Best Practice for Delivering a Computer Based Training Programme to a Transition Year School Group: The Case of Autotrack and Autotest for ECDL

Thomas Brendan Hogan

Masters of Arts in Digital Media Development for Education
University of Limerick

Supervisor: Mr. Gerry Hancock

Submitted to the University of Limerick
October 2009

Declaration

Name: Tom Hogan

Student ID Number: 0617091

Course Title: Master of Arts in Digital Media Development for Education

Date of Submission: 8 October 2009

Declaration:

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

Tom Hogan 8 October 2009

Abstract

Best Practice for Delivering a Computer Based Training Programme to a Transition Year School Group: The Case of Autotrack and Autotest for ECDL

Tom Hogan

The IT 2000 initiative kick started the drive to incorporate ICT into teaching and learning in the Irish education system. In the secondary sector, in particular, the availability of suitable software programmes has been sadly lacking. The ECDL programme is an international benchmark for basic computer literacy. The main focus of this action research project was to find best practice for delivering this computer based training programme to a transition year school group and so explore ways of improving learning and teaching competencies.

The study is based on a comparative analysis between two cohorts of twelve students from within the same transition year group, using a combination of the traditional and the automated training methods [Autotrack and Autotest]. Action research was the research approach thought most appropriate for this study and the following research tools were utilised: assessments; questionnaires; diaries; interviews; research journal; data collection and analysis; focus group discussions; structured and unstructured interviews and observational data.

The main findings of this research show that manual training combined with Autotrack has improved results in Autotest; manual training combined with Autotrack has improved the success rate in Autotest; in-application tuition is essential to get a full understanding of difficult topics; all students felt more confident about their abilities with computer applications on completion of the three designated modules; Autotest was considered to be more realistic, more satisfying and more enjoyable than Autotrack. The key conclusion is that delivery of the course could be improved by using blended learning: a combination of the computer based training (Autotrack) in conjunction with traditional structured lessons.

The main recommendations include the Irish Computer Society (ICS) taking a more active role in the pedagogical implications of their ECDL programme; that course providers incorporate access to live applications; that the course tutor adjusts his or her teaching methods to take account of individual needs of the less able student.

Acknowledgements

I wish to acknowledge the help and cooperation of the following people in completing this thesis:

- Mr. John Curtis, Principal of St. Kieran's College, Kilkenny for allowing me to do my research
- The Transition year students of St. Kieran's College for their enthusiasm and cooperation during the research
- My tutor Mr. Gerry Hancock for his invaluable advice and the sense of calm that he brought to the project
- My critical friend and teaching colleague, Philip, for his participation in the focus group discussions and his positive encouragement
- My friend Jim for his valuable advice and for pushing me in the right direction
- My wife, Nora, and Conor, Tara and Ciarán for their patience and understanding during this process

List of Appendices

List of Abbreviations

ACOT	Apple Classrooms of Tomorrow
BECTA	British Educational Communications and Technology Agency
CAI	Computer Aided Instruction
CAI	Computer Assisted Instruction
CARE	Centre for Action Research in Education
CBL	Computer-based Learning
CBT	Computer-based Training
CDLE	Child-driven Learning Environment
CNA	Concise Narrated Animation
CTGV	Cognition and Technology Group at Vanderbilt
DAC	Development Assistance Committee
DE	Distance Education
DES	Department of Education and Science
ECDL	European Computer Driving License
EU	European Union
ICAI	Intelligent Computer Assisted Instruction
ICDL	International Computer Driving Licence
ICS	Irish Computer Society
ICT	Information and Communications Technology
ID	Instructional Design
JC	Junior Certificate
LC	Leaving Certificate
LMS	Learning Management Systems
MS	Microsoft
NCCA	National Council for Curriculum and Assessment
NCTE	National Centre for Technology in Education
OECD	Organisation for Economic Cooperation and Development
SRL	Self-Regulated Learning
SUMI	Software Usability Measurement Inventory

Table of Contents

Chapter 1 Introduction

The main focus of this action research project is to find best practice for delivering a computer based training programme to a transition year group and so explore ways of improving learning and teaching competencies.

1.1 Background

A concerted effort has been made to incorporate ICT into the Irish education system since the IT 2000 initiative which was launched in 1997 by the Minister for Education and Science, Micheál Martin. Since the late 1990's substantial investments have been made in ICT infrastructure for schools and in teacher training, primarily by the State but also by individual schools and institutions.
In the latest publication by the Department of Education and Science Inspectorate

Investing Effectively in Information and Communications Technology in Schools 2008-2013

we quote Mary Hanafin T.D. who was then Minister for Education and Science:

> "Undoubtedly, digital and interactive technologies can bring a new richness of resources to the classroom and to learning and teaching in general. Evidence from Irish schools shows that where ICT is used innovatively and integrated into the curriculum, the learning experience can be more enriching, collaborative and personally gainful".

The OECD report, '*Learning to Change'* ICT in Schools (2001) had a similar view when it stated that:

"The pedagogical rationale for the use of ICT in teaching and learning is based on the potential of ICT to increase the breadth and richness of children's learning".

