Evaluating the Impact of Digital Media on Apprenticeship Training

Master of Arts
(Digital Media Development for Education)
University of Limerick

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Submitted to the University of Limerick, March 2010
Declaration:

I hereby declare that this project is entirely my own work and it has not been submitted for the award of any degree at any other university.

Signed _______________________
Mike McMahon

Date ________________________
Abstract

Michael McMahon

Evaluating the Impact of Digital Media on Apprenticeship Training

This purpose of this research was to evaluate the use of digital media in apprenticeship training. This digital media was targeted to specific areas of the curriculum using podcasts and a pedagogically designed tutorial program. The digital media utilised has the flexibility to be used by the student anytime or anywhere using modern technology. The results of the study showed a marked improvement in test results and a positive bias among today’s apprentices in the use of technology in education. Furthermore, the research evidence also proves there are reasonably high levels of technological ability and access among apprentices in computer and iPod usage which proves there would be few barriers to implementing this type of pedagogical enhancements.

The research has shown however that there was a lack of motivation among many apprentices during their training which concurs with research conducted in the literature. This lack of motivation can in part be attributed to the effects of job loss suffered by apprentices during training which was caused by a severe economic downturn, especially in the building industry. Research on affective learning was important to this research as it could have a major impact on training and therefore affect test results which could diminish the impact of digital media integration.

Therefore the results and recommendations of this thesis in light of the evidence found is that it is time for FAS, Ireland’s training authority with responsibility for apprenticeship training to invest time and resources in the design and implementation of this technology to cover all areas of the curriculum for each trade. This investment would enhance apprenticeship training into the future. Further research which could be carried out to augment this study would be in methods to actively engage and motivate the 21st century apprentice and the use of online learning environments in the training of apprentices.
Acknowledgements

I wish to express my sincere thanks to the following people, who helped me to complete this thesis, I will be forever thankful.

To Geraldine McWeeney for her lectures and helpful guidance in the graduate diploma and her valued help, patience and encouragement in supervising this Master’s thesis.
To the tutors and staff of the CDI unit of Limerick University for their help and professionalism including Stanley McDonagh for his support which encouraged me to proceed to the second year.
To Tony Mulrennan, assistant manager of the FAS training centre in Shannon for his help and support in facilitating the purchase of any necessary materials and in facilitating time off where necessary.
To Mary Kathy McNamara for her support in reading and critiquing this work.
To Noel Neylon for his help in the production of the videos used with the tutorial program.
To the cohorts of Plumbing apprentices for their time and enthusiasm in participating in this study.
And last but certainly not least, and to paraphrase Reigeluth (1999), I dedicate this project to my loving wife Ann who has understandingly and patiently endured the countless hours my studies have stolen from our relationship and to acknowledge the extra work she has committed to whilst I studied.
I further dedicate this project to our two wonderful children, Shane aged 10 and Darren aged 8 with the hope that seeing me spend so much time over the past years studying will motivate them to value education and work hard at school.

W. McMahon
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<tr>
<td>ADD</td>
<td>Attention Deficit Disorder</td>
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<tr>
<td>ADDIE</td>
<td>Analyse, Design, Develop, Implement and Evaluate. Design for instructional training systems.</td>
</tr>
<tr>
<td>ARCS</td>
<td>Attention, Relevance, Confidence and Satisfaction. Keller’s model of motivational design</td>
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<td>CAL</td>
<td>Computer Aided Learning</td>
</tr>
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<td>CD-ROM</td>
<td>Compact Disc Read Only Memory</td>
</tr>
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<td>DVD</td>
<td>Digital Versatile Disc</td>
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<tr>
<td>FÁS</td>
<td>Foras Áiseanna Saothair. Ireland’s training and Employment agency</td>
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<tr>
<td>ID</td>
<td>Instructional design</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>M-Learning</td>
<td>Mobile learning. Any sort of learning that happens when the learner is not at a fixed, predetermined location.</td>
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<tr>
<td>MP3</td>
<td>MPEG Audio Layer 3. A type of audio file. MPEG stands for Moving Pictures Expert Group</td>
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<tr>
<td>Net Generation</td>
<td>A generation of people who were born after the internet was established and grew up with it</td>
</tr>
<tr>
<td>Nintendo’s D.S</td>
<td>Nintendo’s Dual Screen, a gaming system used mainly by children</td>
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<tr>
<td>PDA</td>
<td>Personal Digital Equipment</td>
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<tr>
<td>Phase Two</td>
<td>The second phase of the Standards Based Apprenticeship training system delivered off-the-job in FÁS Training centres</td>
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<td>Podcasting</td>
<td>A podcast is a series of digital media files, usually digital audio that is made available for download via web syndication</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<td>--------------</td>
<td>-----------</td>
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<td>PC</td>
<td>Personal Computer</td>
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| RSS          | Real Simple Syndication or web syndication  
Automatic updates via the internet on previously selected information topics fed to your computer or iPod. |
| SPSS         | Statistical Package for the Social Sciences |
| SSS          | Scotopic Sensitivity Syndrome, sensitivity to light which can affect reading |
| UK           | United Kingdom |
| URL          | Uniform Resource Locator. A web address |
| Vodcasting   | A vodcast or video podcast is a series of video digital media files that are made available for download via web syndication |
Chapter one

Introduction

1.1 Background and Context

Apprenticeship learning has not progressed significantly over the years according to Fuller and Unwin (2002 [online]). Since medieval times, the term “apprenticeship” has been used to describe a person moving from novice to expert in a specific occupational field. Fuller and Unwin (2008:4 [online]) stated that the “concept transcends occupational boundaries and hierarchies, and is used by surgeons as well as carpenters, chefs, actors and musicians”. Apprenticeship, they said, is also the term used for a set of formalised, state-regulated arrangements for vocational education and training. In many European countries, these arrangements are organised through social partnerships between the state, employers, trades unions, and education and training providers (Fuller and Unwin 2002 [online]).

<table>
<thead>
<tr>
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<th>RESPONSIBILITY</th>
<th>DURATION</th>
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<td>One</td>
<td>“On-the-job” planned training and work experience</td>
<td>Employer</td>
<td>Minimum 12 weeks</td>
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<tr>
<td>Two</td>
<td>“Off-the-job” training, development &amp; modular assessment</td>
<td>FÁS</td>
<td>20 weeks</td>
</tr>
<tr>
<td>Four</td>
<td>“Off-the-job” training, development &amp; modular assessment</td>
<td>Dept. of Education and Science</td>
<td>10 Weeks</td>
</tr>
<tr>
<td>Five</td>
<td>“On-the-job” training, work experience &amp; competence assessment</td>
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<td>Not fixed</td>
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<td>Six</td>
<td>“Off-the-job” training, development &amp; modular assessment</td>
<td>Dept. of Education and Science</td>
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<tr>
<td>Seven</td>
<td>“On-the-job” training, work experience &amp; competence assessment</td>
<td>Employer</td>
<td>Minimum 12 weeks</td>
</tr>
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Table 1. Structure of the Standard Based Apprenticeship in Ireland

Foras Áiseanna Saothair (FÁS), the nations training and employment agency has overall responsibility for the delivery and control of apprenticeship in Ireland. The
apprentice undergoes a four year apprenticeship split into seven phases (Table 1). These phases are served with their respective employers and off the job training occurs at FÁS training centres and Institutes of Technology. During their second phase which is held in FÁS training centres, apprentices undergo eight modular assessments over a twenty week period, and on successful completion of all, they progresses onto the next phase. Table 1 above outlines the different on and off the job phases of the apprenticeship system and “phase two”, held in FÁS training centres is where this research was conducted (FÁS 2009 [online]).

The National Apprentice Advisory Committee (NAAC 2002) began the process of reviewing the apprenticeship system in 2002. The phase two Plumbing curriculum was updated but suffered fundamental flaws. It was poorly re-designed, did not introduce necessary new modules such as a section on renewable energy systems and failed to remove outdated material. In addition to this the educational media was of poor quality and no moves were made to introduce any new digital media. Many trade instructors received black and white PowerPoint presentations and handouts which did not encompass much of Mayer’s (2001: 2005) principles of multimedia.

1.2 Aims and Objectives

The principal aim of this thesis is to examine the benefits of introducing digital media to apprenticeship learning. Specifically the objectives were to integrate a self tutoring DVD training program and appropriate audio podcasts into the existing pedagogy of the plumbing apprenticeship curriculum to ascertain their educational value. Research was focussed on four cohorts of Plumbing apprentices over a two year period. Two cohorts of 2009 students were introduced to new digital media. Research was undertaken on these cohorts who became the experimental group and their views were recorded. Comparisons were subsequently made between the 2009 cohort’s results who used digital media and the results of the previous 2008 cohorts who were the control group and were trained without the use of digital media. The purpose of this was to establish if any improvements occurred with student grades as a result of the technology integration. Appendix A contains the actual test results of both cohort groups for evaluation purposes.
The thesis also examines the literature relevant to the hypothesis and comparisons are made with the findings of the primary research. As further background information the thesis looks at the modern apprentice’s access to the relevant technologies and their ability to use them. A further objective of the research was to elicit the affective learning levels to ascertain if students were motivated and self-directed. Affective learning was researched as it was considered to be relevant to the study.

1.3 Scope and Limitations

The primary research was confined to two cohorts of plumbing apprentices in the Shannon training centre in Co. Clare over a single year with the previous year’s cohorts results used for comparison. The introduction of digital media was limited to two modules out of a possible eight modules of the Plumbing curriculum as it was prohibitive to design educational media for the entire course due to time constraints. Further detail is available in the methodology chapter. There were no major limitations in the planning and writing of this thesis. Due to word count limitations this thesis will evaluate at levels one and two of Kirkpatrick and Kirkpatrick’s (2006) four-level model of evaluation.

1.4 Plan of Development

Chapter one. This chapter will introduce and examine the subject chosen and outline the purpose of the study. It will also outline the scope of the research and any limitations imposed on the study such as time, availability of data, etc.

Chapter Two presents a review of the literature that was found to be relevant to the primary research. Relatively little has been written on apprenticeship training in the literature and this chapter outlines many of the topics closely related to the hypothesis. It examines the learning theories and how they relate to the introduction of digital media. It proceeds to discuss the contributions of other writers in relation to multimedia design with reference to Mayer (2001, 2005). It will then look at the subject of instructional design and examine what is said on evaluation with special
reference to Kirkpatrick and Kirkpatrick’s (2007) four-level model of evaluation. The review will focus on the implementation of multimedia DVD’s and audio podcasts. These two methods of multimedia can be used together with traditional chalk and talk methods of teaching to give a new blended learning style to apprenticeship training. The work of Bonk and Graham (2006) as well as many others will be used to critically evaluate the blended learning approach. Chapter two will examine the views of Laurillard (2002) on tutorial programs. It will also examine Morales and Moses (2006, [online]), Soloway (2009 [online]) and Prensky’s (2005, 2006) views on newer mobile technologies such as miniature portable learning aids which are very relevant to today’s digital society. Finally chapter two will look at the work of Molloy (2005 [online]), Mendler (2000) and Raffini (1996) on intrinsic motivation and its importance to the affective learning domain.

Chapter Three begins by introducing the formulation of the research statement, the research plan and the selection of the sample group. It proceeds to provide the details of the methodology employed for the research process. This chapter outlines how research received from questionnaires and focus groups will be triangulated with test scores received from previous cohorts. The evaluation of test results were made between cohorts of apprentices trained in 2009 who had studied with a blend of digital media integrated into the curriculum and those who were trained in 2008 with chalk and talk methods only.

Chapter Four presents the findings of the primary research. It gives an account of the sample group’s reactions to various aspects of the digital media implemented, their ability to use a computer and their access to the relevant digital devices. It also looks at reasons why apprentices opted for their chosen career and their motivation during the course as the author believes this information is relevant to the success of any proposed pedagogical change.

Chapter Five delivers a discussion on the findings from the primary research. It analyses and critiques the findings in relation to the research of the literature in chapter two. This chapter teases out whether the introduction of digital media to apprenticeship training is worthwhile or just a novel distraction. It also looks at the
related field of affective learning by examining the motivation levels within the sample group and how this may impact on the results.

Chapter six presents the conclusions that are drawn from the findings of the research. It outlines what the thesis has proved or failed to prove and it provides a number of recommendations based on these findings and suggests areas for further research.
Chapter two

**Literature Review**

2.1 Introduction

In recent years, several countries throughout Europe and beyond have been attempting to reform their apprenticeship systems in response to a number of challenges, according to Fuller and Unwin (2002 [online]). They said these challenges include changes in national economies, increased demand for a multi-skilled workforce, decreased commitment shown by employers for substantive training programmes. They continued outlining these challenges by stating that there are persistent problems of social exclusion and a need for lifelong learning strategies as well as the fact that more young people are staying in full-time education to third level (Fuller and Unwin 2002 [online]).

This review of the literature will focus on subjects from learning theories and learning styles to the types of digital media that relate to the primary research. As the research uses a tutorial program, it will also examine the theory of instructional design and Kirkpatrick’s (1998) four step model of evaluation. Finally as student motivation is an important factor in education and will have a large impact on any study evaluating a new pedagogical approach, this chapter will look at the writings in the literature on affective learning.

2.2 Learning Theories

This research utilised a tutorial program and educational audio podcasts which were integrated as a new pedagogy to the teaching practices of two cohorts of Shannon based plumbing apprentices. The multimedia used was designed by the author as no appropriate tutorial programs or podcasts were available for apprenticeship learning. It was therefore necessary to look at the learning theories to determine what theory the new technologies would model. Bednar, Cunningham, Duffy, and Perry, (1995:100) argued, “Instructional strategies and tools must be based on some theory of learning and cognition”.
2.2.1 The Behaviourist and Cognitive learning theories

Forrester and Jantzie (2004) labelled behaviourism as directed instruction. Bandura (1977) emphasized the importance of observing and modelling the behaviours, emotions and attitudes of others. He believed that social learning theory was both a behaviourist and cognitive model. Hayes (1993) claimed that psychologists had recognised the limitations of the behaviourist approach and inspired by the growth of computers, began to look towards cognitivism. Abbott (2001) further claimed that much of the early use of computers in education was based on the behaviourist style of drill and practice where maths games, spelling or reading used rote learning and interesting but aimless adventures that were exciting but had little content or purpose.

Cognitivism was developed as a reaction to the behaviourist theory according to Young (1996 [online]), which in his opinion was too simplistic. Ertmer and Newby (1993) stated that the behaviourist approach may not stimulate the novice learner who is familiar with the content, however neither do they advocate one single learning theory, but say it varies with the level of learners and the content to be learned. Tasks associated with low level processing seem to be facilitated by the behaviourist outlook whereas tasks requiring increased levels of processing are commonly associated with cognition (Ertmer and Newby 1993).

Hoffsetter (1997 [online]) compared the two theories stating that behaviourism was teacher centred and dominated and relied upon rote memory as students used extrinsic motivation to learn facts. Cognitivism on the other hand he stated is learner centred with the teacher observing, coaching and facilitating.

2.2.2 Constructivist learning theories

“There has been a trend away from teacher-directed instructional approaches to student-centered environments” according to Mishra and Sharma (2005:354). The traditional teacher-centered model where knowledge is transmitted from teacher to learner is rapidly being replaced by alternative learner-centered, constructivist, sociocultural models. These models put emphasis on guiding and supporting students as they learn to construct their understanding of the culture and communities of which
they are a part (Duffy and Cunningham 1996). Koschmann, Myers, Feltoovich and Barrows (1994:219–225) concluded that:

The blending of technological and pedagogical advancements has elevated the importance of research on electronic student dialogue, text conferencing, information sharing, and other forms of collaboration. Clearly, as specialized software is developed to support the exchange of information across workstations and various instructional strategies are experimented with and modified, collaborative tools will present unique opportunities for facilitating, augmenting, and redefining learning environments.

Arseneau and Rodenburg (1998 [online]) stated that learners construct their own knowledge by looking for meaning and order; they interpret what they hear, read, and see based on their previous learning and habits. Students who do not have appropriate backgrounds will be unable to accurately hear or see what is before them. Bruner (1966:3 [online]) concurred when he said “we learn best when we are able to construct new ideas or concepts based on current or past knowledge”. This knowledge could simply be information, but it is more often a situation that the learner has experienced that ultimately causes the shift in cognition we call learning (Dewey 1938, Rogers 1969). Cunningham (1991) warned however that with constructivism, there was a danger that some students may move towards individualism. Soloway (2009 [online]) in a podcast entitled ‘Educating the mobile generation’ stated:

I think that what we are starting to see is a more constructivist... a more active learning the kind of classroom where the children are engaged in artefacts production on a constant, continual basis. And that’s a change from more of a ‘sponge’ kind of model where you’re absorbing content, to a model where you’re actually producing content.

In a constructivist course the learners have a lot of control over their own learning and are given the opportunity to negotiate content, assignments, procedures and deadlines (Vrasidas 2000). Hmelo-Silver (2006:150) stated that “eliciting articulation in students enhances constructivism as it encourages reflection by asking students to explain a topic to themselves or others”.
Mayes and Defreitas (2007) stated that there are multiple learning theories available to guide the development of learning activities. They outlined that people learn by association, where they build concepts or competencies step by step, or by active discovery, which they termed individual constructivism. They also outlined how constructivism can be social where understanding is achieved through dialogue and collaboration and that people can learn by developing practice in a particular community termed situated learning. Mayes and Defreitas (2007) stated that apprenticeships are typical examples of situative learning as learning occurs by participating in communities of practice with progression from novice to expert occurring through observation, reflection and mentorship with less emphasis paid to formal learning. They also draw comparisons with social constructivism as there is a large social and collaborative context to apprenticeship learning (Mayes and Defreitas 2007).

