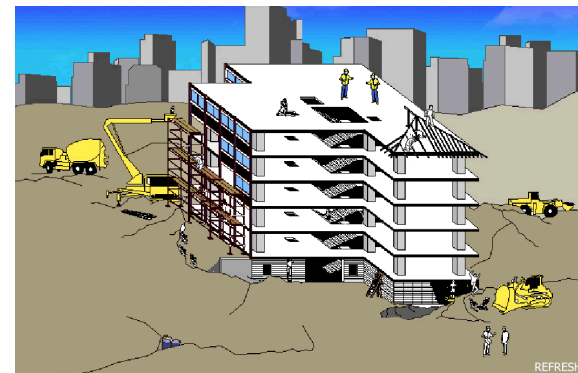
VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Miravva Project 228995-CP-1-2006-14

West view



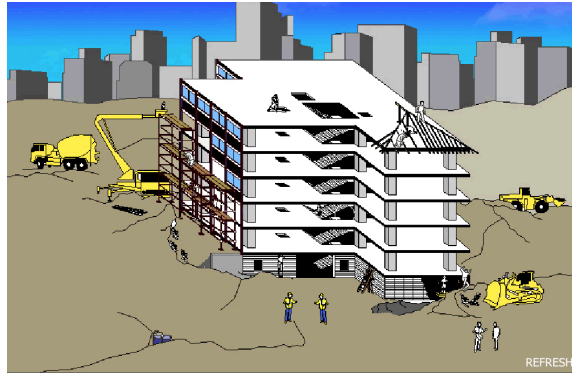
VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Miravva Project 228995-CP-1-2006-14

Roof View



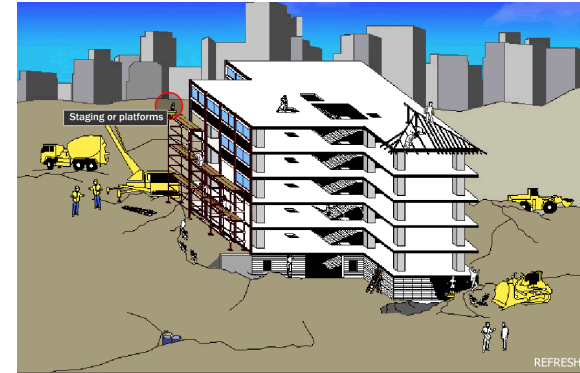
VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Miravva Project 228995-CP-1-2006-14

South view



VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14

Categories of hazards Staging or platforms



VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14

Categories of hazards

Falls from staging or platforms

Incomplete platform or staging, incorrectly erected, over-reaching, unstable ground, not using PPE or using it incorrectly. Unauthorised use, lack of training.



VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14

Question

Rank the following trades in order of highest number of major injuries caused by falls from heights?

- A. Painters and decorators
- B. Bricklayers and masons
- C. Scaffolders, staggers, steeplejacks and riggers
- D. Electrical fitters and cable jointers

Source: UK Health and safety commission, report on statistics of workplace fatalities and injuries - construction

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
Minerva Project 228995-CP-1-2006-14

Question

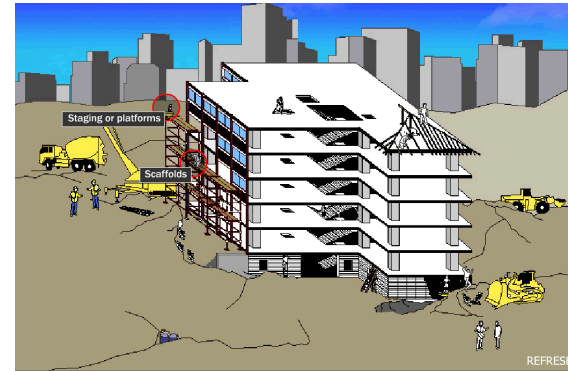
Rank the following trades in order of highest number of major injuries caused by falls from heights?

- Answer: A-1, B-2, C-3, D-4
- A. Painters and decorators (62%)
 - B. Bricklayers and masons (38%)
 - C. Scaffolders, staggers, steeplejacks and riggers (36%)
 - D. Electrical fitters and cable jointers (36%).

Source: UK Health and safety commission, report on statistics of workplace fatalities and injuries - construction



Categories of hazards scaffolds



Categories of hazards

Falls from scaffolds

Incomplete scaffolds, incorrectly erected scaffolds, unauthorised removal of planks, guardrails, toe boards.