With this in mind we introduced an automated training and testing facility for our ECDL students back in the academic year 2006-2007.

The author is teaching in an all boys secondary school in the South East. The European Computer Driving License (ECDL) was introduced into the school as part of the Transition Year Programme in the year 2000. It is an international benchmark for basic computer literacy. The ECDL is a certificate which indicates that the holder has passed one theoretical test and six practical tests. It is a skills based qualification and it is highly regarded by industry and recognized in over 125 countries.

From the academic year 2000/2001 to 2005/2006 we used the traditional method of delivering this programme. Training took place in a networked computer room with one computer per student. Each student had Microsoft Office installed on their workstation and worked through each programme in conjunction with the teacher. The teacher demonstrated the various tasks by way of a data projector and after much practice and pre-testing the student sat an official module test chosen by another approved trainer, rather than his own teacher.

In the academic year 2006/07 it was decided to use an automated training and testing system. The whole ECDL course is installed on the server. Each student logs onto Autotrack. This is an automated training programme which allows users to train at their own pace. There is much drill-and -practice type exercises to reinforce learning. This is an example of where Dwyer(1996) described the computer as a tutor in the knowledge instructivist setting. If and when a student has completed the module and passed the sample tests, he accesses Autotest to attempt an automatically generated test. The test is corrected automatically and instantaneously.

My hypothesis is that learning competencies were greater with the old system of training for ECDL, as opposed to the new Autotrack system. From the author's

observations, as an experienced ECDL tutor and tester of in excess of four hundred and fifty students over the past eight years, it would appear that students from the '**old**' system had a greater competence in the use of Microsoft applications than students of the '**new**' system.

1.2 Research Aims

The purpose of this study is to contrast two methods of delivering a computer based training programme to a transition year group, and, in so doing, explore ways of improving learning and teaching competencies.

My objectives are as follows:

- To establish students attitudes to and knowledge of the ECDL Programme before its delivery
- To compare the competence of transition year students in selected modules of the ECDL programme arising from the Autotrack/ Autotest and manual delivery methods
- To identify improved learning practices based primarily on the experience and views of the students
- To recommend improvements in delivery of the ECDL

1.3 Research Approach

In terms of solving problems in the world of education, there is one form of research that is pre-eminently suited to solving those problems where there "is some discrepancy between an educational practice and the expectations in terms of which the practice was undertaken" (Carr & Kemmis, 1986). This form of research is action-research. Action-research is a form of problem solving based on increasing knowledge through observation and reflection, then following this with a deliberate intervention intended to improve practice. Educational action-research can be said to be "any inquiry teachers undertake to understand and improve their own practice" (McCutcheon & Jung 1990 pg. 144). The idea of self reflection is central. McNiff (2002) states that Action research is an enquiry conducted by the self into the self.

The study will be based on a comparative analysis between two cohorts of twelve students from within the same transition year group.

I have identified a research question and have concluded that action research is the most appropriate method to investigate and, hopefully, improve this situation.

1.4 Thesis Outline

Chapter 1: Introduction

This chapter gives a brief description of the background to the study, the research aims and the research methodology.

Chapter 2: Literature Review

This chapter looks at ICT in the Irish education system and the attitude of government towards ICT in education. There is a review of the main learning theories and theorists. We look at the role of ICT in learning and teaching, the positives and negatives. There is a review of computer based learning versus traditional learning, multimedia, design issues, design models and blended learning. Finally, we examine the ECDL programme, the different approaches to its delivery and an evaluation of the ECDL.

Chapter 3: Methodology

This chapter explores the research question and the setting for this study. There is then a definition of action research, a discussion of the action research process and reasons are given for employing this methodology in the current research. Research limitations and ethics are examined as well as the various research tools. Finally, there is a look at reliability, validity and triangulation and criteria before finishing with a timeline for the study.

Chapter 4: Research Findings

This chapter presents the findings of the research undertaken. The findings are divided into seven sections, each corresponding to a phase in the research process. The findings are based on assessments, questionnaires, focus group discussions and the observations of myself and a critical friend. There is a summary of key findings at the end of the chapter.

Chapter 5: Discussion of Findings

In this chapter, after reiterating the aims and objectives of the study, I discuss each of the research questions in turn, based on the findings chapter. This discussion is developed from the findings and guided by the literature on the subject.

Chapter 6: Conclusions and Recommendations

The study concludes with a list of conclusions drawn from the interaction of the objectives with the literature review and the findings. There is also a brief list of recommendations regarding future developments.