2.2.3 Constructionist learning

Papert (1991:4 [online]) developed Piaget’s theories of constructivism by introducing the constructionist theory of learning. He compared the two theories as:

Constructionism—the N word as opposed to the V word—shares constructivism’s view of learning as ‘building knowledge structures’ through progressive internalization of actions... It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it’s a sand castle on the beach or a theory of the universe.

Kafai and Resnick (1996), Papert (1993) and Papert (1996) stated that constructionists construct knowledge by experimental exploration as they make things. Papert (1999) stated that constructivism is the idea that knowledge is something you build in your head whereas constructionism is something tangible you build outside your head. He said if this knowledge was constructed in a social context then it is of particular value. In his book, ‘Mindstorms, children, computers and powerful ideas’, Papert (1980) states the power of constructionism is that the learner becomes one with the subject under study and that this connectedness is key to learning. Constructionism focuses on
learning how to learn and on the significance of making things in learning (Papert 1980). Papert (1999) continued stating that constructionism particularly applied to learning with digital technology as it had the ability to make things more interesting.

2.2.4 Connectivism

Siemens (2004 [online]) stated that the three main learning theories most often utilized in the creation of instructional environments are behaviourism, cognitivism, and constructivism. He goes on to say that since the early nineties, technology has re-organised the way in which we live, communicate, and how we learn. He argued that the field of learning has been slow to recognise this fact. Gonzalez (2004 [online]) stated that knowledge today has a ‘shrinking half life’ as he referred to the fact that what we learn quickly ages and there is a continuous requirement to re-acquaint ourselves with knowledge. He believed that organisations have been forced to develop new methods of deploying instruction. Vaill (1996:42 [online]) emphasises that:

Learning must be a way of being, an ongoing set of attitudes and actions by individuals and groups that they employ to try to keep abreast of the surprising, novel, messy, obtrusive, recurring events.

Siemens (2004 [online]) continued, by stating that connectivism presents a model of learning that recognises the major change that has taken place from learning being an internal, individualistic activity to one which provides insights into learning skills and tasks required for the learner to flourish in a digital era. Siemens claim is that knowledge is distributed across a network of connections. He believed we have entered a new stage of technologically induced knowledge explosion and a knowledge overflow from the individual into the external network. A new learning theory, connectivism, which is focused on these external networked connections is required as the older learning theories do not address this (Siemens 2004 [online]).
2.2.5 Integrating new technologies into learning theories

Doolittle (2001:2) stated that “it is time to stop professing technological and pedagogical integration and start integrating with purpose and forethought”. The increasing availability and capability of computers, the pressure to provide alternative forms of educational delivery, and the increase in levels of computer literacy, has seen the development of Computer Assisted Learning (CAL) resources becoming a serious option for many educators. It is the hope that multimedia integration will encourage active learning and deter student passivity. Moreover if multimedia can be integrated into the curriculum to promote problem based learning, performance assessment, teaching for understanding, style intelligence and brain compatible instruction, then it can be effective (Silver, Strong and Perini 2000). Burniske (2008:119) warned that for pedagogical reasons, “educators must be fluent in their knowledge of the technology they wish to integrate, knowing the strengths and weaknesses”. He continued, educators must realise when to integrate appropriate technologies based on student age, learning styles used and the curriculum and when to leave technology aside.

In recent years we have seen the growth of what has been termed ‘social software’, a phrase attributed to Shirky (2003 [online]) which describes technologies that facilitate group communication. Some educators claim that online environments are particularly appropriate for collaborative learning approaches because they emphasize group interaction (Harasim 1990).

Mayer (2005:111) showed that there was support for integrating a constructivist theory when he stated that “multimedia advocates have often embraced constructivist-based discovery and problem-based learning pedagogy”. Along with choosing the correct pedagogical style it is important to provide support for the learner according to Hmelo-Silver (2006), this can be achieved using modelling which focuses on the expert’s performance or coaching which focuses on the learner’s performance. He continued, “Coaching is key to apprenticeship training as it is a method of guidance provided to the learner as they perform a task” (p.150). Scaffolding is a more systemic approach to supporting the learner, focusing on the task, the environment, the teacher, and the learner. Scaffolding provides temporary frameworks to support learning and student performance beyond their capacities. Learners need to be helped to perform that which they cannot do alone. Having performed desired skills, they must learn to
perform without the scaffolds that support their performance. Lave and Wenger (1991) cited in O’Donnell, Hmelo-Silver and Erkens (2006:150) stated that “in traditional apprenticeship, scaffolding is used by the master to teach the apprentice”.

Hmelo and Guzdial (1996) described two types of scaffolding which relate to technology training and specifically software programs entitled black box and glass box. Black box scaffolding they said does not increase learning but can aid learning by facilitating it and thereby allowing more time for the student to engage in active learning, it is not designed to fade with time. Examples of black box scaffolds given were, menu systems, wizards or tools like calculators built into software programs.

Glass box scaffolding they continued facilitates both performance and learning and is designed to fade as the learner matures and internalises the functions of the scaffolding process. Hmelo and Guzdial (1996) believed that system prompts, collaborative environments and intelligent agents would be examples of glass box scaffolds which provide the learner with cognitive residue (Salomon 1993) and allow them to construct new knowledge structures or modify existing structures.

It would seem from the literature that multimedia software designed to constructivist principles would promote learning by allowing the student to discover the information for themselves. It is also important to provide support for the learner and allow the learner to socially collaborate, as constructivist philosophy proposes that “powerful gains are made when learners work together” (Strommen, 1992 [online]).

2.3 Relevance to the research statement
Romiszowski (1999) claimed that the physical skills domain has largely been overlooked by educational researchers. He cited Bloom (1956) as a particular example of whose taxonomies have contributed proportionally greater analysis of the cognitive and affective domains than the psychomotor or skills domain.

Brooker and Butler (1997 [online]) have shown that apprentices favoured learning that involved structure and assistance from their instructor, they also suggested that learning or practising alone were not favoured pathways. Smith (1999, 2000a, 2000b
[online]) concurred adding that vocational learners prefer structure and a social context for learning, but assign a low preference to independent learning, preferring instead a collaborative working environment with their peers or instructors. In support, Warner, Christie and Choy (1998 [online]) have shown that vocational education and training learners are not self directed. Boote (1998 [online]) believes this is because they have not developed the skills of meta-cognition adequately. Riding and Sadler-Smith (1997 [online]) suggested that learning strategies and learning preferences can be changed in learners if instructional materials and methods are structured to assist learners to adopt new strategies or modify new strategies. Boote (1998 [online]) suggested that programs aimed at enabling the learner to learn would be useful.

2.4 Affective learning

Bloom (1956) identified three categories of educational activity, the cognitive, the affective and the psychomotor domains. The cognitive domain relates to the development of intellectual skills and the psychomotor domain relates to physical movement, co-ordination and motor skills. The affective domain however examines how the student deals with learning on an emotional level (Krathwohl, Bloom and Masia 1973). Krathwohl et al (1973) stated that affective learning takes place when the student demonstrates a willingness to hear, respond, actively participate in class and show value in what they do. Child (2004:317) added “the affective process involves those motivational and temperamental characteristics which influence an individual in problem solving”

Mendler (2000) in his book ‘Motivating students who don’t care’ stated that educators are increasingly becoming frustrated with lack of motivation among students. Raffini (1996) cited former American secretary of education Terrell Bell who once remarked that the three things to remember about education where motivation, motivation and motivation. Raffini (1996) continued stating that motivation should ideally not be gained using bribes or threats of punishment but instead educators should arrange classroom conditions to meet their student’s psycho academic needs for autonomy, competence, relatedness, self-esteem and enjoyment and
thereby invoke intrinsic motivation. Child (2004) added to this argument stating that
controlled reward is more profitable than punishment.

Molloy (2005 [online]) has shown that many apprentices arrive at a FAS training
centre in passive mode with no self directed learning skills. They simply sit back he
stated and wait for the instructor to impart the information. Citing Knowles (1984,
[online]), Molloy (2005 [online]) summarised that adults are ready to learn when they
realise they need to know something in order to perform more effectively in some part
of their lives. In his research of Irish apprentices attitudes towards learning Molloy
(2005 [online]) found that the apprentices often experienced this ‘need to know’
which Knowles (1984 [online]) referred to but it came as they neared the end of their
phase 2 course. “It is then they begin to realise the opportunities they had been
afforded and in some cases, squandered” Molloy (2005:14) concluded. He also cited
Wenger (1998) stating that apprentices need to become actively and intellectually
engaged with the curriculum in a community of practice early in the course.

Mendler (2000) stated there are many reasons for lack of motivation. He blames the
spoiling of children by parents in this “age of abundance” as one reason and draws
comparisons with lack of discipline, where the student misbehaves to cover up a lack
of academic ability which in turn leads to further decreases in performance and this
becomes a continuing cycle unless appropriate intervention is used.

He also states that students are often more interested in feeling good than working
hard and as such is in agreement with Molloy’s (2005) beliefs on student passivity.
Child (2004) believes all educational theorists would argue that lack of motivation
leads to decreased learning. Mendler (2000:4) made the point that it is the professional
responsibility of all educators to “make our best effort to excite our students”. Digital
Media may have the potential to address the affective learning needs if pedagogically
designed and presented in the correct manner.

2.5 Learning styles

There are many styles of learning proposed, Bersin (2004) described that people have
three basic styles of learning, the visual learner, the auditory learner and the
kinaesthetic learner. He stated that “blended learning programs should encompass all
three of these styles to be effective” (p.50).

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Bersin (2004) discussed what he termed the six modes of learning in his book: The Blended learning handbook. He explained the easiest way to teach a subject was to give students the appropriate materials in book form to read, which he says is only effective if the students are good visual learners, which he concluded, fifty to seventy percent of the population are. Bersin (2004) believed however that the “reading” level is unlikely to achieve proficiency for most.

At the second ‘seeing’ level, the addition of video’s, diagrams and images which can be animated adding some interactivity is typical of traditional early web based courseware and is a step higher in the hierarchy of learning.

Moving to the third level, “Hearing” and fourth level “Watching”, Bersin (2004:37) claimed that adding sound and motion including instructor lectures, demonstrations and scenarios allows the learner to “hear people explain and demonstrate concepts”. These higher steps on the “learning ladder” he concluded “added auditory learning to the mix improving interest and retention”. Bersin stated that twenty to forty percent of the population are auditory learners.

The fifth level of subject mastery comes from experiential learning he continued; stating that the learner never really masters the subject unless they are involved in “doing” and this should be over an extended period of time in order to be effective. He stated that five to twenty percent of the population are kinaesthetic learners (Bersin 2004).

In conclusion, Bersin’s (2004) sixth mode of learning stated that if the learner can become involved in delivering the subject then this is an advance on experiential learning and will be an even more valuable method of learning. Technology based training using simulations, scenario’s and interactivities such as those in a tutorial program can also allow the learner to incorporate levels three and four, utilising Mayer’s (2005) dual coding theory. Technology blended into existing practices can help a student to attain experiential learning (Bersin 2004).
2.6 Instructional design

When designing digital media content for use with training, it is important to ground the design in theory (Reigeluth 1999). As this thesis is based on student responses to educational digital media applications, the author has looked at what other theorists have said on the subject.

Duffy and Jonassen (1991) argued for a theory based approach to instructional design (ID) when they stated that a firmer link should exist between learning theories and instructional practice. “The most promising approach to learning is to assume it is influenced by instructional methods” according to Cronbach and Snow (1997), cited in Mayer (2005:99). Multimedia offers excellent benefits to education including a wide range of instructional options according to Clark (2001). He stated that, with adequate ID there can be considerable reductions in the time required to learn, in the time required for expert teachers and with larger student volumes, a cost saving. ID theory differs from learning theories in that they offer guidance to students on how to learn and develop, they usually focus on the means to attain given goals for learning or development according to Reigeluth (1999).

Diagram 1. The ADDIE Model.

Herrington, Oliver and Reeves (2002:60) stated however that “it is impossible to design truly authentic learning experiences”. In a learning task a student will often need an example to connect new information with their prior experience according to Clark (2001). He stated “if the learner cannot or will not get an adequate example then an instructional design must provide it for them” (p.208).
There are many designs of instructional training systems, such as the ADDIE model (diagram 1) which provides a step-by-step process that helps training specialists plan and create training programs or the Dick and Cary model (diagram 2) which describes all the phases of an iterative process that start by identifying instructional goals and ends with a summative evaluation (Dick and Cary 1990). Most contain in one form or another, planning, development, implementation, and evaluation stages. Each of these stages are equally important in the overall context of instructional design.

Thorndike’s (1913) law of effect was the “guiding principle for early instructional programs delivered by teaching machines” according to Mayer (2005:11). He stated that “this style can still be seen in drill and practice environments such as those which use educational games to teach maths” (p.11). Gagne, Wager, Golas, and Keller (2005:2) loosely defined instructional design as “an arrangement of resources and procedures used to facilitate learning”. Cuban, cited in Reigeluth (1999) stated that historically we made pitiful attempts to reform curricula. Pogrow (1996:658) stated that:

*It is far more difficult to figure out how to implement theory than it is to generate it. I am reasonably intelligent and it took me 14 years of almost full time effort to figure out how to consistently work just four thinking skills into a detailed and effective curriculum.*
Most of the ID models are based on behavioural and information processing theories of learning (Dick, 1996). Cunningham (1991) believed that constructivism provided a clear theory based approach for design. Cuban (1986) outlined that the technology-centered approach to ID generally does not lead to lasting improvements. Norman (1993) suggested that we need to adopt a more human centered approach. Carroll (1993) stated that there are five variables that affect the degree of learning attained:

- Learner perseverance
- Time allowed
- Quality of instruction
- Aptitude
- Students ability to learn

Caroll (1993) advised that these variables are related and an effective model of instructional design should not simply focus on any single variable.

Reigeluth (1999) stated that instructors must provide the best possible cost effective instruction for their students and as it is usually unfeasible to select the type of student to fit a given type of instructional theory. Therefore he suggested that it is the task of the instructional designer to design the program to fit the student profiles within usual parameters and constraints.

Beetham (2005) cited in Beetham and Sharpe (2007:32) stated that ID traditionally has provided “individualised or adaptive learning, matching materials to learner’s performance on set tasks”. She continued stating that “diagnostic tools offer the possibility that materials may be adapted to other learner characteristics such as style or preferred approach to learning”. Beetham (2007) warned that new technological advances which diagnose learner’s needs for them can hinder their ability to comprehend and take responsibility for their own learning.

Clark (2005) cited in Mayer (2005:589) concluded that e-learning design and courseware selection must be based on “credible research evidence of instructional features that lead to learning”. She described e-learning as computer delivered
instruction, designed to deliver specific learning goals. Although traditionally designed for self study, it could be achieved using synchronous or asynchronous methods with a solo participant or collaboratively (Clark 2005).

Clark and Mayer (2002) summarised three e-learning design approaches, the receptive, the directive and the guided discovery approach. They said the goal of receptive approach is to provide information for the learner and assume they will convert this information into useful skills and knowledge. Directive and guided discovery approaches they said use deductive instructional approaches which are designed to build skills by providing chunks of information. The directive approach is based on a behavioural learning theory whereas the guided discovery approach requires learners to build flexible mental models which they can then apply to various learning situations.

These mental models would seem similar to Piaget’s (1952) theory of cognitive development where he believed that by building schemas, we build up an understanding of the world and how we act in it. Mayer (2005:594) believed that “the most robust instructional principles are those based on human psychological learning process. Morales and Moses (2006 [online]) stated that instructional designers play an important role in the process of podcasting where it is used for distance learning by ensuring that there is consultation on the design, usability, production and subsequent use of any audible learning content.

Walsh, Keane, Boyle and McNamara (2006) argued that the key to programme development lies with evaluation as it closes the loop between course objectives and eventual outcomes.

2.7 Evaluating Educational material

Some researchers believe that evaluation is an often neglected task. They said it is difficult, expensive, time consuming and may lead to displeasing results and unwelcome changes. Training can continue without evaluation and therefore is often not considered necessary according to Garavan, Costine and Heraty (1995) and Kirkpatrick (1998). Many people have contributed various models and ideas to the practice of evaluation. Phillips and Stone (2002) believed that with today’s tighter
budgets and higher accountability, stakeholders are demanding a return on their training investments. They say in relation to training programs, stakeholders want to know the ‘end results’, the ‘bottom line’, did training work and if not, why? Kirkpatrick and Kirkpatrick’s (2007) four-level model of evaluation, according to Garavan, Hogan and Cahir-O’Donnell (2003) contains the basis for all other models. Walsh et al (2006) claimed it has become the standard method for reviewing the effectiveness of training programmes.

Kirkpatrick (1998) explained that each of the four levels which measure reaction, learning, transfer and results are equally important and any one should not be bypassed in order to proceed to the next. He stresses that every training programme should, at the very least be evaluated at the reaction level, a view shared by Harrison (2002), and the National Apprentice Advisory Committee. Horton (2001) stated that evaluation of e-learning programs can be undertaken using conventional or electronic means. As previously mentioned this thesis will evaluate at levels one and two of Kirkpatrick and Kirkpatrick’s (2007) four-level model of evaluation.

2.7.1 Level One - Reaction

The objective at this basic level is to gauge participant’s reaction to the course or program. Bramley (1999) suggested that trying to gain positive reactions is a sound strategy, as these can influence the amount of learning that will occur. Kirkpatrick (1998) added that a positive reaction may not guarantee learning, but a negative one will almost certainly preclude it.