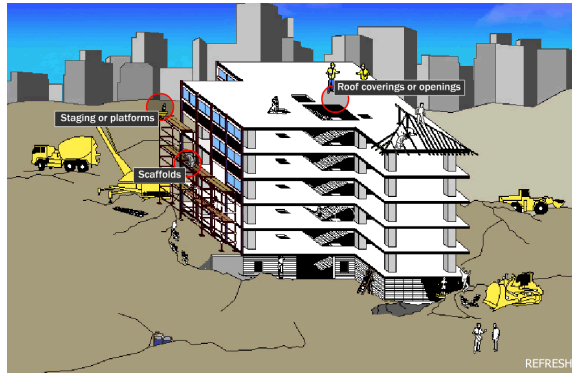


Add your story to the forum

Add a new discussion topic

Discussion	Started by
Your story	Frank McNamee
Video of Working Safely from Heights	John Wall
Falls from heights - your view	Frank McNamee

Categories of hazards roof coverings or openings



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Categories of hazards

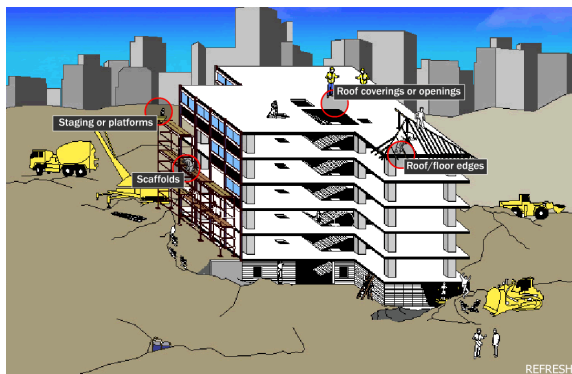
Falls through roof coverings or openings

Unprotected openings, no guardrails, fragile surfaces, fragile coverings (e.g. asbestos sheets and glass roofs). Falling through roof lights.



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Categories of hazards Roof/floor edges



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Categories of hazards

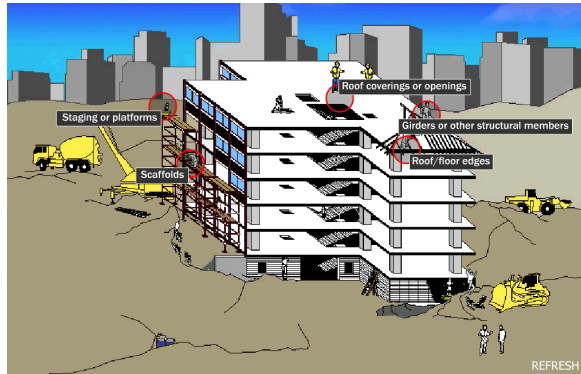
Falls from roof/floor edges

Unprotected edges, no guardrails, not using PPE or damaged or defective PPE, lack of anchor points.



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Categories of hazards Girders or other structural members



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Categories of hazards

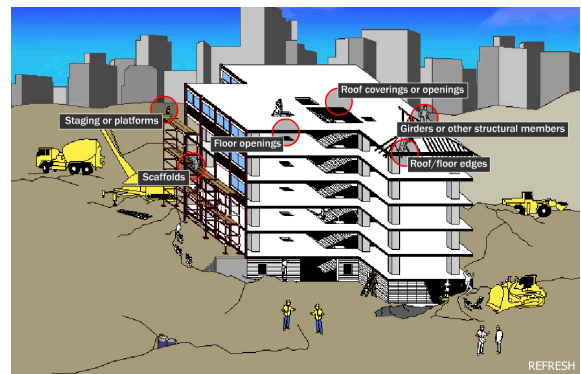
Falls from building girders or other structural members

Not using PPE or damaged or defective PPE. Not using access platforms.



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Categories of hazards Floor openings



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Categories of hazards

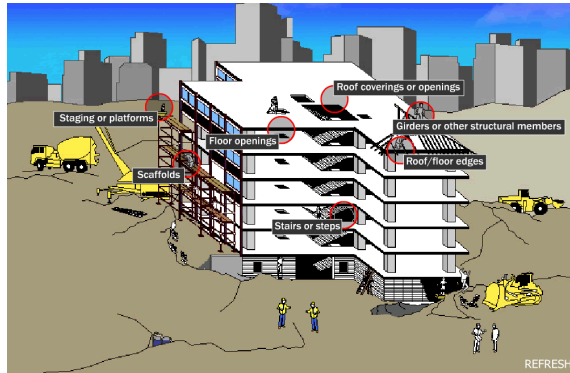
Falls through existing floor openings

Unprotected openings, no guardrails, openings covered with inadequate covering, poor lighting.



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Categories of hazards Stairs or steps



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Categories of hazards

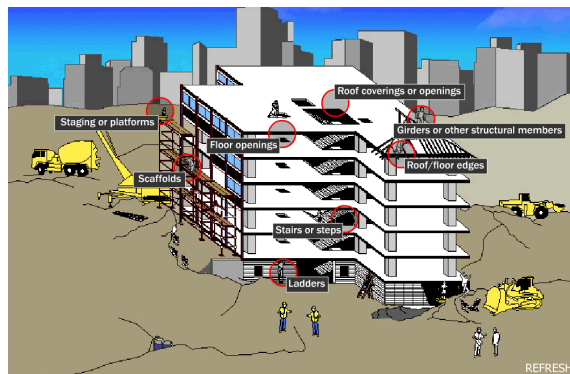
Falls from stairs or steps

Falls from stairs or steps. No handrails, debris/materials on the stairs, poor lighting, trailing cables, incomplete staircases, uneven risers.



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Categories of hazards Ladders



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Categories of hazards

Falls from ladders

Not tied or incorrectly tied, wrong angle, uneven surface, unstable ground, damaged or broken ladders, ladder too short, over-reaching, too much equipment, ladder too weak (wrong classification).



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Question

What is the correct angle that a ladder should be set from a wall?