Chapter 2 Literature Review

2.1 Introduction

Information and communications technology (ICT) is now ubiquitous in the modern world (OECD, 2001). A concerted effort has been made to incorporate ICT into the Irish education system since the IT 2000 initiative which was launched in 1997 by the Minister for Education and Science, Micheál Martin. Since the late 1990's substantial investments have been made in ICT infrastructure for schools and in teacher training, primarily by the State but also by individual schools and institutions. It is now widely accepted that the future prosperity of Ireland is predicated upon our ability to develop a knowledge-based economy (Lisbon Agenda 2000).The government agencies charged with promoting and advancing ICT in schools are the National Council for Curriculum and Assessment (NCCA), the National Centre for Technology in Education (NCTE) and the ICT Policy Unit of the Department of Education and Science (DES) together with their training partners. In fact, the NCCA's work in ICT has as one of its principles that "by the end of compulsory education all students should have achieved a defined level of ICT competence." This commitment is again reiterated in the current social partnership agreement, *Towards 2016*
(Department of the Taoiseach, 2006).
In the latest publication by the Department of Education and Science Inspectorate

Investing Effectively in Information and Communications Technology in Schools 2008-2013

we quote Mary Hanafin T.D. who was then Minister for Education and Science:

> "Undoubtedly, digital and interactive technologies can bring a new richness of resources to the classroom and to learning and teaching in general. Evidence from Irish schools shows that where ICT is used innovatively and integrated into the curriculum, the learning experience can be more enriching, collaborative and personally gainful".

The OECD report, '*Learning to Change'* ICT in Schools (2001) incorporates a broad view of the knowledge society in outlining three primary rationales for the inclusion of ICT in education, namely:

A pedagogical rationale

The pedagogical rationale for the use of ICT in teaching and learning is based on the potential of ICT to increase the breadth and richness of children's learning.

A social rationale

The social rationale for planning for ICT use in classrooms focuses on the development of ICT competence, as an essential "life skill", in the same way as literacy and numeracy are currently viewed, thereby becoming both a requirement and a right.

An economic rationale

The economic rationale focuses on the potential of schools to prepare children to meet the perceived needs of the economy – present and future.

These priorities are also reflected in recent curriculum documents (Primary School Curriculum, Junior Cycle Areas of Experience, Senior Cycle Review) which promote the importance of higher order thinking skills, critical thinking, problem solving, collaboration with others, learning to learn, and the ability to adapt to change, etc., now proposed as key requirements of the knowledge society (NCCA, 2004). That ICT is and should be an integral part of learning and teaching in our education system is no longer the issue. The debate is now concentrated on the best ways to integrate ICT into the curriculum in order to maximize learning and teaching outcomes (competencies).

This literature review will examine the whole debate regarding learning theories, the merits of the behaviourist as opposed to the cognitivist and constructivist approach, and a review of Gardner's Multiple Intelligences. We will look at what Carl Rogers (1969) labelled cognitive and experiential learning and what Siemens (2004) put forward as a learning theory for the digital age, connectivism. The role of ICT in learning and teaching, its pros and cons, will be addressed. Then we will

discuss computer based training versus traditional classroom learning and examine instructional design issues as they pertain to educational software, including issues such as multimedia, design models and the human computer interface. We will introduce the concept of blended learning which combines various pedagogical approaches towards delivering an ICT package. We will conclude with an examination of the European Computer Driving License (ECDL), modes of delivery and a brief evaluation of the programme as a teaching and learning tool.

2.2 Learning Theories

2.2.1 Behaviourism

Edward L. Thorndike (1874-1949) was one of the first psychologists to recognise that the basis for learning was composed of an association between senses and impulses. His observations have been referred to as the ‘Law of effect’ and came to dominate the system of reward, punishment, promotion and incentives found in the education system (O’Reilly 1997). Pavlov (1849-1936) used his experiments with a salivating dog to put forward the theory of classical conditioning and apply it to humans in the form of stimuli or triggers such as memories or scent. Thorndike and Pavlov established the underlying concepts, theories and practices for the behavioural approach. In fact, Thorndike, Watson and Skinner also used animals in laboratory settings to formulate their ideas about behaviour. Skinner designed an apparatus called the Skinner box which was a great improvement on the trials of Thorndike and Watson. Skinner developed the concept of operant conditioning whereby a person is conditioned to respond when the stimulus-response pattern is reinforced or rewarded.

This Operant-Respond theory was to dominate learning theory for thirty years and helped establish the behaviourist movement. Emphasis was placed on 'drill and practice’ tutorial based programmes. Learning could only be measured in the form of a change in observable behaviour (Operant Conditioning). The teacher is in

total control of what the learner learns, limiting the scope to explore and form new concepts. Behaviourism in education promotes the teaching of low level skills as in drills or tables as it focuses on a new behavioral pattern being repeated until it becomes automatic. “Behaviourists believe that learners learn by actively manipulating the learning material, responding to it, then forming associations (O’Reilly 1997)”.

The concept of directed instruction, whereby a teacher is providing the knowledge to the students either directly or through the set up of "contingencies" is an excellent example of the Behaviourist model of learning. The use of examinations to measure observable behaviour of learning, the use of rewards and punishments in the school system, and the breaking down of the instruction process into "conditions of learning" (Robert Gagne, 1985), are all further examples of the Behaviorist influence.

The main features of behaviourism according to Forrester & Jantzie (1998) are:

- It is directed instruction
- It is teacher-centred and controlled
- There are behavioural observations
- There is more focus on individual work

Even the introduction of computer assisted instruction (CAI) to schools was initially behaviourist in approach. CAI uses the drill and practice approach to learning with stimulus and response and operant conditioning built in. However CAI was an improvement on the behaviourist approach in the sense that it allowed for self-paced instruction and the emphasis is taken from the teacher as instructor/ controller.