Evaluation indicates where the course is performing well and where it can be improved. In this context it performs the function of action research, which according to McNiff, Lomax, and Whitehead (1996) is a form of practitioner research that examines professional practices, with a view to improving these practices. Analhoui, (1993) and Rae (2002) argued about the validity of reaction evaluation as a measure of training effectiveness and not just purely of participant satisfaction. However, Kirkpatrick and Kirkpatrick (2007) stressed that the feedback it provides contributes significantly to the improvement of future programmes and to the enhancement of the learning environment.
2.7.2 Level Two - Learning

Kirkpatrick (1998) and Beach (1980) provided a practical description of Gagné’s (1965) well known division of learning outcomes, saying that learning has occurred when people change attitudes, improve knowledge and/or increase skill to the extent that their behaviour is modified.

The recommended method of evaluating if the skills objectives of a programme have been achieved is the use of standardised performance assessments (Hamblin, 1974 [online]: Kirkpatrick, 1998: Harrison, 2002). A pre-test can be given to determine the level of skill before training and a comparison of the results with those of a post training test will indicate the extent to which skills have improved as a result of the training. However, Kirkpatrick and Kirkpatrick (2007) suggested that the ‘before and after’ approach is not necessary where learners have no previous skill. In this case he recommends that a skills assessment after instruction will measure the learning that has taken place.

If conducted while the training is in progress, it falls into the category of formative evaluation, in which case it uses the feedback to amend the programme as it proceeds (Gagné, Briggs and Wager 1992). Kirkpatrick and Kirkpatrick (2007:48) continued:

> The best way to prove that learning took place in a training program is to compare the results of tests from an experimental group that received the training with those of a control group that did not receive the training.

They warn however that if there are variables between the groups such as age, educational background, attitudes etc, then comparisons are not valid (Kirkpatrick and Kirkpatrick 2007).

Similarly it was recognised by Walsh and Hastings (2001:21) that “assessment contributes to the evaluation process by using the performance of the learners to judge the effectiveness of the overall programme”. They suggest that assessment is that part of the evaluation process that focuses explicitly on whether the students learned what they were supposed to learn. It can, in this respect be regarded as a form of summative
evaluation, when conducted at the end of the training to demonstrate how well the course has met its objectives.

To conclude this section on learning, Bramley (1999) advised that measuring the increases in learning is an estimate of the effectiveness of the programme but Kirkpatrick and Kirkpatrick (2007) warned that this is more difficult and time consuming than measuring reaction. He adds however, that it is important to measure learning because unless one or more of the learning objectives are achieved no learning transfer can be expected.

2.8 Multimedia

Thomas Edison claimed in 1922 that the motion picture would change education dramatically, making it possible to “teach every branch of human knowledge and replacing text books in a few short years” (cited in Cuban 1986:9-11). The reality was that most teachers rarely used film as a teaching method (Cuban 1986). In 1932 Benjamin Darrow claimed that “radio would transform the classroom” (cited in Cuban 1986:19). More recently Udell (2005 [online]) claimed that the iPod would be the new radio. Aristotle once stated that “without image, thinking is impossible” (cited in Mishra and Sharma 2005:139). Landauer (1995:3) stated that “the computer and information revolution are likely to be as consequential as the industrial revolution”. Mayer (2005) warned that we should be humbled by the history of the 20th century and as we rush to implement cutting edge technology we should take stock of the mistakes of the past.

Shuler (2009 [online]) made the point that sesame street which begun forty years ago was a major advance in educational technology. It is now viewed by millions of children in more than 140 countries worldwide and is the single largest informal educator in the world. In today’s digital world, “children can watch Sesame Street anytime, anywhere, on devices the size of chocolate bars that they can carry around in their pockets” (Shuler 2009:11 [online]).
2.8.1 Defining Multimedia

Learning occurs when students build mental representations from words and pictures, animation or video according to Mayer (2005). He stated that for hundreds of years, verbal modes of presentation have dominated and been the focus of educational research, whereas research on multimedia learning is just beginning. He warned however that some evidence suggests that although multimedia is an attractive option, it can lead to some students reducing their effort to learn as they feel multimedia courses require less work. Kearsley (2002) considered that interactive media has been recognised for its ability to engage and motivate. He argued that this phenomenon might be due to ‘novelty effects’ that could wear off when the learner tires of the new learning experience. Multimedia presentations encourage learners to engage in active learning by mentally representing the material in words and pictures and by mentally making connections between the pictorial and verbal representations (Clark and Mayer 2002).

2.8.2 The Multimedia Principle

Learners will understand an explanation better when it is presented as text or audio and as static images or animated sequences rather than just in one format such as words alone according to Mayer (2001). He believed that presenting information in audio and text format stimulates learning as it allows both the visual and auditory parts of the brain to be active; he calls this process dual-code learning. Mayer (2005:63) stated that these two distinct forms of information “prime two qualitatively different knowledge representation systems in learners”. Mayer (2005:63) stated that:

The concept of separate information processing channels has had a long history in cognitive psychology and is closely associated with Paivio’s dual-coding theory (Clark and Paivio, 1991) and Baddeley’s model of working memory (Baddeley, 1986, 1999).

Mayer (2005) stated that computer aided learning (CAL) had advantages over traditional methods as it is able to deliver content in visual and auditory modes. The visual content he stated can be delivered dynamically in video or animated
formats and has the ability to “display environments that respond in dynamic and rule bound ways to user responses” (p. 597).

2.8.3 Technology and Learner Centered Approaches

Mayer (2005) believed there are two approaches to multimedia learning, technology centered and learner centered. He warned that technology centered approaches to multimedia may allow us to repeat the mistakes of the past where technology was not adapted to suit the needs of the human learner. Learner centered approaches try to adapt the multimedia to enhance learning by beginning with an understanding of how the human mind works (Mayer 2005). Norman (1993:xi) concurred stating:

Today we serve technology, we need to change the machine centered approach to a human centered approach where technology can serve us and make us smart by increasing our cognitive capabilities.

Kearsley (2002) cited in Galarneau (2004:3 [online]) stated that “imagery has been shown to facilitate recall in many studies,” and dual coding theory suggests “recall/recognition is enhanced by presenting information in both visual and verbal form”. Mayer (2001) described the possibilities offered by multimedia which he outlined in his seven basic principles of why multimedia is so effective. Collins, Bruijstens and Van der Veen (2003) believed that blended learning approaches have increased the usage of learner centred, peer to peer and active learning strategies. They suggest that this has had the impact of improving pedagogical practices, Morgan (2002) and Smelser (2002) concurred.

2.9 Multiple intelligences

In his book Frames of the Mind: Gardner (1993) explained his theory of multiple intelligences, which divides the way people learn into eight categories. This theory he continued is helpful to teachers as it provides them with specific indicators and their corresponding strategies to best serve students who display the varying intelligences. Auditory lectures, discussions, listening, the use of podcasts or audio based programs
suit auditory learners best. Visual learners prefer to see the body language and facial expression of the teacher explaining a process. Audio teaching aids, using spoken voice or with the addition of video (vodcasting) can compliment visual and auditory learners allowing them to retain ninety percent of the information they have learned according to Morales and Moses (2006 [online]).

2.10 Blended learning

Blended learning is the new buzzword according to Thorne (2003) and Graham (2006). Heinze (2008:272) agreed stating that words such as ‘lecture’ and ‘practical session’ are old hat in comparison. He continued that because the term is relatively new there is confusion surrounding its meaning and he defines it thus: “blended learning refers to the learning which takes place through a combination of face to face facilitated learning, e-learning and self-study”.

Oliver and Trigwell (2005:17) gave their definition as “the integrated combination of traditional learning with web based online approaches”. Cross (2006) remarked that the term blended learning is transitory and in time will join terms like programmed instruction and transactional analysis in the dustbin of has-beens. He argued that the term blended learning is a useless concept. He qualified this statement by saying that blending is only new to people who believed that the computer could deliver training without the need for human interaction. Teachers have been delivering blended learning for years he stated, using “storytelling, recitation, reading aloud, flash cards and corporal punishment” (Cross 2006:xvii). Graham (2006) agreed with Cross’s (2006) thinking, stating that blended learning is a very broad term and needs to be defined while Driscoll (2002) also concurred stating that there is a wide variety of responses to the question of what blended learning was. Graham (2006:4) believed the best description may be, “blended learning systems combine face to face instruction with computer mediated instruction”. The challenge according to Bersin (2004) is deciding how to blend different approaches. In a study conducted using Microsoft excel as the learning topic, Bersin (2004) showed that students who received more than one training method performed thirty percent more accurately and forty percent faster in tests than those who received e-learning alone.
Bersin (2004) concluded that this proved students had better retention using blended learning. Osguthorpe and Graham (2003) identified six reasons for using blended learning which they identified as a richer pedagogy, improved access to both knowledge and social interaction, personal agency, more cost efficient and greater ease of revision. Others such as Graham, Allen and Ure (2003, 2005) found people chose blended learning because of its improved pedagogy, increased access, flexibility and for its cost effectiveness. Graham (2006) believed the improvement in pedagogy came about due to improved interactive strategies employed by blended learning with less emphasis on transmissive strategies. Cottrell and Robison (2003:9) believed that blended learning can be used to help students gain tool related skills and technical information allowing “precious face to face class time to focus on application, case studies, and the development of decision making skills”.

2.10.1 Tutorial programs
Laurillard (2002) concluded that one to one student teacher dialogue was the ideal teaching system. She considered the use of tutorial programs in reaching this ideal as high staffing costs would prohibit human interaction on a one to one level. Laurillard (2002) believed tutorial programs can come close to covering all aspects of the learning process but some initial teaching on the topic should have taken place prior to using such programs allowing the programs to focus on related tasks. Online tutorials can offer students “greater flexibility in their studies” according to McDonald (2008:51) but “can lack the benefits of face to face tuition”. She continued that this problem can be overcome to a certain extent by providing students with regular coursework and setting student goals and deadlines whilst providing synchronous support by telephone as well as the use of asynchronous support allowing collaboration of student or tutors. She also stated “we have much to learn about blending face to face or technology mediated synchronous contact” (McDonald 2008:52). Boyle (1997:178) stated that “when video is used in tutorials it should be functionally incorporated into the overall learning program and not just used passively”. When used correctly, including giving the user full control, he believed they enhance the authentic learning experience, an experience he believed constructivists have argued strongly for.
2.10.2 Mobile technologies

Over recent years there has been a shift towards learning aids with social potential according to Conole and Oliver (2007) and Weller (2007). They say this is reflected in the emergence of blogs, wikis, podcasts and other forms of social software. This suggests a pedagogical shift according to Conole (2007:82) as she stated:

There has been a shift from a focus on information to communication, communication itself has become more interactive and less passive and a move has taken place from individual learning to socially situated learning.

Mobile devices are being used more and more in education to enrich learning. Winters (2006 [online]) stated that mobile learning or m-learning can be viewed as any form of learning that happens when mediated through a mobile device. These devices may be miniature notebooks, mobile phones, personal digital assistants (PDA’s), digital audio players (MP3’s) which are often generically referred to as iPods and even games consoles like Nintendo’s D.S.

In a vodcast, Soloway (2009 [online]) made a bold statement by claiming that “mobile technology will make a bigger change to our lives than the combined change the PC and the internet together has made” and that a “deep change in the way we teach is about to happen”. Hoffer (1973 [online]) warned that in a time of drastic change it is the learners who inherit the future and the learned usually find themselves equipped to live in a world that no longer exists.

Soloway (2009 [online]) went on to say that mobile technology takes away all of the existing logistical constraints to learning, such as fixed learning locations, he says learning can now be on demand in the palm of your hand. Norris (2009 [online]) added that mobile technology not only improves learning within the classroom but extends it to the car, bus, train and home. Alexander (2004 [online]) concurs stating that mobile learning has created a new “nomadic” style of learner. Soloway (2009 [online]) expressing his passion for mobile learning stated in a vodcast:

The kids these days are not digital kids. The digital kids were in the 90’s. The kids today are mobile, and there’s a difference. Digital is the old way of thinking, mobile is the new way.
Shuler (2009 [online]) added to Soloway’s comments, stating that adults have not yet caught up with the kids. Prensky (2001 [online]) spoke of students being “digital natives” in terms of their familiarity with technology. Digital natives he defined as any technology user under the age of thirty who was born into the digital world. Most educators he claims can be defined as digital immigrants. Prensky (2006:29) made the observation that most students are able to master and use new technology quicker than their ‘immigrant’ teachers can deliver it. In his book “Do not bother me mum, I’m learning” Prensky (2006:29) continued “parents and teachers, who came from the pre-digital age, are struggling to teach a population that speaks an entirely new language”. Prensky (2005 [online]) encourages educators to reconsider their view of mobile technology and to imagine a pedagogy that embraces its potential, as he firmly believes that mobile phones will be used for worldwide teaching and learning.

Prensky (2001 [online]) and Barnes, Mareteo and Ferris (2007) stated that current Australian students are heavy and proficient users of technology and have been characterised as the “Net generation”, Oblinger & Oblinger, (2005 [online]) concurred. In contrast to these statements however Jones and Kerr (2008) warned that students may not be as technologically advanced as many teachers believe indicating that many students had difficulty downloading podcasts.

Mobile devices are pervasive, ubiquitous, unobtrusive and taken for granted in the lives of most who own them according to Traxler (2008 [online]). He stated that people today are very familiar and comfortable with these mobile devices sending hundreds of millions of messages each week and the practice of downloading songs via the internet is steadily increasing. Traxler (2008 [online]) believes mobile devices have changed how we relate to technology and suggests that future mobile technology will not only be used for social and communication means but will become sophisticated educational tools as well. Jenkins (2005 [online]) stated that it is now impossible to purchase a mobile phone that simply makes phone calls: he says the modern mobile phone is the electronic version of the Swiss army knife. In a report to Becta, Hartnell-Young and Heym (2008 [online]) stated that the reality is that most kids in secondary education have a mobile phone. They say that apart from being a communication device with internet access, it is also a calculator, a stopwatch, a
camera, an MP3 player, a voice recording device etc, and all this in their pocket at no cost to the school. Prensky (2005 [online]) concurred stating his vision of the future of mobile learning was the redesign of the mobile phone which he suggested had endless possibilities and could be utilised for worldwide teaching and learning. Prensky believes that cell phones have sparked new modalities of interaction between people and in concurrence with (Shuler 2009 [online], Prensky (2005:1 [online]) stated, “they are useful computers that fit in your pocket, are always with you, and are nearly always on”. Geser (2004 [online]) noted however that there is some evidence that today’s student’s resent the use of their technological ‘gadgets’ as educational aids. Research conducted in the UK by Attewell and Savill-Smith (2002) produced evidence that only forty nine percent of young adults in the sixteen to twenty-four age group were willing to use their phones for literacy and numeracy learning.

Ganz-Cooney (2008) supports Traxler’s (2008 [online]) theory stating that mobile technology has significant potential to be a key ally in supporting learning experiences. This theory is also supported by Tynan and Colbran (2006:65 [online]) when they stated that “ignoring the opportunities for mobile learning will be to the detriment of current university teaching and learning practices”. Ganz-Cooney (2008:11) warned in contrast, “Most parents and educators are still sceptical about the educational potential of such devices”. Shuler (2009:6 [online]) also supported this argument and adds that there are a number of “cognitive, social and physical challenges to surmount when these devices are incorporated into learning”. He states that “the bulk of public sentiment surrounding mobile devices including the views of many educators and parents is unenthusiastic” and many believe they can be distracting or even harmful. He believes however that “the debate should not be if we should use mobile devices to support learning but how best they can be used” (Shuler (2009:39 [online]).

2.10.3 Podcasting

As outlined previously, there are many types of mobile device that can be utilised for learning purposes, this study will focus on one such mobile device, the MP3 player more commonly known as an iPod and its potential as an educational tool in the area of podcasting.
A study by Rainie and Madden (2005 [online]) revealed that one in five eighteen to thirty year olds had an MP3 player. By contrast, Barton, Horn and Penny (2007 [online]) stated in a later study conducted on student architects in Dun Laoghaire Institute of Art, Design and Technology that eighty to ninety percent of students owned an MP3 player. The value to education from the MP3 player is not in its primarily function to play music but its potential to allow podcasts either in audio or in some cases, video format to be played anytime anywhere on demand. Morales and Moses (2006:1 [online]) stated that:

Podcasting has revolutionised education and particularly higher education by enabling up-to-date content, addressing multiple intelligences and allowing for the anytime/anywhere delivery of instructional content containing audio or video of lectures, interviews, narrations incidental content or general audio or video.

Podcasting is an acronym of Portable on demand broadcasting or a portmanteau of the words iPod and broadcasting (Middle Tennessee State University 2006 [online]). The term iPod is somewhat controversial according to Campbell (2005 [online]) as it implies a strong connection with Apple’s version of an MP3 player the iPod, whereas a podcast can be listened to on a computer, mobile phone, or any make of MP3 player.

Podcasts have been used in higher education to deliver lectures to students via websites with real simple syndication (RSS) feeds to their iPods, allowing them to listen or re-listen to the lectures anytime or anywhere they choose (Belanger 2005 [online]). Copley (2007 [online]) in agreement with Belanger (2005 [online]) stated that lecturers make podcast recordings of their lectures as revision tools for their students. He argued that this is simply an extension of the common practice of giving out electronic versions of lecture slides. Barton et al (2007 [online]) said that iPods could be classed as assistive technology.

Apple (2009:1 [online]) is now capitalising on this new trend, an article on their website claimed that:
Students are already coming to school with portable computers and devices such as an iPhone and iPod in hand. So they’re used to gathering information on the web, getting their email, watching lectures, getting directions, or pinpointing exactly where their friends are — anytime and anywhere. Now they can learn anytime and anywhere, too. As educators all over the world are discovering, students devour engaging, customized curricula when it’s delivered on the iPod or iPhone. It’s a familiar and essential part of their lives. Audio and video podcasts let students study at their own pace, wherever and whenever they want.