Question

What is the correct angle that a ladder should be set from a wall?

Answer: 75 degrees

Ladders can be dangerous



Ladders can be dangerous



Ladders can be dangerous



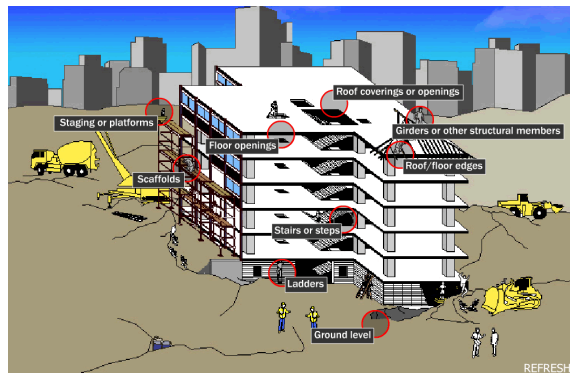
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Categories of hazards Ladders

Figures from Rehab UK, a charity which helps people with head injuries, show that 48,000 people a year in the UK now attend hospital Accident and Emergency departments following a ladder accident in and around the house.

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Categories of hazards Ground level



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Categories of hazards

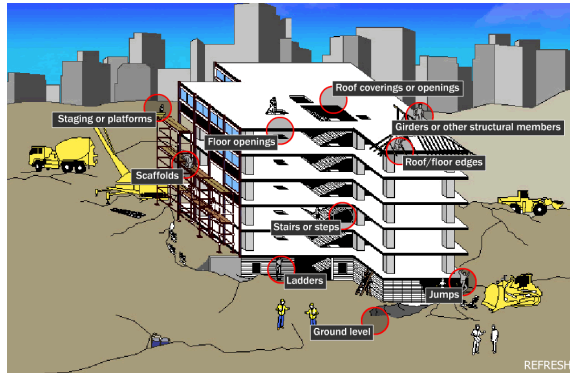
Falls from ground level

Unprotected excavations



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Categories of hazards Jumps



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Categories of hazards

Falls while jumping to a lower level

Taking short cuts, lazy, lack of equipment



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Reflection – post to forum

A hazard is a potential cause of falls from heights but ultimately responsibility is with the individual ?



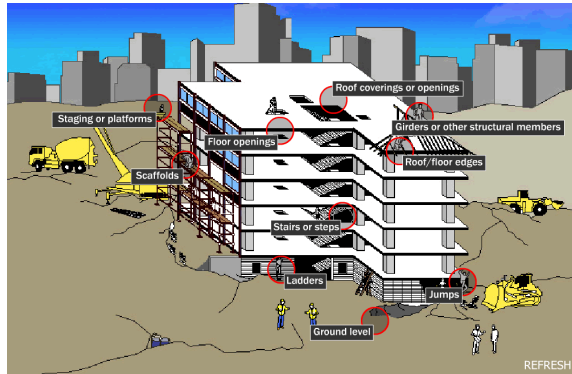
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Warning sound??

What theme tune or piece of music would work best as notification of a hazard??

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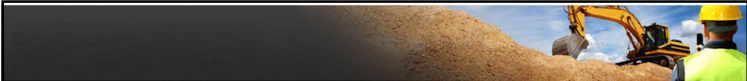
Categories of hazards



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Thank you

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Virtual Class

Consequences of falls from heights

Mannix Carney/Frank McNamee



Learning Outcome

At the end of this class participants will be able to describe the consequences of falls from heights.



Consequences of falls from heights

Results in to following

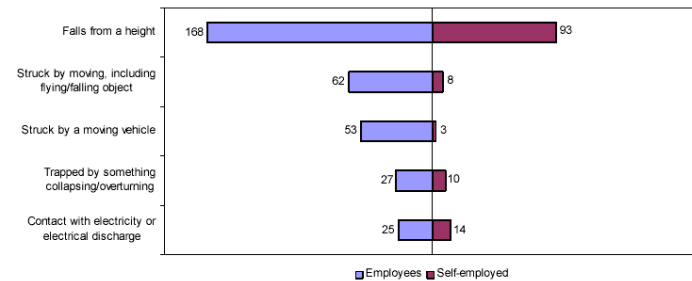
- Death
- Injury
- Financial Cost
- Social Cost



Death

Falls from height are the most common cause of death on a construction site.

2000-2003 UK



Death

Every year many loved ones are left behind due to fatalities caused by falls from heights on construction sites.



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Injury

Serious injury can occur from the smallest of falls.



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Injury

Almost all falls from heights result in very a serious injury. Many falls from heights cause permanent spinal damage.



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Financial Cost

The financial costs to the construction company involved can be crippling through:

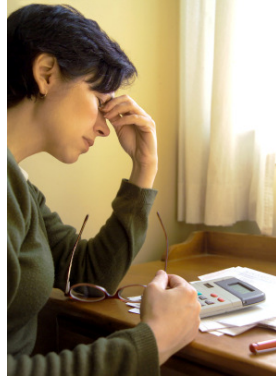
- Criminal prosecution
- Civil actions
- Bad publicity



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Financial Cost

The financial costs to families can be devastating as the accident often results in the main breadwinner in the home being no longer able to work.