2.2.2 Cognitivism

As early as the 1920’s Edward Tolman began to find limitations in the behaviourist approach to understanding learning. But it was not until 1963 in their book, *Social Learning and Personality Development* that Bandura and Walters stated that an

individual could model behaviour by observing the behaviour of another person. Cognitive theorists recognize that much learning involves associations established through contiguity and repetition. Cognitivism is based on the thought process behind the behaviour. Changes in behaviour are observed, and used as indicators as to what is happening inside the learner's mind. The instructor remains the manager of the information process; but the learner is more active in planning and carrying out his/her learning than in the behaviourist environment. Piaget, Vygotsky and Bruner were all prominent cognitivists. Jean Piaget, a Swiss psychologist, observed human development as progressive stages of cognitive development. Flavell (1996) argues that Piaget was the most important figure the cognitive development field has known. His four stages, which commence at infancy and progress into adulthood, characterize the cognitive abilities necessary at each stage to construct meaning of one's environment. Lev Vygotsky is most famous for his 'zone of proximal development' (zpd) theory, which recognizes the differences of how the world is seen by children and by adults. Vygotsky labelled this difference in cognitive ability as the zone of proximal development. The job of educators was to identify this zone and to find out where the child was situated in this zone and build upon their specific level through a "scaffolding" process. This in turn has influenced much research on the assisted learning nature of technology. Jerome Bruner (Bruner, 1991) developed the 'discovery theory of learning' in the 1960's. Bruner's ideas are based on categorization. He maintains that people interpret the world in terms of its similarities and differences.

2.2.3 Constructivism

John Dewey wrote in *How We Think* (1910) "Only by wrestling with the conditions of the problem at hand, seeking and finding his own solution does one learn" (cited in Thanasoulas, 2001). Thanasoulos also reminds us that in the constructivist paradigm, the emphasis is on the learner rather than the teacher. Fundamentally, Constructivism is a cognitive learning theory because of the focus on the mental processes that construct meaning. Mayer (2003) contends that " a

rich and growing body of literature argues that learning is more meaningful when learners construct their own knowledge". Hoover (2003) talks about human learning being constructed, that learners build new knowledge upon the foundation of previous learning. This sharply contrasts with the passive transmission of knowledge in the behaviourist model, a view in which reception, not construction, is key. As a teaching practice it is associated with different degrees of non-directed learning. The term constructivsm is linked to Cognitivism and so Piaget, Vygotsky and Bruner are also considered constructivists. Over the past thirty years there has been a move away from the formal methodology of learning associated with behaviourism or instructivism to a learner-centred approach labelled constructivism. Drawing from the work of Piaget and Bruner, Merrill (1991) outlined a theoretical framework for constructivism:

- Knowledge is constructed from experience.
- Learning is a personal interpretation of the world.
- Learning is an active process of understanding, based on experiences.
- Learning is collaborative with meaning negotiated from multiple perspectives.
- Learning should occur (or be situated in) authentic settings.
- Testing should be integrated into the task, not as a separate activity.

Bruner's (1966,1973) perspective on constructivism suggested that:

- Instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness).
- Instruction must be structured so that it can easily be grasped by the student (spiral organization).
- Instruction should be designed to facilitate extrapolation (going beyond the information given).

The learner should be able to control the pace, direction, and content of learning. The degree of learner control is at the heart of constructivism. Reiber (1992) describes the constructivist approach as "involving the individual constructions of knowledge". According to the theory, learners are active participants in knowledge acquisition, and engage in restructuring, manipulating, reinventing, and experimenting.

Spiro, meanwhile, argues that the traditional role of the instructor has changed from “authoritarian provider of knowledge to a resource who at times is consulted by students and at other times can become a student whom others teach” (CTGV, 1993). The central claim of Cognitive Flexibility is that the learner must be encouraged to tackle the problem or situation more than once. By visiting the situation from a different context and conceptual perspective, the learner is able to build multiple knowledge representations of the case (Spiro et al, 1988).

The education system, as Seymour Papert (inventor of LOGO) saw it, was too structured and it stifled children’s natural curiosity. The means by which children were being taught relegated them to a role of passive recipients of the teaching, hence they were not motivated to construct any learning for themselves. According to Papert:

> “the goal is to teach in such a way as to produce the most learning for the least teaching. Of course, this cannot be achieved simply by reducing the quantity of teaching while leaving everything unchanged. The principle other necessary change parallels an African proverb: If a man is hungry you can give him a fish, but it is better to give him a line and teach him to catch fish himself “. (Papert, 1993, p.139)

Papert's desire to have children become motivated learners, critical thinkers, and problem-solvers is to be achieved through educational reform that provides the learner with the necessary tools to participate in and to take ownership of the learning process. According to Papert, the computer is the appropriate tool to achieve such desired educational reform. In his book *Growing Up Digital: The Rise of the Net Generation*, Don Tapscott, argues that we are now in a digital era of learning. According to Tapscott, a transformation in learning is taking place from what he labels "broadcast" learning to "interactive" learning.” “No longer are

today's generation of learners satisfied at being the passive recipients of the traditional teaching process, rather, they want to discover it for themselves by becoming interactive with the learning" (Forrester & Jantzie 1998). Strommen and Lincoln (1992) in putting forward a constructivist framework state that:

> "Our children have been raised in a world of instant access to knowledge, a world where vivid images embody and supplement information formerly presented solely through text. They are used to an environment where they control information flow and access, whether through a video game controller, remote control, mouse, or touch-tone phone".