The growth of podcasting has been phenomenal even by I.T. standards according to Searls (2004 [online]). He noted that the word ‘podcast’ brought up twenty four hits on Google in 2004 and predicted that within a year this figure would rise to hundreds of thousands or even millions. His estimate was too conservative according to Cambell (2005 [online]) as eight months later Google hits had risen to four and half million. The author notes that in November 2009 this number has again jumped to one hundred and three million hits, proving the ongoing popularity of podcasting.

Kharif (2008) claimed that sales of Apple’s popular iPhone for educational reasons are currently low but are expected to jump to twenty-five percent in the coming years. Attewell (2005 [online]) stated that iPod ownership in recent years has overtaken the proliferation of personal computers in modern professional and social contexts.

The case for using podcasting is in its sheer convenience, low cost and educational value. Back as far as the early nineties researchers such as Bates (1991), Romero-Gwynn and Marshall (1990 [online]) and the Scottish Council for educational technology (1994) all believed that audio had traditionally been neglected and under used as a teaching medium. Clark and Walsh (2004) believed this may be because the perception was that listening to audio was not learning and audio was not held to be synonymous with comprehension and action. This view does not concur with Mayer’s (2005) dual coding theory which suggests the use of audio can avoid problems of channel overload whilst allowing the brain to make connections between the different representations. Adding to the argument Sundar (2000) stated that “audio is recalled better than video”. Durbridge (1984 [online]) cited in Chan, Lee, and McLoughlin (2006:111 [online]) favoured audio learning by suggesting that:
The spoken word can influence cognition by adding clarity and meaning whilst motivating the student by creating a sense of the person creating the words.

Power (1990) concurred stating that the human voice has the ability to adjust itself to the context of the lesson thereby making it easier for the listener to identify the message. This view is again enforced by Campbell (2005) when he put considerable value in what he terms the “explaining voice” which he states delivers more than just information by:

Shaping out of a shared atmosphere, an intimate drama of cognitive action in time. The explaining voice conveys microcues of hesitation, pacing and inflection that demonstrate both cognition and metacognition (p.42).

Cambell (2005 [online]) goes on to say that voice also conveys our common humanity, something that can be lacking in an e-learning package which does not utilise the human voice. Barton et al (2007 [online]) outlined many of the advantages of podcasting by claiming that they increased understanding of a topic and are especially useful to dyslexics as they make content easier to remember. Johnson (2005:195) adds to this theory by suggesting that almost half of students who claim to have learning difficulties actually suffer from Scotopic Sensitivity Syndrome (SSS) which, she said is “an often undiagnosed sensitivity to light which hinders students reading” especially when reading black print on white paper. Barton et al (2007 [online]) continued that podcasts provide a different and novel strategy, give the student good control over learning and are a good way to access lecture notes.

Copley (2007) and Lee, McLoughlin and Chan (2008) noted that most podcasts used in higher education were for the delivery of lectures. In a survey of English students by Jones and Kerr (2008) they stated that student responses on the value of podcasting were mixed with some students fearing that it may replace traditional lectures. They added that many students found podcasts to be worthwhile as a revision or lecture preparation aid and felt they should be seen as backup or supplementary material. This research concurs with evidence from Evans and Jones (2006) who showed similar findings. Gattis (2008) warned that any technology that reduces the implications of non-attendance will surely reduce attendance. Others in contrast however found that
initial experiences with podcasting showed little effect upon attendance (Meng 2005 [online]) and (Lane 2006 [online]).

Petrovis, Kennedy, Chang and Waycott (2008) stated from the findings of research on Australian students that simply providing a podcasting service to a group of undergraduates is unlikely to be sufficient in stimulating widespread participation in informal peer learning process. They favoured an approach were podcasting is integrated and aligned with the curriculum.

Podagogy is the art or science of using podcasts for educational purposes according to Reynolds (2005 [online]). He stated that in order for podcasts to be effective they must follow certain guidelines. He believed they must be an appropriate length usually between two to four minutes and information must be ‘chunked’ to avoid boring the student. Adding to Cambell (2005 [online]) and Power’s (1990) theories on the value of the human voice, he stated that podcasts must use informal tone with high energy to be fully effective. They should have a clear context for the information being presented, and should end with a review of the most important things to remember. Podcasts should differ in design to suit different learning styles and have flexible delivery options (Reynolds 2005 [online]). Finally, theorists such as Lee et al (2008) and Chan and Lee (2005 [online]) believe that the real value of podcasting and its natural progression will be where podcasts are used to disseminate learner generated content. Learners will build their own digital collection, a learning portfolio where “students construct meaning from their accumulated experience” (Paulson and Paulson, 1991:5 [online]).

2.11 Conclusion

Having examined the learning theories it would seem from the literature that in some part all the learning theories are in use in the training of Irish apprentices. Ertmer and Newby (1993) do not advocate one single learning theory, but say it varies with the level of learners and the content to be learned. Behaviourism may have been the dominant theory in the past with the didactic techniques of the instructor and it is still prevalent especially in the early part of many apprenticeship courses or where lower
level processing is required according to Ertmer and Newby (1993). However constructivism is playing a greater part as technology is integrated and the learner becomes more self-directed. Constructionist theories are also prevalent in apprenticeship learning because of its greater focus on learning through making. Connectivism too will need to play a greater role as we move forward into an era of ever changing technological landscapes.

Affective learning has also featured in this review as it has implications in any training course. Bloom (1956), Mendler (2000) and Child (2004) have told us of the importance of motivation and emotions in learning and how students must be intrinsically motivated within the classroom. Failure to create the right conditions for learning will undoubtedly have a negative impact on learning and this thesis explores the affective learning levels of the students taking part in this survey.

The literature also points out that any new training materials or instructional methods should be grounded in theory. Many theorists have stated that although difficult to achieve, instructional design can have a major impact on students learning time, reduction in the need for expert teachers, larger student volumes and cost savings.

The importance of evaluating training programs was also shown with the popular Kirkpatrick (1998) four step model of evaluation. Important customer feedback is essential to any program; it not only allows the user to determine any faults but also shows that you are trying to improve your program. With an effective evaluation you can gauge whether you have succeeded in enhancing your learner’s skills, knowledge and changing their attitudes.

The literature review has also shown a wealth of information on blended learning, how effective it can be and the trend towards mobile learning with special emphasis on podcasting. It has examined the multimedia principle and tutorial programs and finally it has looked at apprenticeship learning in the context of new technologies.
Chapter Three

Methodology

3.1 Introduction
Methodology is the key to all research projects. This chapter provides details of the methodology that was used to introduce multimedia to the apprenticeship system. It outlines the formulation of the research statement and plan. Kaplan (1973) cited in Cohen, Mannion and Morrison (2007:47) suggested that the aim of a methodology is to “help us understand in the broadest possible terms, not the products of scientific enquiry but the process itself”. A mixed method of research methodology was used in this study.

3.2 Data gathering techniques
The two paradigms of quantitative and qualitative data were used in this research. Cohen et al (2007:501) stated that the quantitative approach is “a powerful research form, emanating in part from the positivist tradition” and “can serve large or small research projects”. Qualitative data which emanates from the naturalistic tradition must be fit for the purpose according to Cohen et al (2007). They believe it is “heavy on interpretation” which they say is “both its glory and its headache” (p.461). They continued, stating that both quantitative and qualitative data are both equally important forms of research and though traditionally used independently, the two paradigms can be combined. Software packages such as the statistical package for social sciences (SPSS) and Microsoft’s excel are typically used for data analysis. In the case of the findings for this thesis, Microsoft’s excel package was used to analyse the data received.

Data was gathered from three sources. Firstly questionnaires with a mixture of open and closed questions which produced both quantitative and qualitative information were circulated and collected by hand to the apprentices. The respondents were given ample time to fill in the questionnaires in the presence of the researcher without any
interference. Three focus groups from the 2009 cohorts were also used to gather information for this research. Informal peer groups were arranged in comfortable surroundings to allow information to be collected by the researcher. Finally test results from the 2008 control group were used to cross reference the test results of the 2009 experimental group.

3.3 The Research Statement and Research Plan

Boyle (2002) recommends a series of steps to produce a research statement by progressively narrowing down a general area of interest. Thus, by refining the general area of interest, the following research statement, which is a precise expression of the hypothesis, was formulated: ‘An Evaluation of the Impact of Digital Media on Apprenticeship Training’

The function of the research plan is to clearly define the objectives of the study and the techniques required to achieve them (Boyle 2002). The research plan consisted of a Gantt chart to monitor progress (appendix B). The author was not concerned with a budget as he had easy access to the sample group and the use of FÁS equipment and materials.

3.4 Identifying the population and sample

There are currently hundreds of apprentices attending phase-two courses in fourteen training centres nationwide (FÁS 2009 [online]). Because of geographical and time limitations, it was not feasible to survey all of these. Bell (1999) advises that the objectives of the research can still be achieved by using a representative sample. Kirkpatrick and Kirkpatrick (2007:48) stated that:

*The best way to prove that learning took place in a training program is to compare the results of tests from an experimental group that received the training with those of a control group that did not receive the training.*

Four cohorts of students were used as convenient samples in the research. Two of these cohorts totalling twenty-five apprentices were used as a control group. They
were from the 2008 academic year and were chosen as they did not have digital media used at any stage of their course and were trained with chalk and talk methods only. Two cohorts totalling twenty-seven apprentices were used as the experimental group and were from the 2009 academic year. They were trained using a blend of digital media and existing chalk and talk methods in two of their eight modules. The modules which had digital media integrated were module seven, ‘central heating’ a theory based subject and module eight, ‘copper pipe assembly’ a practical subject (table 2). The 2009 experimental group were trained initially using traditional teaching methods at the start of their course and the new digital media teaching aids were introduced later as the course progressed. This allowed the 2009 cohorts to be somewhat objective on the proposed changes to the pedagogy having worked with both new and old styles.

<table>
<thead>
<tr>
<th>Module</th>
<th>Methods of training delivery for 2009 apprentices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Theory 1</td>
<td>Traditional methods of instruction (Chalk and talk)</td>
</tr>
<tr>
<td>2. Theory 2</td>
<td>Traditional methods of instruction (Chalk and talk)</td>
</tr>
<tr>
<td>3. Gas welding 1</td>
<td>Traditional methods of instruction (Modelling)</td>
</tr>
<tr>
<td>4. Mild steel pipe</td>
<td>Traditional methods of instruction (Modelling)</td>
</tr>
<tr>
<td>5. Arc welding</td>
<td>Traditional methods of instruction (Modelling)</td>
</tr>
<tr>
<td>6. Gas welding 2</td>
<td>Traditional methods of instruction (Modelling)</td>
</tr>
<tr>
<td>7. Copper pipe</td>
<td>Digital media program and traditional methods</td>
</tr>
<tr>
<td>8. Theory 3</td>
<td>Blending digital media with chalk and talk</td>
</tr>
</tbody>
</table>

Table 2. Modules covered by Plumbing apprentices in their phase two training

The apprentices of the 2008 cohorts who were trained with chalk and talk methods only were not part of this research other than to have their test results compared with the 2009 cohorts for the purposes of evaluation (appendix A). This comparison of the test results was used as a summative evaluation for the proposed integration of digital media into the curriculum. The 2009 cohorts were actively involved in this research and provided both quantitative and qualitative information through focus groups and questionnaire survey.
The same instructional material was delivered to all four cohorts by the same instructor to ensure the reliability and validity of the research. Both 2008 and 2009 cohorts were representative of the population being all males with an average age of nineteen years and geographically spread among seven counties of Ireland. The researcher ensured that the sample group selected had not previously covered the same material. Kirkpatrick (1998) suggested that where learners had no previous skill, it is easier to evaluate learning. Kirkpatrick also stated that the best way to prove learning takes place is to compare test results between experimental groups and control groups. With the groups selected, the researcher was content that no sources of bias were present which could distort the results.

3.5 Purpose of the survey

The main focus of the research was to investigate if the integration of digital media to apprenticeship training would be worthwhile and have realistic benefits or would it be a novel distraction as suggested by Kearsley (2002). Further objectives were to ascertain what barriers if any would prohibit the proposed introduction of technology. This was achieved by researching computer access levels among apprentices and their abilities to use the appropriate technology. The research also investigates the affective learning domain and its impact on learning as the author believed it would have an important influence on any proposed pedagogical change.

3.6 Questionnaire design

The questionnaire was pilot tested by two colleagues who instructed similar cohorts before the final copy was sent out to the respondents. Oppenhein (1992), Morrison (1993), Wilson and Mclean (1994) cited in Cohen et al (2007:341) believed that questionnaires must be thoroughly piloted even down to details such as type face and paper quality. Cohen et al (2007) stated that an effective questionnaire design will ensure that valid feedback is gained. They stated it must have clarity and readability whilst eliminating ambiguities, leading questions and redundant or irrelevant questions. Greenfield (2002) stated that good design will ensure the questions are tested under various headings such as reliability where the questions must draw the same response on different occasions. Validity will ensure the question draws the
appropriate response while repetition of questions can lead to non responses making analysis difficult. Greenfield (2002:175) continued that the questions must be “interpreted the same way by all respondents and each question must earn its place in the survey by the scrutiny of relevance”. The researcher took the advice of the theorists above in the design of the questionnaire.

The 2009 cohorts were given the questionnaires to complete with cover letters explaining the purpose of the research and assuring them of anonymity and confidentiality to protect their wellbeing. The cover letters function was also to let the respondent know details such as:

- Why they were picked.
- How long it would take to fill out the questionnaire
- What was in it for them?
- The purpose of the study

The questionnaire was semi-structured which according to Cohen et al (2007:320) is a “powerful tool”. The first questions were non-threatening and followed the quantitative approach of research, using structured closed-ended questions, which are easy to analyse and are more likely to prompt a response from the respondent (Alreck and Settle 2004). Comment lines were also added on questions allowing for the inclusion of qualitative data. Other questions were more unstructured and open-ended which would make analysis harder and may lead to redundant or irrelevant information but would provide a richer source of information, providing the participant was willing to share this information (Cohen et al 2007). The goal of qualitative research is the development of concepts which help us to understand social phenomena in natural rather than experimental settings, giving due emphasis to the meanings, experiences and views of all the participants (Pope and Mays, 1995).

Other questions were either of the dichotomous style or used a rating scale similar to the likert scale or utilised the rank ordering system. The first questions of the survey were designed to elicit information on technological ownership and abilities among
the 2009 sample group. These questions would be useful in determining the cost of introducing digital media to apprenticeship learning and if any major barriers existed. The final questions on the survey questionnaire were designed to elicit the attitudes of the respondents and their reasons for opting for an apprenticeship. These final questions would give the researcher an idea of the motivation levels and academic abilities of the modern apprentice which would be valuable in determining if multimedia could be used as an aid for learning. All other questions on the survey were designed to elicit information on the respondent’s views of the digital media which was integrated into their curriculum to aid their learning.

The questions were designed to give the survey focus, brevity and clarity focusing directly on topics relevant to the research statement. The questions were expressed clearly avoiding the possibility they may be ambiguous, leading, loading or indeed double-barrelled. Other advice taken from Alreck and Settle (2004:205) was to ensure that:

- The questionnaire was easy to complete at a glance.
- The pages and questions were clearly numbered to allow respondents to follow the sequence easily.
- The questionnaire was uncluttered with ample white space
- The pages were stapled or similar to avoid individual page loss.

The questionnaires were self administered by the researcher which was helpful according to Cohen et al (2007) and it also ensured a one hundred percent response rate from each student. However no checks were made to ensure all questions were filled in by respondents as suggested by Cohen et al (2007) as some of the questions were sensitive and the researcher felt this would be a breach of anonymity. The researcher kept a low profile so as not to make respondents feel under any sort of pressure or compulsion to complete the survey and ample time was given for the slower writer. The survey was not too long to prevent the respondent from loosing concentration (Cohen, et al 2007).
3.7 Focus groups

Focus groups were also held with the 2009 cohorts to gain further qualitative information and triangulate research as suggested by Morgan (1998). The author discovered that there was little free discussion among the participants of larger focus groups and the interaction was solely with the researcher. To combat this, focus groups were split into three smaller sub-groups, each consisting of six apprentices. Alreck and Settle (2004:386) suggest “typical focus groups consist of eight to twelve people”. They stated that groups of this size are small enough to be conversational without any of the shyer members feeling threatened while also being large enough to deter any single member from dominating. The researcher acting as the moderator to focus the discussion prepared the individual groups by delivering a brief synopsis based on the hypothesis and then allowing information to be gained through group interactivity as advised by Krueger (1998) Morgan (1998) Bailey (1994) and Robson (2002) cited in Cohen, et al (2007). With open discussion among the smaller groups of peers which provided qualitative data, the researcher recorded the collective views of the groups and transcribed the information gathered. Alreck and Settle (2004:387) warned that focus groups may require a skilled moderator to bring out the best from the group and prevent dominant members controlling the conversation. They also stated however that there were many advantages to using focus groups such as their spontaneity, simplicity, speed, subjectivity and ability to be dynamic.

3.8 Triangulation

Multiple forms of diverse and redundant types of evidence are used to check the validity and reliability of the findings. Over-relying on any one form of evidence may impact the validity of the findings according to Jacob, (1990 [online]) O'Malley and Valdez Pierce (1996 [online]) and Wiggins (1998 [online]). By using multiple forms of evidence and perspectives, a truer portrait of the research can be developed. While the same biases in evidence collection still come into play, because more types of evidence are being used to form one's opinion about the study, there are more cross checks on the accuracy of the decision (Wiggins 1998 [online]). Questionnaires were filled by the 2009 cohorts and both paradigms of quantitative and qualitative data were received from these research methods. To obtain further
qualitative data focus groups were selected from the 2009 cohorts. All of the apprentices were invited to take part in the focus groups but some declined the offer, therefore three focus groups were selected with six apprentices in each group to improve the group dynamic. Finally to triangulate the research data, end of module test results of the 2009 cohorts who used digital media in specific areas of their curriculum were compared with end of module test results of the two 2008 cohorts who had used only chalk and talk methods of instruction. This comparison of test results would serve as a summative evaluation of the digital media integrated into the curriculum of the 2009 cohorts.