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Social Cost

Its not all about money. There is also the loss of a father, son, brother, companion, friend.



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Social Cost

There is the cost to the economy in the form of:

- Traffic delays
- Lost production
- Incident management (police, ambulances, doctors, nurses etc)
- Public prosecution costs
- Public investigation costs



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Psychological cost

There are psychological costs for both family and work colleagues in the form of:

- Stress
- Anxiety
- Anger
- Guilt
- Depression



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Case Study

Phil was two months into a build and felt he knew his site pretty well, so he was confident that he was safe on the job. Unfortunately he experienced a bad fall after the scaffolding loading bay collapsed due to unauthorised removal of a guard rail.



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The Outcome

Phil's life will never be the same

He is now wheelchair bound. This is not the life Phil expected to lead in his late thirties. He can no longer enjoy days out with his two sons and his family had to be uprooted from their home.

Phil's self esteem has taken a huge blow and his social life is a thing of the past. Phil's accident would never have happened if his manager had arranged for the scaffolding to be inspected regularly.



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Implications for Phil

- **A change of career**
- Phil had to give up his career as a carpenter. He retrained in telesales which left him unfulfilled and really low.
- **Family upheaval**
- Now that Phil was in a wheelchair his family soon realised their home of 15 years just wasn't suitable. The family was uprooted to a new house and area, leaving everyone unhappy.

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Implications for the employer

Building on hold

The building site was closed for investigation, leaving the build behind schedule. The building site contractors were fined £20.000, which was a huge knock to their income.

Loss of income


Due to the accident the building contractors insurance costs rocketed, as the managers were deemed neglectful. On all future projects the building contractors had to disclose their safety record and naturally they lost many opportunities for future contracts.



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Conclusion






FALLS FROM HEIGHT


Preventive Measures

VIR FreeFoto.com

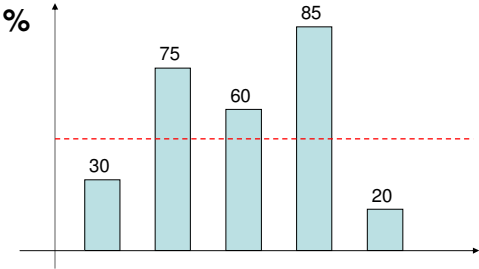


“Falls from height is any activity that involves people working in a position from which they could fall and injure themselves”

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What percentage of fall injuries, do you think, are result of falls from below head height?



Percentage of fall injuries from below head height
30
75
60
85
20

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risk assessment should be made prior to all projects.

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A **risk assessment** aims to identify risks before the work starts and to assure that the necessary equipment, appropriate precautions and systems of work are provided and implemented.

Factors that cause falls

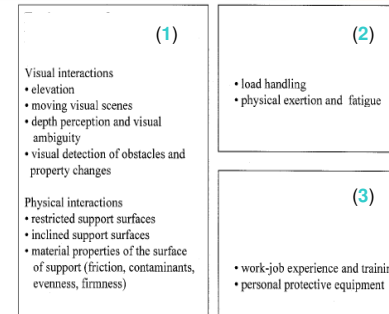
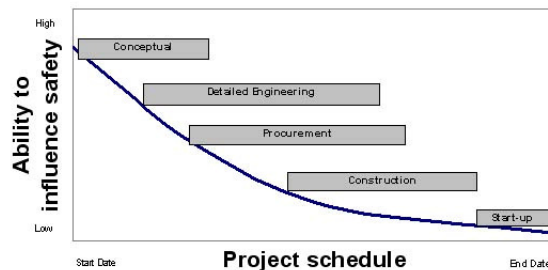


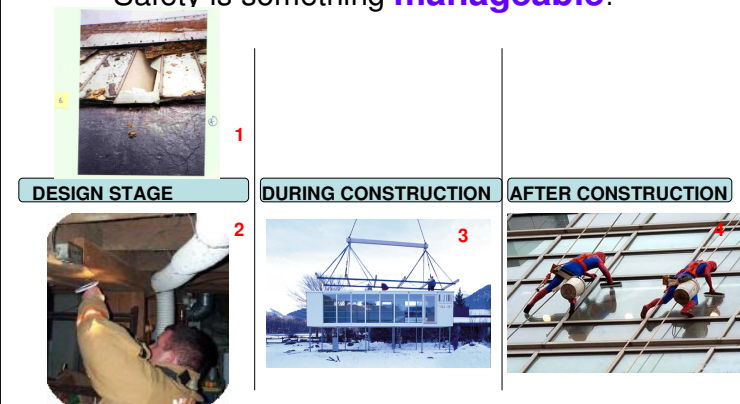
Figure 1. Factors involved in the control of balance during work on roofs.

(T) Task-related Factors / (E) Environmental Factors / (P) Personal Factors

Design and planning is of particular importance because the ability to influence safety is reduced over the life of the project.