However, on entering the classroom these children are presented with knowledge in a manner that is dramatically different to their previous experience.

2.3 Experiential Learning and Scaffolding

Kolb (cited in Hansen, 2000, p.2) defines learning as " a process whereby knowledge is created through the transformation of experience". He cited Lewin's (1951) work which states that learning takes place when a learner interacts with, or is stimulated by, an environment. According to Boud (cited in Hansen, 2000) experiential learning can be regarded as the earliest approach to learning, but its significance and potential have not been fully recognized until recently. In the formal education system it has been regarded as fundamentally inferior to subjects or disciplines. Hansen (2002) uses the example of technology teachers in Ontario, Canada, who must have a minimum of five year's work experience before qualifying for teacher education. These teachers have been socialized into a business and industry culture which preaches the virtues of experience over rote learning.

Carl Rogers (1969) was another strong exponent of experiential learning. He distinguished between two types of learning, cognitive and experiential. Cognitive learning refers to formal, academic knowledge, while experiential is applied knowledge such as learning about engines in order to repair a car. The main distinction is that experiential learning directly addresses the needs and wants of

the learner. Learning is improved when the subject matter is relevant to the personal interests of the student and self-initiated learning is the most lasting and pervasive. He argues that all humans "have a natural propensity to learn" and it is the role of the teacher to facilitate such learning. According to Rogers, learning is facilitated when:

- the student participates completely in the learning process and has control over its nature and direction
- it is primarily based upon direct confrontation with practical, social, personal or research problems
- self-evaluation is the principal method of assessing progress or success

John Bransford developed anchored learning or ‘scaffolding’ at the Cognition and Technology Group at Vanderbilt (CTVG) where the learner and instructor create a learning environment that encourages exploration. Scaffolding can be characterized as acting on Bruner’s motto of “Where before there was a spectator, let there be now a participant” (Bransford, Brown & Cocking, 1999). Murphy (1997) labels scaffolding an important concept for social constructivists which is a process of guiding the learner from what is presently known to what is to be known. According to Vygotsky (1978) students’ problem solving skills fall into three categories:

1. Skills which the student cannot perform
2. Skills which the student may be able to perform
3. Skills that the student can perform with help

Once the ’zone of proximal development’ has been identified, scaffolding can be used to bridge the gap in a learner’s knowledge. Scaffolding, therefore, allows students to perform tasks that would normally be slightly beyond their capabilities, with the guidance of the teacher. This is an important characteristic of constructivist learning.

2.4 Gardner's Multiple Intelligences

Howard Gardner identified seven intelligences in the Theory of Multiple Intelligences (Gardner 1983) and later in 1999 he added an eighth:

- Linguistic intelligence
- Logical-mathematical intelligence
- Spatial intelligence
- Musical intelligence
- Bodily-kinesthetic
- Interpersonal intelligence
- Intrapersonal intelligence
- Naturalist intelligence

In the same year he defined intelligence as "a biopsychological potential to process information that be activated in a cultural setting to solve problems or create products that are of value in a culture". Even though this is not a learning theory it is popular with educationalists. However, only the logical-mathematical and the linguistic intelligences can be measured scientifically. Gardner's idea of learning is certainly based on the constructivist model. He advocates distributed intelligence and uses the example of the Key School, an Indianapolis elementary school, where children carry out theme-related projects which nurture each of the intelligences.

> " Their project evaluations centre on the ways in which participation in a project has been cooperative: the help given by others in the presentation of the project, and the reactions of other individuals--peers as well as experts--to the final project". (Gardner 1990)

He also states that Intelligences must be assessed in ways that are "intelligence fair". For example, he tests logical, spatial, and bodily-kinaesthetic intelligences by getting children to take apart and then put back together items such as a doorknob.

In support of Gardner's view, Meier (2000) states that:

> "Accelerated learning is natural learning. It's based on the way people naturally learn. As children, we practiced it every day of our lives. We learned all the basics not through sitting in a classroom, reading a book, or staring at a computer screen, but through interacting with others and with the world using our whole bodies, our whole minds our whole selves". (Meier 2000)

The interactivity of these technology environments is a very important feature for learning. Interactivity makes it easy for students to revisit specific parts of the environments to explore them more fully, to test ideas, and to receive feedback.

The use of technology appeals to this view of intelligence in that Gardner's theory acknowledges that cognition is not a linear process. The computer as a learning tool has enormous potential in developing the different forms of intelligences of Gardner's theory. It is the first two intelligences that are of most interest to schools because they can be easily tested. The challenge for education is to design technologies for learning that draw both from knowledge about human cognition and from practical applications of how technology can facilitate complex tasks in the workplace (Bransford, Brown & Cocking, 1999).