3.9 Validity and Reliability

Jope (2000:1 [online]) defined reliability as:

*The extent to which results are consistent over time. An accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable.*

Alreck and Settle (2004:59) sum up reliability as “the freedom of random error” and its greatest test they say is “repeatability, the ability to get the same data values from several measurements made in the same way”. Jope (2000:1 [online]) gave his definition of validity as the determination of whether the research truly measures what it set out to measure and “how truthful the research results are”. The author was aware that some variables in this research may be inevitable, but attempted to keep them to a minimum. Kirkpatrick and Kirkpatrick (2007) warned that comparisons should not be used between groups if variables such as age, educational background, attitudes etc are apparent, as they would make the study invalid. All four of the cohorts involved with this research had the same educational material delivered by the author to ensure validity and reliability.

Nationally the economy experienced a deep recession at the time of writing this research with many of the current 2009 apprentices reportedly losing their placement.
with their employers while in their phase two training. The apprentices openly stated that this had an effect on their motivation levels and their desire to excel within the course. Adding to this, Mendler (2000) noted that 21st century students lack engagement and motivation with Prensky (2005) concurring with this fact. Prensky (2005) added however that as current students are digital natives, they can and should be motivated using digital media. The fact that the student’s attitudes may be changing based on their intrinsic motivation levels being affected by job loss may have an effect on the results of this study if Kirkpatrick and Kirkpatrick’s (2007) advice is to be taken literally.

Therefore the author felt that a decline in motivation due to job loss may have had an effect on research reliability and may negate some of the benefits of the integration of technology for the 2009 cohorts. Being aware of Keller’s (1983) use of the Attention, Relevance, Confidence and Satisfaction (ARCS) model of motivational design for instruction, the author had built good relationships with the students and motivated them to the best of his abilities. A further factor which may help lessen the impact of motivation loss in this study is the fact previously mentioned by Prensky (2005) when he stated that students are motivated by digital media. To research this theory of motivation loss, attitudes and moods, questions in the survey sought to elicit how many apprentices had suffered job losses and if there was any motivation loss among redundant apprentices as a result. A similar question was put to the focus groups to obtain qualitative information.

Another variable that could possibly affect the research was the possibility that there may have been different proportions of apprentices with learning difficulties in the control and experimental cohorts. Again the research questionnaire contained questions on learning difficulties as it is common for students with learning difficulties to choose apprenticeship training in the author’s experience. An average of two to three apprentices from a cohort of fourteen report to have some form of dyslexia, attention disorder or learning difficulty. This information although of interest to the study cannot be cross referenced with previous cohorts as no records are kept on file of learner difficulties unless they present with documentation and this information is only included to ensure there were not an unusually high proportion of
students with learning difficulties used in this research. Finally despite the possibility of some variables existing, the author believes it is possible to gain reliability in this study. It should be possible to generalise from the results, the results should be replicable and they will be measure what they set out to measure and for these reasons they can be considered valid (Golafshani 2003 [online]).

3.10 Ethical issues

“Whatever the method of investigation used, we must not allow any of our subjects to be distressed or damaged as a result of our investigations” (Hayes 1993:11). Although not a psychological investigation, some of the questions in the research questionnaire based around the affective learning domain were of a personal nature and therefore the subject of ethics was taken seriously. “Ethics are a set of moral principles which aim to prevent researchers from harming those they research” according to Dickinson-Swift (2005:21). They say that “with sensitive topics, researchers need to be acutely aware of their ethical responsibilities”.

The respondents who took part in this study were informed of the purpose of the study and assured of confidentiality and anonymity prior the research taking place. The cover letter attached to all questionnaires (appendix C) outlined these assurances and a further reminder was given within the questionnaire prior to the section on sensitive questions. The official test results which were also a matter of privacy were recorded in appendix A and had the personal details of each respondent removed to protect the assurances given. The author believed that this assurance of confidentiality and anonymity would allow the respondents the opportunity to give freely and honestly of their information without reserve. Abbot and Sapsford (1997) stated that with true anonymity, even the researcher will not be able to determine where responses came from, and this was the case with this research.

3.11 Bias

The researcher was aware of his own positive bias towards technology use in education which may have inadvertently influenced the result by affecting the attitudes of the students towards technology use. Furthermore this positive bias can
inadvertently influence questionnaire design. Alreck and Settle (2004:101) call this instrumentation bias and the researcher endeavoured to avoid this in the design of the questionnaire. Mendler (2000) claimed however that an educator’s role must also be to make their best efforts to “excite” their students by engaging them actively and intellectually with the curriculum.

It is also possible that the actual process of introducing digital media to the apprentices training had positively biased the sample group by “exciting them” as Mendler (2000) mentions above. Alreck and Settle (2004:59) called this response bias and again questions were designed to limit this factor where possible. With response bias, respondents may choose to respond in a way they perceive as “socially acceptable” at the time (Alreck and Settle 2004:102). The danger may be that “novelty effects” as described by Kearsley (2002) could wear off when the learner tires of the new learning experience. Whether affecting student bias or not, Kearsley (2002) proposed, that interactive media has the ability to engage and motivate. Burns and Groves (2009) concluded that good design can reduce but not eliminate bias.

3.12 Limitations of the study

The author would like to have used a larger sample group and conducted this study over a longer period of time. However time was a factor in this research and a more longitudinal study was not appropriate in this case due to time factors. Also the author believed that extending the sample size by using other cohorts in different centres would have introduced too many variables to this particular study. The tutorial program used in this research had a facility to allow for online class collaboration using Huddle, a web communication tool. This aspect of the program was not used in the primary research due to time constraints and to allow the focus of the research to be narrowed, but would be a recommendation for further development. Moodle, a virtual learning environment which appears to be one of the industry standard online learning environments should be considered for this proposed further development.
3.13 Digital Media used

The digital media used with this thesis comprised of a DVD tutorial program designed by the author (appendix G) to offer both practical and theory based support to apprentice plumbers learning in the workshop and from home. It was primarily targeted at the copper pipe work module of the curriculum. The program followed the directive and guided discovery approach which Clark and Mayer (2002) said uses a deductive instructional approach which is designed to build skills by providing chunks of information. The program delivers textual and audio information as well as demonstration videos and quizzes which were used to elicit performance. Pictures were also used to enhance visual learning. Bersin (2004) claimed that blended learning programs should encompass three basic styles of learning, the visual learner, the auditory learner and the kinaesthetic learner to be effective. The author believes the tutorial program was designed befitting the ideas of Bersin (2004) and Mayer’s (2005) dual coding theory.

A CD-ROM with audio files was also used (appendix G). These files were used mainly to augment classroom theory and were used as an audible revision aid prior to exams. The audio files or podcasts used the spoken voice simply to ask relevant questions based on particular topics related to the module. The students were given time to respond with an answer and then the answer was provided for them verbally. Kruse and Keil (2000) citing Gagne (1965) stated that when the student is asked to recall information learned previously it helps with retention. Hmelo-Silver (2006:150) concurred and added that “eliciting articulation in students enhances constructivism as it encourages reflection by asking students to explain a topic to themselves or others”.

The podcasts were uploaded to the apprentice’s iPods or mobile phones and were used by the apprentices outside the classroom, in transit or at home. Audio teaching aids, using spoken voice can compliment visual and auditory learners allowing them to retain ninety percent of the information they have learned according to Morales and Moses (2006 [online]). These aids therefore were considered very appropriate when blended with the existing training methods. Durbridge (1984 [online]), Power (1990), Cambell (2005 [online]), Johnson (2005) all support the use of podcasting in learning.
Barton et al (2007 [online]) said that podcasts could be classed as assistive technology, therefore its use as a teaching aid was considered appropriate.

To further test the viability of the tutorial program used, written tests were carried out before and after viewing the tutorial program by the experimental group (appendix F). These evaluation tests were part of the tutorial program and are available on the homepage. Bramley (1999) advised that measuring the increases in learning is an estimate of the effectiveness of the programme but Kirkpatrick and Kirkpatrick (2007) warned that this is more difficult and time consuming than measuring reaction. The before and after test did reveal an increase in learning but this thesis is primarily concerned with the test scores of the official assessments (appendix A) undertaken by the apprentices as a measure of effectiveness. Walsh and Hastings (2001:21) stated that “assessment contributes to the evaluation process by using the performance of the learners to judge the effectiveness of the overall programme”.
Findings of the primary research

4.1 Introduction
This chapter will analyse the findings of the primary research which sought to ascertain whether multimedia enhances the learning experience for the apprentice and if apprentices would welcome this technology. The survey also researched apprentice’s levels of computer and MP3 player access and their ability to use them.

The sample group, made up from two cohorts of 2009 apprentice plumbers were asked for their views on a tutorial program entitled “The copper pipe tutor” which was introduced to augment the work of the instructor in the workshop and aid apprentices learning from their homes. Further to this, podcasts were introduced to allow mobile learning to take place. The respondents were asked to provide feedback on their findings of both the podcast material and the tutorial program. As further background information for this survey the research also attempted to show the affective learning levels of the respondents as the author felt it was relevant to the research. Both quantative and qualitative research from questionnaires and focus group discussions are documented in this chapter.

4.2 Computer access amongst apprentices
The first questions dealt with the apprentice’s accessibility to the appropriate technology such as computers and MP3 players or mobile phones as a large percentage of mobile phones have the ability to accept and playback audio files. Eighty-one percent of the sample group owned a computer with a further fifteen percent claiming they had access to a computer from home. Incidentally ninety-six percent of respondents stated they would be prepared to purchase a computer if it was necessary. One apprentice representing four percent of the sample claimed he neither had access to, nor would be willing to purchase a computer.
4.2.1 MP3 player and mobile phone access

The study also showed that MP3 player/iPod ownership among apprentices was also high at eighty-five percent, with fifteen percent of the apprentices not owning an MP3 player. One hundred percent of the apprentices owned a mobile phone, giving all the ability to access audio files via their phone if necessary.

4.2.2 Apprentices ability to use computers

The research progressed to elicit the apprentice’s ability to use computers and associated tutorial programs such as email, word processor and the internet. Sixty-six percent of the sample group stated they had average abilities to use a computer with fifteen percent stating their ability was above average. A further fifteen percent declared their ability to use a computer was below average, these respondents also reported to not owning a computer or MP3 player. One apprentice representing four percent failed to answer.

Sixty-three percent of the sample group declared that they had average ability to use the internet with the twenty-six percent stating they had above average ability, the remaining eleven percent declared they had below average internet use ability.

Forty-one percent claimed they had a below average ability to use a word processor with another forty-four percent claiming average abilities and fifteen percent claiming above average ability.

Twenty-two percent claimed they had no experience with email use and a further thirty-three percent stated they were below average users. Thirty-three percent
declared they had average abilities with email and twelve percent felt they had above average abilities.

Finally sixty-three percent of the sample group believed they had average ability in file transfer to their MP3 players. Seven percent claimed above average ability leaving fifteen percent with below average abilities and a further fifteen percent who stated they cannot transfer files to their MP3 players.

4.2.3 Groups impressions of the tutorial program

The respondents were asked their views of the multimedia tutorial program. Sixty-three percent of the sample group concluded that their first impressions of the tutorial program were very good with twenty-six percent stating their first impression was good, the remaining eleven percent stated it was ok.
Fifty-five percent of the sample found the programs ease of use very good. Forty-one percent found the ease of use good and four percent representing one respondent felt ease of use was ok. Fifty-five percent of the sample group thought the programs educational value was very good while forty-five percent thought it was good.

![Chart no. 3](chart.png)

Forty-one percent stated that the programs navigability was very good, with a further forty-eight percent claiming they felt it was good. Eleven percent of the sample felt the navigation through the program was ok.

When asked what they thought of the video tutorials contained in the tutorial program the sample group responded with fifty-nine percent stating that they thought the video tutorials were very good while thirty percent felt they were good. Eleven percent felt the video tutorials rated as ok.

When the survey sought to elicit the apprentices view on the text based information contained in the program. Forty-four percent felt it was very good with twenty-six percent choosing good and the remaining thirty percent felt it was ok. One respondent commented however that he valued the theory content especially the verbal information, but would like to see more of it. In contrast to an earlier comment, one
respondent commented “I found it easier to learn with the videos”. Finally one respondent commented he would recommend the program to his peers.

![Chart no. 4](chart.png)

Other qualitative information gained from comment lines in the questionnaires provided evidence that digital media adds interest and motivates with comments like “It makes the course more interesting”. Another comment suggested the programs use for independent learning “If an apprentice missed a day or fell behind he could use the program to catch up”. While further comments suggested its use as a blended learning tool, “The program could be used in conjunction with workshop demonstrations and classroom based theory”.

The collective view of the focus groups was that the tutorial program was useful and should be used as an aid to compliment the work of the instructor and not replace them. The group felt the program could be helpful with the pupil teacher ratio and could also be used when a student is absent as a method of catching up or to prevent weaker students falling behind. Further comments on the group’s views are available in appendix D.
4.2.4 Educational value of the program

When asked if the quizzes contained within the tutorial program were completed successfully to evaluate learning, ninety-two percent answered yes to this question with eight percent answering no. Additional information suggested it should not be essential for the apprentice to spell answers correctly in the quizzes as dyslexics or poor spellers may not be able to make full use of them. One respondent commented that ‘true or false’ or ‘multiple choice’ answers would be a good alternative. Other qualitative comments suggested the program helped with memory retention, made learning more fun and was a better way to learn than reading.

The questionnaire then asked if they would use an educational program in a workshop for further practical help after an initial instructor demonstration. Thirty-seven percent of the sample stated their first choice would be to consult a demonstration video on a tutorial program for additional help rather than ask a classmate or the instructor. Forty-four percent said they would prefer to ask the instructor with the remaining nineteen percent stating their first choice would be to ask a classmate for help. Qualitative information suggested that students liked the independence of using the program rather than disturbing a class mate or their tutor. A further comment suggested that it was easier to view the skills based demonstrations by using the program rather than watching the instructor when part of a large group. This was due to visual limitations caused by the large group.

Further open questions on the design of the educational tutorial program brought the following information. “The program can be viewed at a pace to suit the individual” and “rewinding video demonstrations when necessary was very useful in the learning process”. Other comments suggested the theory sections and quizzes were the most useful. Two respondents suggested that a search engine would be useful in program navigation. Other respondents commented, “I would find the program useful at home before tests” and “the program is good but should not take the place of the instructor”. The limitations pointed out by the sample group were that they wanted more control over the video demonstrations and incorrect quiz spelling should not affect the answer.
When asked if they thought the tutorial could be used to train apprentice plumbers the skills and knowledge of working with copper pipe, one hundred percent of respondents answered yes. Comments suggested the programs use for independent learning; “Yes the program is very helpful as it can be used anytime and when the instructor or classmates are busy” and “there are fourteen apprentices in the workshop and one instructor, so instead of an apprentice waiting around for practical help the program could be used.

When asked if blending technology to their training would be welcomed, ninety-six percent of respondents reported positively. Interestingly the respondent who preferred instructor led training only was also the respondent who did not have access to a computer, was not prepared to purchase one and he did not own an MP3 player.

![Chart showing willingness to use technology](chart)

Chart no. 5

Showing that the program may suit a broader range of multiple intelligences one respondent commented “Using this technology is good because some people learn differently and prefer different ways of learning and this gives them a choice. Others commented on its value for home study and ability to be re-used on multiple occasions until a skill was mastered. Further qualitative comments are available in appendix D.

4.3 Podcasting

When the questionnaire moved to elicit information on the apprentice’s experiences of using podcasts in their studies, seventy percent of respondents agreed they found it
easier to learn with a further nineteen percent strongly agreeing with the statement. Eleven percent expressed no opinion.

On the question of how the respondents used the podcasts, fifty-two percent stated they preferred listening to podcasts and then reading the same information from their handouts. Nineteen percent strongly agreed this was their preferred learning method. A further twenty-one percent disagreed with the statement and eight percent expressed no opinion.

When responding to the statement “I did not find the podcasts useful” seventy percent disagreed with the statement, eighteen percent strongly disagreed and twelve percent offered no opinion.

Sixty-three percent of respondents also agreed that podcasts were a convenient method of learning and a further twenty-two percent strongly agreed with this. Fifteen percent of the sample offered no opinion on this question.

When asked if the podcasts were too long, forty percent disagreed that the individual fifteen minutes podcasts used were too long and should not be shortened to three or four minutes. Twelve percent strongly disagreed with this question while thirty
percent agreed with shorter lessons similar in length to a typical song. Eighteen percent offered no opinion on this question. Qualitative comments showed some students found it a novel way of learning. Others believed it was an easy way of learning, while further comments suggested it was a helpful aid to students who have difficulty reading.

Asking if they would use audio podcasts in their future learning, all respondents answered yes. Some commented further “Yes it is the future” and “It is very useful for revision after class work”. Other comments in support of audio learning suggested it was an easy, quicker and more convenient way to learn and one which supported independent learning.

Further qualitative information from focus group discussions revealed that the group’s general thoughts were that it was a different way of learning than reading text at home which was the normal revision route. They felt it was novel and showed a high level of interest in it. They noted it was a learning method which does not tie you down and allows you to learn whilst on the move. Further comments are available in appendix D.

4.4 Apprentice moods and attitudes

To gain information on affective learning, the research sought to elicit the moods and attitudes of current Irish apprentices. When asked if they chose a trade because they felt they would be unable or dislike college or did not gain enough points, thirty-four percent of the sample agreed. Sixty-six percent cited different reasons for opting for a trade. Some of the comments revealed trades are chosen by people who did not have a strong aptitude or like for academia, while others reported the desire for manual work.