Safety is something **manageable!**



BUILDING PHASE	RESPONSIBLE ORGANIZATION	WORK REQUIREMENT	CONSTRUCTIVE ACTION
BEFORE CONSTRUCTION	a. Manufacturer	a. Skylight Design	a. Improve the Design
	b. Architect	b. Skylight Specification	b. Specify: 1. Improved Designs, AND 2. Protective Barriers.
	c. Building owner or operator	c. Contract specifications for skylights and roof openings	c. Emphasize fall protection and prevention programs for skylights and roof openings. Make these a requirement of the contract specifications.
DURING CONSTRUCTION	a. Building Owner/ Operator	a. Monitors compliance of contract with the safety & health requirements.	a. Ensure that contract safety and health specs are implemented.
	b. Prime Contractor	b. Manage job-site safety & health (S&H) program.	ALL PARTIES (a, b, and c):
	c. Subcontractor	c. Responsible for S & H of OVN workers.	"... must assure ... safe and healthful working conditions..."
AFTER CONSTRUCTION (including final demolition)	a. Building Owner/ Operator	a. Overall Responsibility for: 1. Contract Compliance, and 2. S&H of maintenance workers.	BOTH PARTIES (a and b):
	b. On-site Contractor(s)	b. Responsible for safety of OVN workers	"... must assure ... safe and healthful working conditions..."

*Source: Occupational Safety and Health Act of 1970, sec22(b).



Table 1 is an example of

- (A) Work schedule
- (B) Job site analysis
- (C) Injury reduction matrix
- (D) Accident report

Common on-site measures

- edge protection (or 'guard rail systems')
- protection of halls and openings
- safe access to and egress from work area
- use of fall protection ('injury prevention')
- individual protection: use of personal protection equipment (PPE)



Edge protection

- often referred to as a 'guard rail system'
- is used to reduce the risk of a person falling from one level to another.



Protection of halls and openings

Above: Unprotected holes are a severe hazard and must be covered.






Safe access to and egress from work area

In areas where there is the risk of falling, “employers must provide a safe method for people to get to and from and move around that work area.



What if one falls?

FALL PROTECTION SYSTEMS (FALL INJURY PREVENTION SYSTEMS)



‘**Fall injury prevention system**’ means a system designed to arrest a person’s fall from one level to another and also minimize the risk of injuries or harm during the fall.



Fall injury prevention systems include:

- restraint systems
- fall-arrest systems
- catch platforms
- scaffolding
- safety nets
- safety mesh

Restraint systems

'Its purpose is to limit horizontal movements from an anchorage point or a horizontal life line or life rail so that the user is totally restrained from reaching a position where either a free fall or limited free fall is possible'



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Fall arrest systems

'Fall arrest is the form of fall protection which involves the safe stopping of a person already falling'



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Catch platforms (fans)

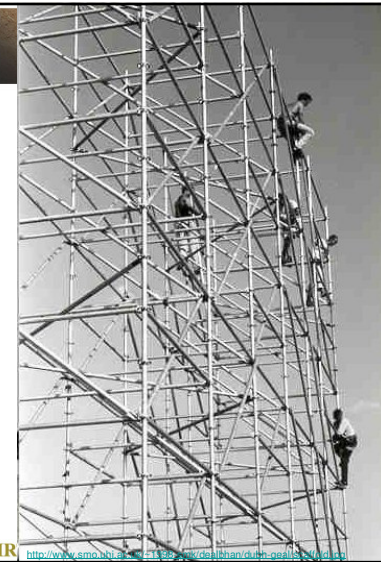
'A catch platform is a temporary platform located below a work area. It may be constructed of scaffolding components'



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Scaffolding

Scaffolding is an effective protection measure if specific requirements regarding its design, construction and erection are met.



VIR <http://www.sma.nl/...>



Safety nets

http://www.ceshepherd.com/images/machine_guard_13.png

'Safety nets can provide a satisfactory means of protection against fall injuries while allowing workers maximum flexibility of movement.

They should not be used for access to or egress from a work area or as a working platform'



Safety mesh

'Galvanised safety mesh securely fixed provides fall injury protection for roof installers and offers long-term protection for maintenance and repair workers.'



http://www.ceshepherd.com/images/machine_guard_13.png



Ongoing monitoring and regular inspections are integral to all kinds of safety practices.



Fall Hazard Checklist

Check all boxes that apply. Check "Yes" if hazards exist at your worksite; check "N/A" if not.

Hazard	Yes	N/A
Hoist areas	<input type="checkbox"/>	<input type="checkbox"/>
Holes	<input type="checkbox"/>	<input type="checkbox"/>
Formwork	<input type="checkbox"/>	<input type="checkbox"/>
ebar	<input type="checkbox"/>	<input type="checkbox"/>
Runways	<input type="checkbox"/>	<input type="checkbox"/>
Excavations	<input type="checkbox"/>	<input type="checkbox"/>
Dangerous equipment	<input type="checkbox"/>	<input type="checkbox"/>
Overhand bricklaying	<input type="checkbox"/>	<input type="checkbox"/>
Floor joists and trussing	<input type="checkbox"/>	<input type="checkbox"/>
Floor sheathing	<input type="checkbox"/>	<input type="checkbox"/>
Erecting exterior walls	<input type="checkbox"/>	<input type="checkbox"/>
Roof trussing and raftering	<input type="checkbox"/>	<input type="checkbox"/>
Roof sheathing	<input type="checkbox"/>	<input type="checkbox"/>
Roofing	<input type="checkbox"/>	<input type="checkbox"/>
Wall openings	<input type="checkbox"/>	<input type="checkbox"/>
Falling objects	<input type="checkbox"/>	<input type="checkbox"/>