2.5 Connectivism

According to Siemens (2004) behaviourism, cognitivism, and constructivism are the three broad learning theories most often utilized in the creation of instructional environments. These theories, however, were developed in a time when learning was not impacted through technology. Over the last twenty years, technology has reorganized how we live, how we communicate, and how we learn. Learning needs and theories that describe learning principles and processes should reflect underlying social environments. He discusses the shrinking "half-life of knowledge" and where once it was measured in decades, it is now measured in

months and years. Siemens reminds us that many of the processes handled by learning theories, especially in cognitive information processing, can now be off-loaded to, or supported by, technology. He puts forward a learning theory for the digital age, connectivism. The main principles are:

- Learning is a process of connecting specialized nodes or information zones
- Learning may reside in non-human appliances
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning
- Decision-making is itself a learning process (Siemens, 2004)

Connectivism presents a model of learning that acknowledges that our ability to learn what we need for tomorrow is more important than we know today. When knowledge is needed, but not known, the ability to plug into sources to meet the requirements becomes a vital skill.

2.6 The Role of ICT in Learning and Teaching

2.6.1 ICT in Learning and Teaching – The Positives

In general, the use of computers in education is seen as beneficial. Technology use is ultimately good. Students are comfortable about using technology and it raises questions for teachers about their teaching (Gibson 2001). It has been claimed that using technology effectively in classrooms has enabled teachers to be more successful and assists students in learning what they need to know to be effective citizens (Bialo & Sivin, 1990; Cotton,1991; Means & Olsen, 1993; Sheingold & Hadley, 1990 cited in Gibson, 2001). According to John (2002) in terms of generic learning, the research indicates that levels of collaboration and communication are enhanced by the use of computers as are knowledge building and thinking skills. Chung and Reigeluth (1992) suggest that networked

instruction “encourages exploration and maximises students’ preferred learning style". In the Apple Classrooms of Tomorrow (ACOT) research, Dwyer et al (1990) have found, in learning environments supported by technology, that teachers expect more from students; believe students understand more difficult concepts; can more effectively meet the needs of individual students; can be more student-centred in their teaching; feel more professional because they help people learn rather than dispense information. Again Dwyer (1996) suggests that ‘technology plays a catalytic role in opening the minds of teachers to new ideas about children, about learning and about their own role in the education process’. Finally, Dwyer considers the computer as a tutor in the knowledge instructivist setting, and as a tool in the constructivist setting (Dwyer 1996). Chou, McClintock et al (1993) discuss learning and teaching in the modern and the postmodern school. The printed textbook has been the keystone of the education system, but in the postmodern school technology is being introduced. This same technology, with its “emphasis on student inquiry will introduce the element of unpredictability into daily discourse and disturb any possibility of the routinization of the educational discourse”.

Strommen and Lincoln (1992) lament the fact that children’s experience of IT prior to school has not been matched in the education system and they propose a constructivist philosophy of a child-driven learning environment" (CDLE). For a generation of children weaned on technology “we have allowed our schools to remain in the past, while our children have been born in the future. The result is a mismatch of learner and educator. But it is not the children who are mismatched to the schools; the schools are mismatched to the children”.

Tapscott (cited in Forrester & Jantzie, 1998) outlines eight shifts in learning today:

- From linear to hypermedia.
- From instruction to construction and discovery.
- From teacher-centered to learner-centered education.
- From absorbing material to learning how to navigate and how to learn.
- From school to lifelong learning.

- From one-size-fits-all to customized learning.
- From learning as torture as learning as fun.
- From the teacher as transmitter to the teacher as facilitator.

Ghicas (2000) reminds us that education has, perhaps wisely, been reluctant to allow technology-led change to revolutionise traditional pedagogy, and educational computing has passed through some gentle revolutionary stages, which complement existing teaching and learning practice.

> "Our future is a digital one, in which all information is captured, manipulated, stored, transmitted, and received in digital form through a wide variety of compatible digital devices. The particular characteristics of the various devices will be far less important than the central fact of common digital format, because digitisation makes all information (data, sound, video, etc.) malleable, fluid, combinable, changeable. However, recognising those changes and taking advantage of them we can improve the quality and accessibility of learning at school in particular addressing knowledge and skills required by future citizens of the Information Society".
>
> (Passey and Samways, cited in Ghicas, 2000)

2.6.2 ICT in Learning and Teaching - A Note of Caution

All the literature thus far has confirmed the importance of ICT in teaching and learning with barely a word of dissent. However, Muir-Herzig (2003), while acknowledging that technology can facilitate the knowledge-constructed classroom, has some reservations. She warns against the action 'of teaching to the test' whereby schools and teachers limit instruction to drill and practice in order to meet the set standards on standardized tests. In her study of students at K-12 schools she found that they became better test takers but worse at higher order cognitive learning. In *Techno Promoter Dreams, Student Realities* by Peck et al (2002) where a year long study into technology use in two San Francisco Bay Area high schools was conducted, it was discovered that despite the

increasingly high access to technology in schools it had little effect on the classroom and the instructional experience of students. Cuban (1997) in *So Much High-Tech Money Invested, So Little Use: How Come?* states that regardless of the billions of dollars spent on ICT over the past twenty years the fact remains that less than two out every ten teachers are serious users of computers in their classrooms, three to four are occasional users and the rest – four to five never use ICT for instruction. He concludes that teachers' workload and an inherent unreliability of technology are the causes, but resolving these issues would be prohibitively expensive and time consuming. Another critic of over reliance on ICT in education is Oppenheimer (1997) in *The Computer Delusion*. Of the battle over the computer in education he warns :