Further questions on this topic sought to elicit if the apprentices found any particular part of the course difficult. This question was asked so that further work could be undertaken using digital media to address these difficulties. Forty-seven percent of respondents felt the course was difficult whereas forty-six percent did not find it difficult and seven percent offered no opinion. Fifty-two percent found the theory difficult while the remainder felt it was not.
When asked on the difficulty levels of the practical subjects thirty percent found practical difficult, twenty-two percent offered no opinion and forty-eight percent stated the practical was not difficult.

![Chart no. 7](image)

Seventy percent responded that gas welding was difficult with twenty-six percent offering no opinion and four percent believed it was not difficult. Fifty-nine percent of apprentices responded to the question that the course should be longer by disagreeing with the statement, a further four percent strongly disagreed. Twenty-two percent agreed the course should be longer, eleven percent strongly agreed and four percent offered no opinion.

Fifty-two percent agreed they expected the course would have been easier with a further twenty-two percent strongly agreeing. Fifteen percent had no opinion and eleven percent said they did not expect the course to be easy. When asked if they felt the phase two course at FAS was similar to school, fifty-two percent felt it was not with thirty-two percent stating it was like school and eight percent had no opinion.
Four percent strongly agreed the course was like school and four percent strongly disagreed.

<table>
<thead>
<tr>
<th>The apprentices views on the course 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>The course should be longer</td>
</tr>
<tr>
<td>Strongly agree</td>
</tr>
<tr>
<td>Agree</td>
</tr>
<tr>
<td>No opinion</td>
</tr>
<tr>
<td>Disagree</td>
</tr>
<tr>
<td>Strongly disagree</td>
</tr>
</tbody>
</table>

*Chart no. 8*

Finally forty-four percent of respondents expected less theory on their apprenticeship course with eleven percent strongly agreeing with the statement. Fifteen percent offered no opinion, leaving twenty-six percent disagreeing and four percent strongly disagreeing.

A comment from one respondent suggested “The course was easy and hard depending on whether you wanted to learn or not” A similar comment stated “The course was hard but if you had put more work in, it would have been easier”. Another respondent commented; “I had the impression that the course would be fairly easy but it is good that the course is difficult as it makes better tradesmen”.

The respondents were also asked if they had a learning difficulty. The question was asked because if a high proportion of the sample group had learning difficulties it could affect the evaluation between the test scores of the 2009 cohort’s and the 2008 cohort’s results.
Twenty-two percent of the sample indicated that they had a learning difficulty. Four of these students claimed to be dyslexic, one claimed to have attention deficit disorder (ADD) and one claimed problems with learning mathematics suggesting he may have some degree of dyscalculia. A further eight percent said they had no opinion on whether they had a learning difficulty or not, which left the remaining seventy percent with no reported learning difficulty.

The final questions in the survey asked if the apprentice’s had a job to return to in light of the economic downturn which was accounting for many job losses at the time of writing this thesis. While forty-four percent claimed to have an employer to return to after their phase two course, twenty-six percent had lost their employment and become redundant apprentices and a further thirty percent were unsure if they had work to return to.

Also the respondents were questioned whether their motivation to work towards gaining good results would be affected if they lost their job during the course. Forty-one percent stated it would not affect motivation. Thirty-seven percent however felt that job loss would have an effect with a further twenty-two percent stating that job loss would have at least some effect on motivation levels during the course.
The collective feeling of the focus groups was that suffering job loss would have an impact on their attitudes during training. Comments suggested there was a feeling of insecurity and desolation among those without employers. Some respondents claimed they lost the desire to work hard or gain high marks with their learning due to redundancy. Further comments are available in appendix D.

4.5 Comparison of test results
To achieve triangulation in this research a comparison of test results was made between 2008 cohorts and 2009 cohorts. Table 3 on the next page shows the appropriate results of the 2008 cohorts who had their entire course modules delivered using traditional chalk and talk methods only. Results of the 2009 experimental cohorts who had two of their course modules delivered using a blend of traditional methods and newly integrated digital media are also shown with full details of all results available in appendix A.

Two modules from a curriculum of eight were used in this research; the first covered a practical based subject on copper pipe work. This module was delivered mostly in the workshop with the aid of a pedagogically designed tutorial program which students availed of at will within the workshop and from home. The second module was a theory based chapter on central heating which was delivered in the classroom. The central heating module used podcasts to aid traditional instruction. These podcasts were not used in the classroom, but instead augmented classroom instruction being used in the student’s spare time at home as an audible revision aid. Results for the
2008 cohorts who used only chalk and talk methods of delivery showed a combined total of eight credits, five passes and twelve referrals on their practical copper pipe work test results. Results from their central heating test showed fourteen credits, eight passes and three referrals. Twenty-five students attended the tests from a possible twenty-eight as three withdrew from the course.

Results for the two 2009 cohorts who used chalk and talk methods of delivery combined with new digital media showed a combined total thirteen credits, six passes and eight referrals on their practical copper pipe work test results. Results from their central heating test showed twenty-one credits, two passes and three referrals on their central heating test. Twenty-seven students attended the copper pipe test from a possible twenty-eight as one withdrew from the course. Two students withdrew from the central heating test from a possible twenty-eight. Table 3 below outlines both cohort test scores at a glance with more detailed results available in appendix A.

2008 Cohorts who did not use technology in learning (Control group)

<table>
<thead>
<tr>
<th>Test Results of the 2008 Cohorts (25 students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper Pipe work</td>
</tr>
<tr>
<td>Credit attained</td>
</tr>
<tr>
<td>Passed</td>
</tr>
<tr>
<td>Referred</td>
</tr>
<tr>
<td>Withdrew</td>
</tr>
</tbody>
</table>

2009 Cohorts who used technology in learning (Experimental group)

<table>
<thead>
<tr>
<th>Test Results of the 2009 Cohorts (27 students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper Pipe work</td>
</tr>
<tr>
<td>Credit attained</td>
</tr>
<tr>
<td>Passed</td>
</tr>
<tr>
<td>Referred</td>
</tr>
<tr>
<td>Withdrew</td>
</tr>
</tbody>
</table>

Table 3. 2009 cohort test results
4.6 Conclusion
The significant findings of this chapter are that most Irish apprentices own or have access to the appropriate technology which can be used to augment their learning. Furthermore the majority of respondents were reasonably competent in their use of this equipment. This chapter also examined affective learning and showed that the economic downturn had an impact on student motivation levels.

Finally and perhaps most importantly the findings show that test results of the experimental group of apprentices who used digital media were significantly better than a control group who used only traditional training methods.

These findings will be discussed in more detail in the following chapter and conclusions will be drawn in the subsequent chapter.
Chapter Five

Discussion of the Findings

5.1 Introduction

This chapter analyses the findings of the primary research conducted among Irish apprentices on the subject of the integration of digital media to their curriculum. It discusses the use of pedagogically designed tutorial programs and mobile learning aids in Irish apprenticeship training. It debates whether it is the appropriate time to implement this type of technology to the apprenticeship system based on student perceptions and test results. It also discusses student access to technology and the need for specific training which could be seen as a barrier to the implementation of this proposed pedagogical change.

This discussion also looks at the affective learning domain such as the effects of motivation on current students. Theorists like Boote (1998 [online]), Warner, Christie, and Choy (1998 [online]), Mendler (2000) and Molloy (2005 [online]) showed that apprentices can lack a self directed approach to learning instead being passive learners. Any lack of motivation will undoubtedly have a negative impact on student education as indicated by Molloy (2005 [online]) and Raffini (1996). Technology may be able to help in this respect by providing methods of help in “gaining attention” as outlined by Gagne (1965) in his conditions of learning or by providing coaching and scaffolding as mentioned by Hmelo and Guzdial (1996), Hmelo-Silver (2006) and Lave and Wenger (1991).

5.2 Technology access and user ability

If digital media is to be successfully used to assist the modern apprentice in learning the skills and knowledge of their trades then it is important that they have access to the appropriate technology and have the ability to use it. In this research the technological hardware used were PC’s and MP3 players. The survey showed that the vast majority of today’s apprentices at ninety-six percent have access to a computer.

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and further more eighty-one percent stated they would be comfortable in their use of these computers. This concurred with Prensky’s (2001 [online]) beliefs on today’s students being “digital natives” in terms of their familiarity with technology. It is clear from the results that there is no major barrier to digital media integration based on technology access.

The research does however suggest that a small percentage may need training in computer use although the program used for this research is user friendly and does not require much computer knowledge. An exception to this is the use of email which could be used as a means of asynchronous communication with the group or the tutor. The tutorial program also supports collaboration which would be useful, as Strommen (1992 [online]) and Hmelo and Guzdial (1996) believed there are powerful gains to be made from social collaboration. As fifty-six percent of the sample group stated they were not comfortable in the use of email, training on this application would be beneficial to allow for collaboration from within the program. This form of training could be introduced as part of their apprenticeship.

In relation to the modern student’s ability to use technology, Prensky (2006) made the observation that most students are able to master and use new technology quicker than their immigrant teachers can deliver it. This suggests that any lack of technological knowledge would not necessarily impose a barrier to integrating new digital media techniques but his theory does suggest there may be a need for training of teachers and instructors in this type of delivery. To add credence to Prensky’s remarks, Burniske (2008) warned that for pedagogical reasons, educators must be fluent in their knowledge of the technology they wish to integrate, knowing the strengths and weaknesses. He continued that educators must realise when to integrate appropriate technologies based on student age, learning styles used and the curriculum and when to leave technology aside. This comment from Burniske (2008) may suggest that technology might be wasted on the youth or at least be more appropriate for the self directed.

A very high ninety percent of the sample group also had MP3 player access which mirrored the evidence of Barton et al (2007 [online]) who found that eighty to ninety
percent of students had access to MP3 players. Earlier studies by Rainie and Madden (2005 [online]) revealed that only twenty percent of eighteen to thirty year olds had an MP3 player which shows a marked increase in ownership of this type of technology in a few short years. This evidence is not surprising when you consider that Google results on the word ‘podcast’ had risen from four and half million in 2005 (Cambell 2005 [online]) to one hundred and three million by November 2009.

Also with the sample group’s mobile phone ownership at one hundred percent and the ability of the modern phone to play audio files it is safe to say that all apprentices could access educational audio files to aid in their learning. The author in agreement with the views of Jenkins (2005) and Traxler (2008 [online]) believes that it is a little known fact in the educational field that all mobile phones have the ability to record and play audio files. Some phones facilitate this as a main feature such as the Nokia’s 5310 xpress music model or Apples iPhone which serve as much as audio players as they do communications devices. In light of the research evidence and the review of the literature, the argument must be that these devices should be utilised for educational use to advance learning. The author can understand the enthusiasm of theorist’s like Soloway (2009 [online]) or Prensky (2005 [online]) when they speak passionately about the value of mobile devices.

Geser (2004 [online]) noted however that there is some evidence that students resent the use of their technological ‘gadgets’ as educational aids. The cohort’s responses did not outline any of this negativity and the author can report that students were happy to utilise their own gadgets in educational settings. Mobile phones were used as calculators in class and for the replay of audio and video files (appendix E). The camera function of their phones was also used to bring related photos into class and they seemed pleased to do this and were encouraged by their tutor to make full use of these tools.

With regard to the apprentice’s abilities to upload files to their MP3 players, the findings showed that thirty percent of the sample group would need some form of training to enable them to carry out this procedure. This concurs with evidence from Jones and Kerr (2008) who warned that students may not be as technologically advanced as many teachers believe indicating that many students had difficulty
downloading podcasts. For the purposes of this study all MP3 files were uploaded to the sample group’s equipment for them by their tutor.

5.3 Views on the tutorial program and its perceived Educational value

All respondents supported the use of the tutorial program used with this research for educational purposes, with sixty-three percent of these being very enthusiastic about it. Again one hundred percent of respondents felt the program was of educational value to them with fifty-six percent believing it was very helpful in learning. This is encouraging when considering the views of Laurillard (2002) who suggested that tutorial programs can come close to the ideal teaching system of one to one attention without the high cost associated with human interaction. In agreement, McDonald’s (2008) beliefs that tutorials offer students great flexibility when used in conjunction with face to face tuition also supports the current Irish apprenticeship training methods.

Laurillard’s (2002) theories on tutorial programs would also support the current system used in the training of Irish apprentices as she states that initial instruction must first be given to apprentices allowing tutorial programs to focus on related tasks. In support of this theory, Cottrell and Robinson (2003) stated that blended learning can allow the student more precious face to face class time to focus on decision making skills. A comment from one respondent in agreement with Laurillard’s (2002) views stated that there may be merits to a tutorial program but it should not be allowed to replace the instructor and the instructor should always provide the initial tuition. In the ‘excitement’ of using technology with education (Soloway 2009 [online]), it would seem prudent to regard the advice from this respondent and that of Mayer (2005) who warned that as we rush to implement cutting edge technology we should take stock of the mistakes of the past.

The author believes from the research results and the review of the literature that there is good reason and a desire for integrating pedagogically appropriate tutorials in the training of apprentices. It could be argued that the educational value of the tutorial program is that it promotes what Mayes and Defreitas (2007) termed as individual constructivism as the students learn by association and active discovery, building competencies step by step. It also appears to ally Papert’s (1991 [online]) theory on
constructionism where the learner is consciously engaged in constructing a product, which is the basis of apprenticeship training. A respondent commented that the tutorial program was useful as a step by step tutor which could be paced to suit the individual. It was interesting to note from the findings that thirty-seven percent of students would actually prefer as a first choice to use educational video demonstrations if further help or clarification was required after an initial instructor led demonstration rather than ask the instructor or a classmate. This would suggest that thirty-seven percent of apprentices may be self directed when introduced to educational technology. Warner, Christie and Choy (1998 [online]) had reported that vocational education and training learners are not self directed. However in contrast Riding and Sadler-Smith (1997 [online]) suggested that learning strategies and learning preferences can be changed in learners if instructional materials and methods are structured to assist learners to adopt new strategies or modify existing strategies. Brooker and Butler (1997 [online]) also outlined that apprentices favoured learning that involved structure and assistance from their instructor, they also suggested that learning or practising alone were not favoured pathways. Smith (1999, 2000a 2000b [online]) also support this statement. These theories support the respondents who believed that digital media should not replace, but instead be used to augment instructor led training practice.

Further questions on the suitability of the program to deliver training to apprentices showed that all felt the program could be used in their education suggesting that a large proportion of today’s student apprentices are very comfortable and trusting of technology in their training, which again concurs with Prensky’s (2005 [online]) comments on today’s student being digital natives. These positive comments also suggest that benefits could be derived from changing the current apprenticeship training system allowing more flexibility in training delivery. Blended learning approaches where technology augments learning and apprentices change from behaviourist to constructivist or constructionist principles or even align to the connectivist views of Siemens (2004 [online]) would be appropriate.

The use of this type of software would also appear to support the views of Duffy and Cunningham (1996) who suggested that students get guidance and support as they
learn to construct their understanding of the culture and communities of which they are a part. Mayes and Defreitas (2007) stated that apprenticeships are typical examples of situative learning as learning occurs by participating in communities of practice with progression from novice to expert occurring through observation, reflection and mentorship with less emphasis paid to formal learning. The findings reflected the views that the respondents enjoyed the self-paced style of the program and the different approach to learning it offered.

This observation reflection and mentorship may now take on the more connectivist learning approach by the use of technology in the form of digital media tutorial programs or when students collaborate online using email or synchronous communication programs such as Huddle, Blackboard, Moodle etc. Koschmann et al (1994) stated that the blending of technological and pedagogical advancements in support of collaboration would redefine learning. The findings suggest that training would be necessary for apprentices when integrating collaboration tools into the pedagogy.

The sample group did however note that improvements such as video control access and some adjustments to the design of the quizzes within the program would be beneficial to the learning outcome. The author is in agreement with Reigeluth (1999) who stated that any newly designed educational media must be grounded in theory and have had a good instructional design so that it offers guidance to students on how to learn and develop. Advice from Boyle (1997) also concurs with the respondents claim on video control when he stated that greater user control in tutorial videos would enhance the authentic learning experience for the user.

Hmelo and Guzdial’s (1996) advice on Glass box scaffolding may be pertinent to training with tutorial programs especially where collaboration is encouraged within the tutorial. Strommen (1992 [online]) concurred with Hmelo and Guzdial’s (1996) beliefs on the benefits of collaborative education when he stated that powerful gains are made from social collaboration. The lessons learned from Gardener (1993) and Mayer (2001:2005) should also be apparent in any software design. Theories on multiple intelligences and dual code learning must be taken into account in any vocational learning program if it to be effective the author believes. A student added support to this theory when he commented “Using this technology is good because
some learn differently and prefer different ways of learning and this gives them a choice”.

5.4 Podcasting and Mobile learning
In the findings of this research, eighty-nine percent of apprentices stated that using audio podcasts had helped them in their learning, with nineteen percent of this group strongly agreeing with the use of podcasting as a means of learning. Bersin’s (2004) in some contrast had claimed that only twenty to forty percent of the population were auditory learners and it was interesting to note that nineteen percent of the sample group appeared to be strongly in favour of auditory learning. Seventy percent however stated that they would actually prefer to revise at home using audio files on their personal entertainment systems than read from text based notes suggesting again there may be a higher percentage of audio learners in the group. Perhaps as one respondent commented, “it is easier to revise using the audio than reading from your notes”. Other respondents suggested listening was a lazier method of revising. Also worth consideration is Mayer’s (2001) cognitive theory of multimedia learning where the students are not necessarily audio learners but are avoiding channel overload by using a combination of both visual/pictorial and auditory/verbal methods of learning. Mayer (2001) stated he believed that presenting information in audio and text format stimulates learning as it allows both the visual and auditory parts of the brain to be active; he called this process dual-code learning. Again seventy-one percent stated they would read their notes and then listen to audio files as a method of revision. This would also suggest Mayer’s (2001) redundancy principle was in effect by preventing students especially the auditory learners from overloading the visual channels.