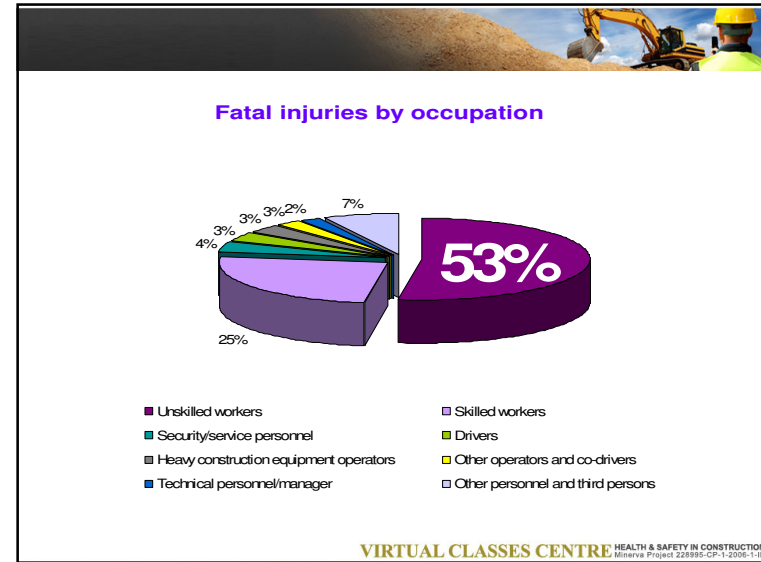



Individual protection, such as the use of **personal protective equipment (PPE)**, is used when the risks cannot be reduced by other means.

Building a **safety culture** at industry and company levels and sustaining it by **continuous training** is always the best method for accident prevention.

FreeFoto.com VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION Miravsa Project 228985-CP-1-2006-14

THANKS FOR YOUR ATTENTION

😊

Please visit
<http://virtualclassescentre.com>
 to download the supportive resources for preventative measures.

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FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

**CONTINUING PROFESSIONAL DEVELOPMENT
 FOR
 CONSTRUCTION MANAGEMENT**

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
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FALLS FROM HEIGHT
Mobile Work Platforms

FALLS FROM HEIGHT
Mobile Working Platforms
 2
Mobile Elevating Work Platforms

NOTTINGHAM TRENT UNIVERSITY **facelift** **VIRTUAL CLASSES CENTRE** HEALTH & SAFETY IN CONSTRUCTION
 Minerva Project 228956-CP-1-2006-1-IE

FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE WORK PLATFORMS

```

  graph TD
    A[MOBILE WORK PLATFORMS] --> B[Unpowered]
    A --> C[Powered]
    B --> D[Mobile Access Scaffolds (Tower scaffolds)]
    C --> E[Mobile Elevating Work Platforms (MEWPs)]
    C --> F[Mast Climbing Work Platforms (MCWPs)]
    E --> G[Scissor Lifts]
    E --> H[Telescopic Boom ('Cherry Pickers')]
    E --> I[Articulated Telescopic Boom]
  
```

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
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FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

MEWPs can provide safe access to high level work, and can be easily moved from one location to another.

There are three types of MEWPs:


Scissor lifts:	These provide vertical lift only.
Telescopic Booms :	These provide vertical lift and horizontal outreach. They are generally known as 'cherry pickers'.
Articulated Telescopic Booms :	These provide vertical lift, horizontal outreach, and rotation within the reach. They are generally vehicle mounted and used for specialist applications such as bridge inspection and repair.

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FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)


Scissor lift



Telescopic Boom



Articulated Telescopic Boom



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 Mineaya Project 228995-CP-1-2009-1-02

FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

Before you use a MEWP you must carry out a risk assessment to assess:

- 1) The risk of person falling or being thrown from the cradle;
- 2) The risk of equipment or materials falling or being thrown from the cradle;
- 3) The risk of the MEWP overturning;

Having carried out the risk assessment you must then take precautions to eliminate or control these risks.

ALWAYS READ AND FOLLOW THE MANUFACTURER'S OR SUPPLIER'S INSTRUCTIONS CAREFULLY!


VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
 Mineaya Project 228995-CP-1-2009-1-02

FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

Before you start work you must make sure that:

- 1) The work is properly planned;
- 2) The operator is fully trained and is familiar with the controls and performance of the MEWP to be used;
- 3) The MEWP has been thoroughly examined and that there is a current inspection report for it;
- 4) The MEWP is fitted with an emergency stop at ground level which can be used if the cradle becomes trapped against a fixed structure;



ALWAYS READ AND FOLLOW THE MANUFACTURER'S OR SUPPLIER'S INSTRUCTIONS CAREFULLY!

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
 Mineaya Project 228995-CP-1-2009-1-02

FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

Before you start work you must make sure that:

- 5) The cradle (work platform) is fitted with guard rails and toe-boards, or other suitable barriers;
- 6) The MEWP is used on firm and level ground. You may have to prepare this in advance;
- 7) Any openings over the MEWP might pass are covered with covers strong enough to bear the weight of any imposed load;
- 8) Any outriggers or stabilisers are fully deployed and chocked before raising the platform;

ALWAYS READ AND FOLLOW THE MANUFACTURER'S OR SUPPLIER'S INSTRUCTIONS CAREFULLY!


VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
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FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

Before you start work you must make sure that:

- Any area surrounding the MEWP where people might be struck by materials, etc., falling from the platform is sealed off with barriers;
- Other vehicles (e.g. dumpers, lorries, excavators) are segregated from the MEWP work area;



ALWAYS READ AND FOLLOW THE MANUFACTURER'S OR SUPPLIER'S INSTRUCTIONS CAREFULLY!


VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
 Manage Project 228998-CP-1-2006-1-18

FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

Before you start work you must make sure that:

- The MEWP is protected from adverse weather. High winds can destabilise MEWPs. Establish the maximum safe wind speed for operation;
- The MEWP is always inspected after storms and snow as they can have caused damage;
- Everyone knows what to do if the MEWP fails with the cradle raised.



ALWAYS READ AND FOLLOW THE MANUFACTURER'S OR SUPPLIER'S INSTRUCTIONS CAREFULLY!


VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
 Manage Project 228998-CP-1-2006-1-18

FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

When using a MEWP you must make sure that:

- Operatives do not use MEWPs close to overhead cables or other dangerous machinery;
- Operatives are not allowed to climb out of the cradle to reach their work;



ALWAYS READ AND FOLLOW THE MANUFACTURER'S OR SUPPLIER'S INSTRUCTIONS CAREFULLY!


VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
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FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

When using a MEWP you must make sure that:

- The elbows and/or knuckles of the arm do not protrude into traffic routes when working near vehicles;
- The MEWP is not moved with the cradle in the raised position unless it has been designed to do so.



ALWAYS READ AND FOLLOW THE MANUFACTURER'S OR SUPPLIER'S INSTRUCTIONS CAREFULLY!

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
 Manage Project 228998-CP-1-2006-1-18

FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

When using a MEWP you must make sure that:

- 5) The MEWP is **not** used as a support for other forms of access;
- 6) Unauthorised alterations and adaptations have **not** been made to the MEWP.




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MOBILE ELEVATING WORK PLATFORMS (MEWPs)

At the end of each day you must make sure that:

- 1) The platform has been cleared of tools, equipment and materials;
- 2) All power has been switched off and any keys removed;
- 3) The MEWP is secured where it will not be accessible to vandals or trespassers;
- 4) The MEWP's log has no record of any faults, malfunctions, repairs or maintenance needs.

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Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

Rough Terrain MEWPs

- This generally means that the MEWP is suitable for use on some uneven and rough ground.

- Always check the manufacturer's handbook before taking an MEWP onto unprepared or sloping ground.

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FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

Residual Risks

If, after having carried out a risk assessment and risk control measures have been put in place, there is still a residual risk of impact or people falling of the MEWP then the use of fall protect equipment must be considered, e.g.:

- When working next live highways where there is a risk of the MEWP being hit by traffic.



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FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

Residual Risks

- When there is risk of hitting tree branches or structural members if the MEWP travels with the platform raised.
- When the MEWP is being used for structural frame erection and has to move in and around structural members with the platform raised.




Photo: Di Fazio

ALWAYS READ AND FOLLOW THE MANUFACTURER'S OR SUPPLIER'S INSTRUCTIONS CAREFULLY!

VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
 Mineiro Project 228998-CP-1-2020-1-02

FALLS FROM HEIGHT
Mobile Work Platforms

MOBILE ELEVATING WORK PLATFORMS (MEWPs)

Personal fall protection



- Wearing a harness incorporating a short work-restraint lanyard gives the most suitable form of protection as it prevents the wearer from getting into a position where they could fall from the cradle in the first place: (unless the MEWP overturns).
- Here the harness does not usually have a shock-absorbing capability, and **MUST** be fixed to a suitable anchor inside the cradle.

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VIRTUAL CLASSES CENTRE HEALTH & SAFETY IN CONSTRUCTION
 Mineiro Project 228998-CP-1-2020-1-02

***Appendix G The Interactivity
Matrix Results***

G 1. Phase One

Table G.1 Virtual Class 23rd April 2008

Session Title	The Hazards of Falls from Height	
Presenter	Frank McNamee	
Number of participants	16	
Date and time of Session	April 23rd, 2008	
Duration	30 minutes	
Number of slides presented	41	
Number of group-wide interactions: Requiring responses from all attendees simultaneously to a presented question	14: comprising multiple choice, and two-option, and mood indicators	
Number of individual contributions	Speaking: 0	
Interactions addressed at specific attendees	Public Chat: 6	
Total interactions	14 group + 6 individual = 20	
Average number of minutes between interactions: Total minutes divided by total interactions	30 / 20 = 1.5	
Average number of total interactions per person	20 / 16 = 1.3	
The number of posts made to the class forum.	0	

Table G.2 Virtual Class 2nd May 2008

Session Title	The Consequences of Falls from Height	
Presenter	Frank McNamee	
Number of participants	17	
Date and time of Session	May 2nd, 2008	
Duration	25 minutes	
Number of slides presented	16	
Number of group-wide interactions: Requiring responses from all attendees simultaneously to a presented question	10: comprising multiple choice, and two-option, and mood indicators	
Number of individual contributions	Speaking: 0	
Interactions addressed at specific attendees	Public Chat: 4	
Total interactions	10 group + 4 individual = 14	
Average number of minutes between interactions: Total minutes divided by total interactions	25/14 = 1.8	
Average number of total interactions per person	14 / 17 = 0.8	
The number of posts made to the class forum.	0	

G 2. Phase Two

Table G.3 Virtual Class 10th November 2008

Session Title	The Hazards of Falls from Height	
Presenter	John Wall	
Number of participants	5	
Date and time of Session	November 10th, 2008	
Duration	35 minutes	
Number of slides presented	46	
Number of group-wide interactions: Requiring responses from all attendees simultaneously to a presented question	15: comprising multiple choice, and two-option, and mood indicators	
Number of individual contributions	Speaking: 10	
Interactions addressed at specific attendee	Public Chat: 15	
Total interactions	15 group + 25 individual = 40	
Average number of minutes between interactions: Total minutes divided by total interactions	35 / 40 = 0.9.	
Average number of total interactions per person	40 / 5 = 8	
The number of posts made to the class forum.	2	

Table G.4 Virtual Class 11th November 2008

Session Title	The Consequences of Falls from Height	
Presenter	John Wall	
Number of participants	5	
Date and time of Session	November 11th, 2008	
Duration	27 minutes	
Number of slides presented	17	
Number of group-wide interactions: Requiring responses from all attendees simultaneously to a presented question	8: comprising multiple choice, and two-option, and mood indicators	
Number of individual contributions	Speaking: 4	
Interactions addressed at specific attendees	Public Chat: 15	
Total interactions	8 group + 19 individual = 27	
Average number of minutes between interactions: Total minutes divided by total interactions	27 / 27 = 1	
Average number of total interactions per person	27 / 5 = 5.4	
The number of posts made to the class forum.	5	

Table G.5 Virtual Class 17th November 2008

Session Title	The Preventative Measures from Falls from Height	
Presenter	John Wall	
Number of participants	7	
Date and time of Session	November 17th, 2008	
Duration	36 minutes	
Number of slides presented	27	
Number of group-wide interactions: Requiring responses from all attendees simultaneously to a presented question	15: comprising multiple choice, and two-option, and mood indicators	
Number of individual contributions	Speaking: 9	
Interactions addressed at specific attendees	Public Chat: 14	
Total interactions	15 group + 23 individual = 38	
Average number of minutes between interactions: Total minutes divided by total interactions	36 / 38 = 0.95	
Average number of total interactions per person	38 / 7 = 5.4	
The number of posts made to the class forum.	1	

Table G.6 Virtual Class 18th November 2008

Session Title	The Use of Mobile Elevated Work Platforms	
Presenter	John Wall	
Number of participants	5	
Date and time of Session	November 18th, 2008	
Duration	20 minutes	
Number of slides presented	18	
Number of group-wide interactions: Requiring responses from all attendees simultaneously to a presented question	7: comprising multiple choice, and two-option, and mood indicators	
Number of individual contributions	Speaking: 6	
Interactions addressed at specific attendees	Public Chat: 9	
Total interactions	7 group + 15 individual = 22	
Average number of minutes between interactions: Total minutes divided by total interactions	20 / 22 = 0.9	
Average number of total interactions per person	22 / 5 = 4.4	
The number of posts made to the class forum.	4	

***Appendix H The Evaluation
Questionnaire***



Jump to...

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Virtual Class

Mode: Anonymous

(*)Answers are required to starred questions.

How would you rate the following areas of website

- 1.) The operation of the website www.virtualclassescentre.com was stable* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 2.) I was able to navigate the website* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 3.) Please leave any comments in relation to this section here:

How do you rate the following statements about DimDim?

- 4.) I was able to use the interactive voice over internet protocol DimDim system* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 5.) Dim Dim was easy to use and trouble free.* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 6.) The clarity of the audio through Dim Dim was clear and understandable* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 7.) Did you use the class polls?* Not selected Yes No
- 8.) Did you use the shared microphone?* Not selected Yes No
- 9.) Did you use the chat features?* Not selected Yes No

- 10.) Please leave any comments in relation to this section here:

How do you rate the following statements about the class content?

- 11.) The content was delivered visually through diagrams or pictures* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 12.) The content was delivered through a story or case study* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 13.) The virtual class content was clear and easy to understand.* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 14.) Please leave any comments in relation to this section here:

The role of the instructor

- 15.) How did you find the pace of the instruction* Not selected Very slow Slow Perfect Fast Very Fast
- 16.) To what degree did you feel you could interact with the instructor* Not selected Below average Average Above Average
- 17.) Please leave any comments in relation to this section here:

How would you rate the followings questions on the learning community created through the virtual class?

- 18.) The virtual class made it easy for you to interact with the instructor* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 19.) The virtual class made it easy to share what you learned with the rest of the class.* Not selected Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
- 20.) Please leave any comments in relation to this section here:

EV101

You are logged in as **Barrie Cox** (Logout)