Or perhaps the popularity of podcasting can be attributed to the fact that the human voice is more appealing to the student as it makes it easier for the listener to identify with the message (Power 1990) and the students like to hear the “explaining” voice as proposed by Cambell (2005 [online]). Durbridge (1984) found, audio added clarity and meaning whilst motivating the student. Comments from respondents in agreement with the theorists suggested that some find it a better way to learn (appendix D). This information may also suggest that learning from home using audio files recorded with
a human voice may be bringing the tutor back into the learning experience and prevent the student feeling that they are on their own which may be a motivating factor. Mendler (2000) stated that learning requires risk taking and suggested that for learning to take place, classrooms need to be psychologically and physically safe places. Mendlers beliefs may suggest that affective learning can take place within the student’s home environment using the digital media supplied assuming they consider it to be a psychologically and physically safe place.

The findings revealed other reasons for the popularity of the podcasts which were that eighty-five percent felt that they were a convenient method of study as it allowed the student to learn whilst on the move. They stated that this was useful while travelling, exercising or even relaxing. Qualitative research findings revealed podcasts were useful for those with reading difficulties such as those with varying forms of dyslexia or scotopic sensitivity syndrome. Barton et al (2007 [online]) said that podcasts could be classed as assistive technology and outlined many of the advantages of podcasting by claiming that they increased understanding of a topic and are especially useful to dyslexics as they make content easier to remember. One respondent commented; “Great for students who have difficulty reading, it’s much easier to take in the information”. Another comment in which the respondent states he mentally heard the voice in the podcast reciting the answer to a test question, also suggests the value of audio for recall.

On the question of whether the podcasts were too long in duration, there was a more mixed opinion. One third of the sample group felt each podcast should be three to four minutes long in agreement with evidence from Reynolds (2005 [online]) who stated that in order for podcast to be effective they must follow certain guidelines. He believed they must be an appropriate length usually between two to four minutes similar to a song and information must be “chunked” to avoid boring the student. However in contrast to Reynolds (2005 [online]) fifty-two percent of respondents who had used the fifteen minute long audio podcasts stated they were happy with the length and would prefer they were not shortened, a further eighteen percent offered no opinion suggesting they did not mind whether they were longer or shorter.
Qualitative information gathered from respondents suggested that some students found the audio files were a good way of memorising the necessary information. Kruse and Keil (2000) citing Gagne (1965) stated that when the student is asked to recall information learned previously it helps with retention. Furthermore if students are then encouraged to elicit this performance it gives the opportunity for learners to confirm their correct understanding, and this repetition further increases the likelihood of memory retention. This stimulation of prior recall and eliciting of performance which Gagne (1965) outlined in his conditions of learning is the basis of the podcast design used in this research.

Morales and Moses (2006 [online]) had stated that podcasting addressed multiple intelligences and had revolutionised higher education. Qualitative comments in agreement with this statement suggested that those with reading and comprehension difficulties often prefer using audio which suggests their intelligence lies in different centres. Barton et al (2007 [online]) continued that podcasts provide a different and novel strategy, a point which was mentioned by a focus group member, and they stated that podcasts give the student good control over their learning a point again echoed by the respondents of the questionnaire survey. Davis (2001 [online]) added to the argument when he stated that podcasting frees up time for active learning exercises which has been shown to enhance learning.

5.5 Evaluation of the digital media used

The research showed that the respondent’s reaction to the tutorial program was very positive which helps with the learning process according to Kirkpatrick’s (1998) level one evaluation. The research evidence would also help improve future software design. A pre-test (appendix F) was completed by the respondents prior to use of the tutorial program. Although Kirkpatrick and Kirkpatrick (2007) suggested that the ‘before and after’ approach is not necessary where learners have no previous skill. In this case they recommend that a skills assessment after instruction will measure the learning that has taken place. However the author felt it was reasonable to allow the pre-test take place to help with the evaluation of the program. A post test evaluation (appendix F) was conducted after the apprentices had used the program for a sufficient time and it demonstrated a marked improvement in the respondents learning.
According to Kirkpatrick (1998) this showed learning was attained and was part of a level two evaluation on the tutorial program.

A comparison between the 2008 control groups test results and the 2009 experimental group used in this research who were supported in their learning by digital media also served as an evaluation of the digital media used. As the 2009 results showed major improvements over the 2008 cohorts it can be inferred that the technology had a positive impact on learning (appendix A).

5.6 Learning difficulties
The findings also disclosed that twenty-two percent of the sample group claimed some disadvantage in their theoretical learning abilities. Although not documented the author would consider this to be the norm, as twenty percent of apprentices on average will claim some form of learning difficulty. The author believes that this evidence may also be a reason that some students opt for a trade believing that the theory content would be low and that course content would be mostly practically based. As a relatively high proportion of the sample group claimed to have some level of learning difficulty, the author also believes that in concurrence with Hmelo and Guzdial’s (1996) advice this may suggest a role for technology as a coaching aid. Barton et al (2007 [online]) add to this theory when they said that iPods could be classed as “assistive technology”. As previously mentioned by Morales and Moses (2006 [online]) a well designed piece of digital media could address the range of multiple intelligences. Laurillard (2002:134) suggested that “tutorial programs allow more individual attention to an academically weaker student allowing one to one student teacher dialogue” which she stated was “the ideal teaching system”.

5.7 Moods and Attitudes
This research thesis also examined affective learning among today’s apprentices. This information is very relevant to this research as it can reveal if the average learner is in any way self directed. Mendler (2000) in agreement with Molloy’s (2005) theory on student passivity suggested that student motivation was at an all time low and blamed
the age of abundance suggesting that the students are too spoilt to learn, a fact one would hope the current economic downturn would address.

While it is clear from the many theorists that lack of motivation has an effect on performance, the age of abundance is not the only reason attributed to loss of motivation. The findings revealed that due to the quick onset of the recession which occurred at the time of writing, students lost motivation because they had been made redundant or they were unsure if they had a job to return to. Twenty-six percent of respondents claimed to have lost their jobs with a further thirty percent stating they were unsure if their jobs would be available after the course finished. Qualitative information revealed that there was a feeling of insecurity and in some cases, desolation among those who lost their jobs. Although some lost motivation, others in the minority reported they would try even harder in the circumstances to achieve better results in the hope that good results would help in gaining new employment. Fifty-nine percent of the sample group stated that job loss would affect their motivation and evidence has shown that lack of motivation can affect the progress of learning. From this it should be clear that an educator’s role must also be to make their best efforts to “excite” their students (Mendler 2000) by engaging them actively and intellectually with the curriculum in a community of practice early in the course (Wenger 1998). A student comment “I found the layout and sound of the quizzes made the learning more exciting” supports this argument. Furthermore technology could be used as a tool for “gaining attention” as outlined by Gagne (1965) in his conditions of learning or as a coaching and scaffolding aid as outlined by Hmelo and Guzdial (1996), Hmelo-Silver, (2006) and Lave and Wenger (1991).

Further comments on the issue of motivation from one respondent revealed that the course was “easy and hard, depending on whether you wanted to learn”. These comments can be linked to the comments of Knowles (1984) when he summarised that adults are ready to learn when they realise they need to know something in order to perform more effectively in some part of their lives. Wenger’s (1998) comments on intellectual and active participation early in the course are also relevant again and similarly another respondent suggested that “the course was hard but if you put more work in then it would have been easier”. This comment suggests the student had a
sense of regret that Molloy (2005 [online]) spoke of when he stated students often only realise they can overcome their passive learning nature and begin to engage with the curriculum in a more constructivist manner as they near the end of their training, when it can be too late.

Thirty four percent of the sample group reported they chose a trade as a career either to avoid college or as they had not completed a Leaving Certificate or they failed to receive the desired amount of points in their Leaving Certificate. Qualitative comments on this question suggested that many students avoid college because of a dislike of school or the belief that a trade would be an easier route academically. Motivation for these students must be a key focus for educators. Hmelo and Guzdial’s (1996) advice on Glass box scaffolding may be pertinent to training with tutorial programs or MP3 usage especially where collaboration is encouraged within the tutorial.

Approximately half of the respondents found the theory content long and difficult. This again suggests that there is scope for technology to assist these learners rather that just dismiss them as academically poor learners. Pedagogically designed courseware could target the individual intelligences of the vocational learner and stimulate them, allowing them to excel in their chosen occupation. A comment from one respondent outlined his approval for audio learning:

Great for students who have difficulty reading, it’s much easier to take in the information. Also you can relax and listen to the information on the iPod.

Although a higher proportion of the group at seventy percent found difficulty with the gas welding, the author believes that this particular skill lies mainly outside the reach of technology based help and must be mastered by practice with tuition as it has been traditionally taught. However help from tutorial programs in other areas could free up more time for the weaker student to devote to the harder practical skills such as gas welding. In support, Laurillard (2002) claimed that tutorial programs allow more individual attention to an academically weaker student and she believed that using such programs allows the students more time to focus on related tasks. The research showed that thirty percent of the sample group found difficulty with the practical work.
and a further twenty-two percent offered no opinion on this question. As the sample group had endorsed the value of the tutorial training program used with this research, it is feasible to suggest in line with Laurillard’s (2002) views that these programs could be used to help overcome difficulties in this area.

Sixty-three percent felt the course duration was however long enough and seventy-four percent expected the course to have been easier. Qualitative data suggested that if apprentices were motivated then their passage through the course was easier. This comment together with evidence from Molloy (2005 [online]) who showed that apprentices have little self directed learning skills and are passive in nature with regard to learning, suggests that passive learners need more direction and more motivation to excel in their training. This point is strongly reinforced by Raffini (1996), Mendler (2000) and Warner, Christie and Choy (1998 [online]). Boote (1998 [online]) believes this is because they have not developed the skills of metacognition adequately. However comments from respondents suggested that while some apprentices lost motivation when faced with job loss, others did not. Prensky (2005) stated that today’s students should be motivated using digital media. Raffini’s (1996) advice that motivational aids in the design of digital media highly motivate students allowing them to excel should also be tested. Soloway (2009 [online]) excitedly claimed that mobile learning will change how we educate today. Indeed if Soloway’s claims are true then it is conceivable that tutorial programs, vodcasts, podcasts or even web based tutorials could be used to blend training with our vocational students in the future.

5.8 Conclusion
This discussion of the findings has shown that evidence from the research of today’s Irish apprentices has mirrored much of what was said in the literature. Apprentices are in favour of using technology and for the most part have the ability to use the necessary hardware and have high ownership of this equipment. This removes many of the barriers which could prohibit the introduction of digital media in apprenticeship education.
Comparisons from the findings were also drawn with the literature on the value of implementing tutorial programs and audio based podcasts. Conclusions on the use of this digital media have supported the theory that it augments learning and allows the trainer more time. This extra time can then allow more flexibility for the trainer to focus on the weaker student or even further curriculum development etc. Furthermore the student can avail of the technology anytime anywhere to progress their own learning which can entice the learner to be more constructive and self directed which must be the goal of any educational system.

Finally in consideration of the affective learning domain evidence suggests that the use of technology can be helpful to combat problems of student passivity. Whilst this thesis does not try to prove student passivity during the course it does examine affective learning among student apprentices. It suggests that motivation loss may have prohibited certain students from overcoming their passive tendencies and prevented them from adopting the constructivist style of learning. The author believes this fact could have an effect on cohort test results during recessionary periods and may affect the outcome of any research on digital media integration during these times. Misko (1994) and Woodley (1987) believed that a student’s level of motivation can be a significant factor in determining success. Making the course content interesting (Woodley 1987) and showing student progress can help with motivation (Calder and McCollum 1998 and Grugeon 1987).
6.1 Introduction
The conclusions that can be drawn from the review of the literature, the research conducted and the evaluation of test scores over the two year period are that the integration of digital media to apprenticeship training has a positive outcome on learning. From the research findings, apprentices are ready for this pedagogical change and are already capable of using the necessary technologies. Lack of motivation is a factor highlighted from this research and if motivation can be increased then results could be improved further. More attention must be paid to the affective learning domain.

6.2 New technologies
From the literature review we have seen how many theorists such as Traxler (2008 [online]) believed we have changed in our relationship with technology. They suggested that future mobile technology will not only be used for social and communication means but will become sophisticated educational tools as well. We have also seen how Jenkins (2005 [online]) in comparing the mobile phone to the Swiss army knife suggested that the mobile phone is now a multifunction tool and not solely a communications device. As further persuasion to encourage the use of the mobile phone as a learning aid, Hartnell-Young and Heym (2008 [online]) added that educationalists should make the most of the fact that today’s adolescents already own this multi faceted educational aid. Evidence from this research concurred with these views as one hundred percent of apprentices surveyed owned a mobile phone which suggests they may be conducive to learning.

It is interesting to note that Prensky (2005 [online]) stated his vision of the future of mobile learning was the redesign of the mobile phone which he suggested had endless possibilities and could be utilised for worldwide teaching and learning. The author believes that mobile phones similar to apples ‘iPhone’ or the new ‘Samsung Jet’
which was launched mid 2009 could be the beginning of this new redesign Prensky (2005 [online]) mentions (appendix E). It is also easy to visualise when discussing the views of Prensky (2005 [online]) and Soloway (2009 [online]) that today’s MP3 player will be incorporated into the majority, if not all of tomorrow’s mobile phones as it is in many of the today’s current models such as Apple’s iPhone.

These newly designed multi function devices could also play a large part in the huge change foreseen by Soloway (2009 [online]) when he excitedly claimed that mobile learning will change how we educate today. Soloway’s claims may well be true and therefore could have a large impact on apprenticeship learning. This again suggests a move towards the blended learning approach for theory based subjects however the author believes that as a large percentage of apprenticeship learning is practical based instruction then this learning should still follow the traditional instructor led method with digital media acting as a scaffolding aid to compliment this traditional approach. Technology however may lead to a streamlining of apprenticeship training into the future. Research evidence has also shown that pedagogically designed tutorial programs can have a valuable place in the education of our vocational learners. There are warnings that good design of digital media is crucial to success but the overwhelming evidence suggests there is merit to its use.

Finally it is also clear from both the literature and the findings that introducing digital media to apprenticeship learning would not have significant cost implications. Apart from investing in the design of the new digital media, there would be little further setup costs as the apprentices already own the necessary hardware and for the most part do not need training to use it.

### 6.3 Instructional design

As we have seen, the research evidence from this thesis claims that there is value in integrating technologies such as podcasting and specifically designed tutorial programs to the pedagogy of training of apprentices. However we have also seen that the design of any technology is critical to the learning outcome. Reigeluth (1999) showed us that any newly designed educational media must be grounded in theory and
have had a good instructional design so that it offers guidance to students on how to
learn and develop. Reigeluth (1996) also warned that what works for one student may
not work for another as he stated “we are all different”. According to the review of the
literature, theorists such as Pogrow (1996) suggested that good instructional design is
a difficult objective to achieve and can take years to achieve successfully. This
suggests that there are dangers associated with novices attempting to design digital
media content. Care should be exercised in the design stage to ensure it follows some
recognised form of industrial design such as the ADDIE or Dick and Cary models of
design.

Pedagogically appropriate software would need to support the apprentice by acting as
a scaffold as the instructor continues to coach the apprentices (Hmelo and Guzdial
1996). It can also be concluded from this research that correctly designed digital
media would support dual coding theories (Mayer 2005) and multiple intelligence
theories (Gardener 1993). Comments from respondents have showed how digital
media has helped both the auditory and visual learners (appendix D).

6.4 Motivation in training
Molloy (2005 [online]), Raffini (1996) and Mendler (2000) have all written on the
importance of motivation to learning. We have heard from Molloy (2005 [online]) that
apprentices typically arrive for phase two training at FAS training centre in passive
mode, awaiting information to be delivered to them in a behaviourist style. The
behaviourist style is indeed used still in many FAS training centres in the teacher
centered and dominated way as stated by Hoffsetter (1997 [online]). It may be true of
Mishra and Sharma (2005) to state that teacher directed instructional approaches are
decaying. However the author believes that there is little evidence of this in current
Irish apprenticeship training as the behaviourist style is still evident in the training of
apprentices as they observe and model the behaviour of their instructor in traditional
apprenticeship style (Bandura 1997). Taking Molloy’s (2005 [online]) view however
that apprentices become less passive and more self directed as they near the
completion of the course suggests they become more aligned to the constructivist
approach as the course progresses. The author believes that as Ertmer and Newby
(1993) stated, the learning theories used in apprenticeship training in Ireland vary with
the learner and the content to be learned, and as much of the content of the phase two plumbing apprenticeship requires lower level processing, then the behaviourist style is sufficient in these cases.

With the proposed introduction of digital media however the hope must be that there could be an earlier shift towards the constructivist style with more student-centered environments (Mishra and Sharma 2005). This advance towards the constructivist style should allow increased levels of processing which is often necessary to match course content as indicated by Ertmer and Newby (1993). Siemens (2004 [online]) would argue that when using technology in education, connectivism would be the desired approach for the apprentice after moving from their behaviourist style. This approach has many similarities with the constructivist style and would seem in the authors view to be a form of constructivism with the integration of technology.

6.5 Main conclusions of the thesis

The conclusions of this research thesis therefore are that integrating digital media such as audio files and pedagogically designed software both aids and improves apprenticeship learning. It had a positive impact on the apprentice’s education and they both welcomed and supported it. The findings also show that apprentices have easy access to the appropriate technology, allowing them to use digital media outside the classroom without the need to purchase any equipment. Furthermore the vast majority of apprentices have the technical ability to use this equipment. It was noted that training would be required for approximately fifty percent of apprentices if they were to use the program for communication and/or collaboration purposes.

This research has outlined a willingness or even excitement among apprentices to embrace this technology. An evaluation of test results with students who used digital media with those who did not use digital media has shown concrete evidence that digital media can improve results. Motivation in students was however shown to be a key factor in learning. The research showed that an economic downturn at the time of writing had a negative effect on student motivation. Taking the views of many theorists from the literature, poor motivation has a negative impact on student’s abilities to learn and therefore may impair the benefits derived from digital media.
integration. However with regard to this research, there is little evidence to suggest that this had any major effect on training considering the positive test results. It was also noted that the integration of digital media itself can be a motivating factor.

This research and evidence from the literature also concludes that we can expect mobile learning to feature strongly in future education. Appropriate use of mobile phones and “iPods” and other mobile devices may have to be encouraged by educators. If suitable education material is designed, mobile learning will bring education outside the classroom to allow the self directed approach of anywhere, anytime learning which Morales and Moses (2006 [online]) spoke of, which Lee & Chan (2007 [online]) suggest is an attractive option.

Arguments in the literature have been made supporting digital media while others have warned of its limitations. Alexander (1996 [online]) stated that there is overwhelming evidence that the mere presence of technology does not improve learning. Laurillard (2002) said that when new technologies are fully integrated into the educational system they do make a noticeable difference. This thesis shows positive results for digital media use but suggests results could be even better if intrinsic motivation levels improved. Therefore we need to consider the writings of Molloy (2005 [online]) Raffini (1996) and Mendler (2000) and learn to excite and motivate our students. Digital media must be instructionally designed to intrinsically motivate students as Alexander (1996 [online]) stated its mere presence will not improve learning.

Therefore the findings of this thesis are that in relation to the Irish apprenticeship system, we should as Doolittle (2001:2) stated, “stop professing technological and pedagogical integration and start integrating with purpose and forethought”.

6.6 Recommendations
The author would make a number of recommendations to enhance the digital media designed for this research and for further research on the subject of digital media integration to apprenticeship learning:
• Enhance the digital media tutorial program to cover all three modules of the course on separate DVD’s which could be given to the apprentices at the start of their apprenticeship. The DVD’s could also include a digital version of the apprentice’s handouts for each module. When presented to the apprentice in advance of their course the slower learner could avail of the technology to get a head start by browsing the software or audio files prior to starting the course.

• Improved instructional design to the tutorial program quizzes to prevent problems arising from misspelt answers. The author would recommend adding more close up sequences to the video demonstrations whilst also adding pause, stop and start buttons for better control to aid understanding for the learner as mentioned in the findings.

• Evaluate the collaboration facility of the tutorial program to introduce a peer to peer teamwork approach for evening study purposes to help low knowledge, low spatial learners. Currently the program uses ‘Huddle’ as a collaboration tool but the author would like to investigate the use of Moodle as an online learning alternative.

• Progression of audio files to cover all modules of the course and not just the chapter on central heating

• Further research could study affective learning behaviour among apprentices. This study would add to research previously conducted by Molloy (2005 [online]). As the attitudes of the modern apprentice have changed so much over the years, further research could investigate the best methods to motivate today’s apprentice. It is clear that if the learner can be excited to embrace education rather than have to be persuaded to learn in a behaviourist manner, then this will bring benefits for all concerned.


Ganz-Cooney, J. (2008) *Center and Common Sense Media*. Growing up digital: Adults rate the educational potential of new media and 21st-century skills. In Shuler,


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and models, a new paradigm of instructional theory. New Jersey: Lawrence Erlbaum associates.


APPENDIX A

2008 & 2009 COHORT TEST RESULTS
## 2008 Cohort Copper Pipe Work Test Results (Control group)

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<th>Course Title</th>
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<th>Instructor</th>
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<td>FAS Training Centre, Shannon</td>
<td>Michael McMahon</td>
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*Students names removed for confidentiality*

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**TOTALS**
- Credit = 8
- Pass = 5
- Referral = 12
- Withdrew = 3
**2008 Cohort Central Heating Test Results (Control group)**

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<tr>
<td>Training Centre</td>
<td>FÁS Training Centre, Shannon</td>
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<tr>
<td>Instructor</td>
<td>Michael McMahon</td>
</tr>
</tbody>
</table>

*Students names removed for confidentiality*

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**TOTALS**

- Credit = 14
- Pass = 8
- Referral = 3
- Withdrew = 3
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**TOTALS**  
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**Assessment** Central Heating

**Students names removed for confidentiality**

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**TOTALS**  
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- Pass = 2  
- Referral = 3  
- Withdrew = 2
APPENDIX B

RESEARCH PLAN GANTT CHART
Research plan for writing of thesis

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APPENDIX C

SURVEY QUESTIONNAIRE
&
COVER LETTER
UNIVERSITY OF LIMERICK

Survey Questionnaire

An Evaluation Of The Use Of Technology On Apprentice Training
Dear Apprentice,

I am undertaking a study of the impact that digital media will have on apprentice training. This study forms part of a master’s degree that I am completing with the University of Limerick.

Over the past number of weeks you have been using “The copper tutor” a multimedia DVD training aid in the workshop and viewed it from home. You have also used an accompanying CD with new podcasts which allowed you to download information to your iPod player when revising your module three theory.

I would be very grateful if you could please complete the attached questionnaire which should take you approximately fifteen minutes. I can assure you that the questionnaire is one hundred percent anonymous and confidentiality is guaranteed.

Please tick the appropriate boxes for each question. Where possible try to use the comment lines also, as this will provide me with unique information, which will be very useful to the research.

Your honest, truthful response as an apprentice is vital to this research and is very much appreciated. I feel the study will be worthwhile and it may lead to us integrating technology to our teaching methods which may help apprentice learning.

If you have any queries please do not hesitate to contact me at 061 706 124 or at my email address at michael.mcmahon@mw.fas.ie. If you wish to view the results of this research report you can contact me in December 2009.

Thank you once again for your time and effort.

Yours Sincerely,

_________________

Mike McMahon
The following questions seek to elicit your access to technology.

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<th>Please tick to indicate your response</th>
<th>Yes</th>
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<th>Occasionally</th>
<th>Maybe</th>
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<td>☐</td>
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<td>2. Do you have access to a computer where you live</td>
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<td>3. Would you be prepared to purchase a computer (approx €500)</td>
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<td>☐</td>
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Please comment if necessary.

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
The following questions seek to elicit your average computer experience?

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<td>7. Ability to use the internet</td>
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Do you have any comments to add regarding your computer experience?

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

The following questions seek your views on the copper pipe tutorial program.

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Please add comment where necessary to expand on any of the questions.

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

17. Did you complete the assessment quizzes successfully

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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Please comment.
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18. Assuming your instructor has delivered a demonstration to the class on “Machine bending” and as you practice you find you are unable to complete the task, please indicate your 1st choice.

*Indicate your likelihood to use any of the following options by scoring 1 to 3 in the boxes with 1 being most likely and 3 being least likely.*

- Ask the instructor to help
- Ask a classmate for help
- Use a workshop based program like this one to replay a demo video
19. Please comment on where you found the program useful.

_____________________________________________________________________
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20. Please comment on where you thought the program was limited.

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21. Do you think the tutorial program has a place in training apprentices the skills and knowledge of working with copper pipe?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>☐</td>
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</table>
22. Would you welcome the introduction of this type of technology or do you prefer the traditional direct instructor led instruction encountered in module one and two?

<table>
<thead>
<tr>
<th>Introduce technology to our learning</th>
<th>Prefer instructor led without technology</th>
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<tbody>
<tr>
<td>☐</td>
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Please comment.

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The following questions seek to elicit information on your use of an iPod as a learning aid.
23. Having used audio podcasts for evening study on the central heating chapter, do you think they helped you to learn?

<table>
<thead>
<tr>
<th>Please tick to indicate your response</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. I found it easier to learn by listening to the podcasts</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b. I found it easier to learn by listening to the podcasts and also reading from the handouts</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c. I did not find the podcasts useful and used the handouts only</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>d. I found it more convenient to learn by listening to the podcasts</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e. I found the individual podcasts lessons were too long and would have found it easier if each section was 3-4 minutes long similar to the length of a song</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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Please add your own comment.
________________________________________________________
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24. Would you use audio podcasts in future as a method of learning?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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</table>

Please comment.

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The next set of questions are of a somewhat personal nature but are very important to the survey. Please be assured your answers are one hundred percent anonymous and confidential.

25. Why did you opt for a trade/plumbing as a career *(please tick *any* appropriate boxes)*

a. Family member or friend already in the trade.  

b. I heard it was a good trade from friends

c. I researched all the trades and chose plumbing

d. Career guidance teacher encouraged me to choose plumbing

e. I Just picked plumbing at random

f. I like to work with my hands.
g. A trade offers me the ability to move from place to place

h. I believed I could earn a good living from a trade

i. I do not like the school environment so I chose a trade

j. I felt college would be too difficult for my abilities

k. I did not receive enough points to opt for a college course

l. I felt a trade would be an easier option than going to college

m. I have a learning difficulty so I avoided college

n. Other, please state below

I chose plumbing as a career because

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

26. Please tick the relevant boxes below with regard to your view of the phase two course you are currently conducting in Fas.

Please tick to indicate your response

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Overall the course is easy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Overall the course is hard</td>
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</table>
c. The theory is difficult

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Please make further comment below if necessary.

_____________________________________________________________________
_____________________________________________________________________
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27. If you agreed to question J in the section above stating you have some form of learning difficulty, can you please clarify what your learning difficulty is?

*Again this information is both anonymous and strictly confidential.*

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
28. If you became unemployed during your phase two training, do you think this would affect your motivation to gain good results while on the course?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Somewhat</th>
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<tr>
<td>Icon</td>
<td>![Icon]</td>
<td>![Icon]</td>
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</table>

Please comment.

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Thank you most sincerely for the time and effort you have contributed to this survey it is a valuable contribution to this study.

Kind regards,
Mike McMahon
The focus groups comments on the DVD copper pipe tutor program

It’s really handy cause if you like, miss a day for whatever reason you can either look over it at home or catch up in the workshop by viewing the demo’s.

Well I like it because you can watch them video’s over and over and it won’t lose its patience, sorry Mike.

In fairness though lads you don’t want to lose the instructor here, the programs grand an all but you need the instructor to show you first, I think it’s a great idea but we still need a proper instructor teaching us.

I think it was good because it was good to hear and see the demos and the text at my own pace.

The CD could be used to prepare for tests.

It takes you step by step, using a visual and audio at our own pace.

I couldn’t do the 45 degree offset but then I watched the video, I had to watch it a couple of times though but I got it.

It’s great if the instructor is busy and I did not want to bother the lads so I used the program.

There should be one of these for the steel pipe work and welding too.

O god I just looked at the soldering video there last week and saw that the heat is applied to the bottom and the solder to the top, no wonder I was getting it wrong.

I think we should have this in all the phases, I mean it’s in phases 4 and 6 you’re gonna need them (why) Because you don’t get the same help in the colleges as you get in Fás there’s less tutor support.

Great for the instructor, it takes the work load off them.
The focus groups comments on the educational value of the program

I found the quiz very helpful because when you have the chance to go over the questions they stick in your head and it also gives you an idea of the type of questions that could come up.

Quizzes are a good way to learn, better than reading

Quizzes were very useful for refreshing the memory of past theory work

I found the layout and sound of the quizzes made the learning more exciting

Using the computer program means you are not disturbing anyone.

It depends, if it was just a small problem I would ask the instructor.

I’d rather ask the instructor than look at a computer

The instructor is usually so busy I would try the demo video or ask a classmate

I liked the video demonstrations because when you are watching the demonstration given by the instructor it can be hard to see with a large crowd standing around

It’s an easy way to study for people who find it hard and don’t like doing it. It is very useful to look over both theory and practical if you were finding things hard.

The program goes through everything in great detail.

It’s helpful for apprentices who don’t take in information as easily as others.
Using this technology is good because some people learn differently and prefer different ways of learning and this gives them a choice.

It’s great to be able to use it in the house when studying, watching videos and listening to podcasts.

It is more helpful to use the technology because you can go over it as many times as you like.

I would like to see the program cover all subjects.

It is a very good way of learning.

I think we will learn better using this software.
The focus groups comments on the value of educational podcasts

I thought it was very good and got a buzz out of it. It was something new so giving it a try was hard at first but when you get into it you realise how good and helpful it is. I’d recommend it to anyone.

I think the podcasts are easier as the information sticks in your mind. Podcasts make it easier to learn.

I thought it was excellent when you’re in a hurry or busy and can’t study.

It’s better than reading the handouts at home and a lot handier.

I believe the combination of power point and handouts in the class are useful and the podcasts reinforce the learning from the class at home.

Great for students who have difficulty reading it’s much easier to take in the information. Also you can relax and listen to the information on the iPod.

The podcasts are great! I was looking at a question in the test the other day and I didn’t know the answer at first, but then it’s like I heard your voice giving the answer in the podcast.

Good for revision for theory tests.

Good to look over when the teacher is not there.

I find it better to hear things than see them when I’m studying.

I think it’s a lazy way to study.

Listening is easier to learn than reading.
I thought the iPods were helpful out, I fall asleep listening to them, they say your mind takes in information when you sleep.

I listened to them on the way home last Friday, sure what else would you be doing, it’s great, not the coolest thing I’ve ever listened to though, but if it gets me through the test.

iPods should be used all the time for every chapter, could I get the whole course from you?

Ya you can head out for a walk with the iPod, it gets you away from the notes and you’re not stuck in the house.
The focus groups comments on motivational loss

*What is the point of striving for good results when you don’t know what you’ll be doing in six months time?*

*Well I was trying to impress my employer with a good result, but he has let me go now.*

*To be honest my head has been wrecked since I found out I might not have a job to go back to.*

*I know a heap of the lads on site have been laid off: to be honest I’m afraid to contact my employer at the moment.*

*Actually I think it has made me try harder, I am going to need a good report for when and if a job comes up again.*

*It gets you down having no job and it’s really hard to give it one hundred percent down here then, I mean we will be stuck waiting to get a job and our apprenticeship will be on hold, how could you be keen after that.*

*Nah, if I lost my job the only thing keeping me here would be the money, the pays better here than on site.*

*Well I don’t think I have a job to go back to. It’s a worry but what can you do, you have to give the training your best shot: it’s going to benefit you.*
APPENDIX E

EVIDENCE OF DIGITAL MEDIA USED
PHOTO’S OF DIGITAL MEDIA USEAGE AMONG APPRENTICES IN A FAS TRAINING CENTRE
An apprentice revising using podcasts on central heating over lunch break

An apprentice using his Samsung Jet mobile phone to play a video of a pipe bending demonstration in the workshop
APPENDIX F

PRE & POST EVALUATION TEST
INCLUDED WITH THE TUTORIAL PROGRAM
**Pre-Evaluation test contained within the DVD program**

Attempt all questions. Time allowed 1 hour.

Name_________________________

1. Explain the term Laminar flow

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2. State one possible problem associated with hacksaw cutting copper pipe.

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3. How much pipe must be heated to make a 75mm radius spring 90 degree bend.

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4. List two types of compression joint.

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5. What reduction in the bore of a 15mm copper pipe can be expected if the pipe is not reamed after using a pipe cutters.

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6. What material is used in the soldering process to lower melting points?

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__________________________________________________________________

7. What is the permitted allowance of lead levels in drinking water.
8. Name two forces that are present in the capillary attraction process.

9. Can plastic coated copper pipe be bended using a bending machine?

10. When soldering plastic coated copper pipe, how much should the plastic be slit back from the solder point?
11. Name two chemicals used for disinfecting systems prior to use.

12. Name one disadvantage of using elbows on copper pipe.

13. What is the purpose of heating copper pipe prior to spring bending?

14. What is the name given to this type of heating of copper pipe?
15. List three types of copper pipe.

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16. What is the bending allowance made when machine bending a 90 degree offset.

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17. When machine bending a 90 offset where is the bending line positioned on the machine?

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18. Explain what precaution is used to protect the pipe when fixing alignment on a spring bent offset.
19. List two methods used to aid spring removal on a tight spring bend.

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20. List three advantages of using machine bends.

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Now please hand this evaluation sheet to your instructor, thank you.

Score
Post-Evaluation test contained within the DVD program

Attempt all questions. Time allowed 1 hour.

Name_________________________

1. Explain the term turbulent flow..

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2. State one possible problem associated with using a pipe cutter when cutting copper pipe.

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3. How much pipe must be heated to make a 100mm radius spring 90 degree bend.

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4. Explain the non-manipulative compression joint.

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5. What reduction in the bore of a 15mm copper pipe can be expected if the pipe is not reamed after using a pipe cutters.

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__________________________________________________________________
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6. What material is used in the soldering process to lower melting points?

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__________________________________________________________________

7. What is the most common form of mechanical bending of copper pipe?
8. Explain the capillary attraction process.

9. What are the benefits of laminar flow?

10. How are crossovers made?
11. In what form is light gauge tubing supplied?

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12. What treatment is given to copper prior to spring bending.

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13. List three ways of joining copper pipe?

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14. What is the name given to this type of heating of copper pipe?

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__________________________________________________________________
__________________________________________________________________
15. List three type of copper pipe.

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16. What is the bending allowance made when machine bending a 90 degree offset.

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__________________________________________________________________

17. When machine bending a 90 offset where is the bending line positioned on the machine?

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18. Explain the term biostatic.
19. What type of compression fittings are used underground.

20. Is lead allowed as an element in the making of solder for use with potable water?

Now please hand this evaluation sheet to your instructor, thank you.

Score
APPENDIX G

MULTIMEDIA TUTORIAL PROGRAM DVD

&

AUDIO FILES CD-ROM
(PODCASTS)