> "it is about encouraging a fundamental shift in personal priorities -- a minimizing of the real, physical world in favor of an unreal "virtual" world. It is about teaching youngsters that exploring what's on a two-dimensional screen is more important than playing with real objects, or sitting down to an attentive conversation with a friend, a parent, or a teacher. By extension, it means downplaying the importance of conversation, of careful listening, and of expressing oneself in person with acuity and individuality".
>
> (Oppenheimer,1997)

According to Lillian McDermott in *How we teach and how students learn — A mismatch?* (1993) caution is urged with regards to computers. A computer task completed successfully does not ensure that a skill can be transferred to other environments. She concludes her article by saying that "the successful incorporation of contemporary topics or advanced technology into the introductory course is likely to depend as much on how the material is taught as on what is taught". Gregoire et al. (1996) sound a warning that technology of itself is not a panacea, and that without skilled application by the teacher its benefits may soon recede.

2.6.3 Computer Based Learning Versus Traditional Learning

Grégoire et al (cited in John, 2002) report that new technologies permit teachers to avail themselves of new information sources, facilitate collaboration among teachers and others, spur spontaneous interest among students more than traditional approaches, seem to lead teachers to develop lessons with more authentic tasks and collaboration among students, and, used appropriately, result in a shift in teacher role to guide or mentor who interacts with students more than in a traditional environment. However, the benefit to students of using new technologies is greatly dependent, at least for the moment, on the technological skill of and the teacher's attitude to ICT. This skill and attitude is, in turn, dependent on the training staff receive in this area. John (2002) also discusses the importance of pedagogical style and how the variations in style are influenced by the pervasive subject sub-culture that have become embedded within the department in which the teacher is located.

> "Just because computer technology can lead to improvements in learning does not mean that it will do so merely as a result of infusing technology into the classroom. Studies overwhelmingly suggest that computer-based technology is only one element in what must be a coordinated approach to improving curriculum, pedagogy, assessment, teacher development, and other aspects of school structure".(Roschelle et al. 2001,p.3)

Roschelle et al. (2001) found that learning increased with computer-based programmes that encouraged students to reason deeply about maths, whereas, programmes that attempted to make repetitive skill practice more entertaining seemed to decrease learning. Learning is most effective when four fundamental characteristics are present:

1. Active engagement
2. Participation in groups
3. Frequent interaction and feedback
4. Connections to real-world contexts

Students learn by actively ‘constructing’ knowledge through engagement with experience and interactions with peers and teachers. ‘Transmission’ learning, on the other hand, often fails to develop sufficient understanding to allow learning to be applied to real-world situations. In traditional classrooms, students typically have very little time to interact with materials, each other, or the teacher.

In contrast, research suggests that learning proceeds most rapidly when learners have frequent opportunities to apply the ideas they are learning, and when feedback on the success or failure of an idea comes almost immediately. Teacher upskilling in ICT is again highlighted as one of the prerequisites for enhanced learning and teaching through technology.

Kearsley and Shneiderman (1999) have put forward a similar framework for technology-based teaching and learning which has emerged from their experiences teaching in electronic and distance education environments. They call it the engagement theory and it emphasizes meaningful learning, collaboration among peers and experiential and self-directed learning facilitated through technology. Wang (2008) concurs that a sound generic model for guiding integration of ICT into teaching and learning should contain three elements – scaffolded pedagogy, social interaction to assist collaboration and easily accessible technology. Mandell et al. (cited in Wang, 2008) emphasise that the primary factor influencing effectiveness of learning is not the availability of technology, but the pedagogical and social design of same.

Cronjé (2006) argues that the traditional conflicting objectivist and constructivist approaches to learning are actually complementary. They are at right angles to one another rather than at opposite ends of a continuum (Vrasidas, cited in Cronjé, 2006, p.394). Alessi and Trollip go further with their assertion that the educational theories of behaviourism, cognitivism and constructivism are at the vertices of the same triangle, whereas most educators are somewhere in the middle. Yet Mayer (2001) argues that, regardless of the medium or method used, learning involves three processes:

- Selecting = objectivist learning
- Organising = constructivist learning

- Integrating = middle ground

On the subject of triangles, Ellington et al. (cited in Adams, 2003, p.6) refer to a triangle of technology used in education, namely hardware, software and underware, the latter being the pedagogy associated with computer-based learning (CBL). Adams (2003) mentions some of the advantages of using ICTs in education. They enable truly flexible learning in terms of time and location, they allow quick and easy sharing of ideas across the world and they can provide multimedia rich, interactive learning experiences. As more emphasis is put on the learner as a person, the computer becomes less of a focus and merely a tool used to help students achieve their desired learning outcomes. Mogey (cited in Adams, 2003, p.9) maintains that one of the advantages of a CBL package is that information can be presented to students in different ways and using a variety of pedagogical approaches, thereby catering to individual learning styles. Adams concludes her article by advising that technology needs to be used judiciously, and with pedagogical theories in mind, to give added value to the traditional delivery of content. Continuing the debate, Desai et al. (2005) compare and contrast distance education (DE) with traditional learning. For DE to be successful, high levels of interaction typically need to be present for learners to have a positive attitude and greater satisfaction. Four types of interaction are put forward: learner-content, learner-instructor, learner-learner and learner-technology. Social presence and transactional distance are strongly related and together influence the learner's control of the learning process. Technology has changed knowledge transmission to learning facilitation and classroom learning to learning packages with the possibility of face-to-face learning becoming a peripheral activity. Traditional learning provides synchronous communication. It is usually linear, structured by time and with a closed environment, and it tends to filter reality and foster sameness. Online learning is non-linear, independent of time and has an open environment. However, online instructors have to employ more individualized teaching methods, e-learning requires greater maturity and discipline (making its flexibility a double edged sword), and it demands that learners interact and collaborate which is not always the case in traditional

learning. Then there is the frustration encountered with technical problems and the difficulty in assessing learner achievement. E-learning needs to combine traditional learning materials with flexible technology-based course content.
Camstra (1986) discusses the shortcomings of CBT (computer-based training) in the form of three specific criticisms:

1. Teaching strategy is built in to the programme – not formulated explicitly
2. Content and teaching strategy are inextricably intertwined
3. Individual differences between students are not accomodated

His solution to the problem is intelligent computer assisted instruction (ICAI). But every ICAI programme has to be designed from scratch with very little generalization, which takes between 100-200 hours per hour of student training.

Carnevale (2002) reports on a study at Michigan State University which found that students who took an economics course online did not fare as well as students in a traditional classroom. Students who took the traditional course on average answered 65.49 percent of the questions correctly, while the students who took the course online got 61.19 percent correct, on average. A third group of 258 students who took a hybrid course, mixing technology and face-to-face aspects, answered an average of 64.51 percent of the questions correctly. Ramage (2002) in The *"No Significant Difference" Phenomenon:*
A Literature Review examines some of Richard Clark's observations regarding the use of ICT in learning. Clark presents the idea that measurable learner outcomes, when replicable using different media, indicate that the selection of the media has little to do with learner outcomes, rather the method that the media share in delivering content is the true catalyst that leads to understanding. Further, Clark stated that, "there are no benefits to be gained from employing different media in instruction". A multitude of studies have been conducted that review effectiveness of online instruction when compared with the traditional classroom, focussing on measurable student outcomes. Ramage found no studies that exposed lower grades or test scores of online students compared to traditional

students. Phipps & Merisotis (cited in Ramage, 2002) stated that, "...much of the research is to ascertain how technology affects student learning and student satisfaction, many of the results seem to indicate that technology is not nearly as important as other factors, such as learning tasks, learner characteristics, student motivation, and the instructor". According to Laff (2007) in the Information Technology field, instructor-led training remains the preferred method for many applications. He says that it is ironic that while trainers in other fields are wrestling with the best way to offer active learning in the digital age, intensive classroom curricula are still widely available for IT professionals. Krezel, an instructional designer (cited in Laff, 2007), claims that classroom training is still needed, that simulations only take you so far. She proposes offering IT workers blended training consisting of classroom training followed by participants working on their own to build skills and learn techniques.

2.7 Multimedia

In her article *The Value of Multimedia in Learning* (2005) Patti Shank gives two definitions of multimedia. The first, by Richard Mayer defines multimedia as a presentation of content that relies on both text and graphics. Another, by Mao and Neo extends this by calling it the “combination of various digital media types, such as text, images, sound and vision”. Mayer explains that we process information through two basic channels, verbal and visual. Well-designed multimedia helps learners build more accurate mental models than text alone. Potential benefits include active participation, accelerated learning, retention and application of knowledge, problem solving and decision making skills, control over pacing and sequencing of information. On the other hand, Shank (2003) warns that although multimedia can provide opportunities for improved learning, it can also be ineffective, even detrimental, when implemented poorly. Ryan (1995) warns of the danger of unreal expectations and hype about this media. Again, Bransford et al (1999) remind us that the mere existence of technology in the classroom

provides no guarantee that student learning will improve. The real purpose of technology in education is education (Anderson, 1996).

Richard Mayer (1999) puts forward seven basic principles for effective multimedia, namely, multimedia, spatial contiguity, temporal contiguity, coherence, modality, redundancy and individual differences. Mayer uses the model of a CNA (Concise narrated animation) as an effective multimedia presentation. It should be multimedia which is integrated, concise, channelled and structured. He calls CNAs the building blocks of effective computer-based multimedia messages. Clark (cited in Carman, 2005) highlights the importance of three of Mayer's principles:

- Multimedia principle: adding graphics to text improves learning
- Contiguity Principle: placing text near graphics improves learning
- Modality Principle: explaining graphics with audio improves learning

Forrester & Jantzie (1998) warn multimedia designers that although current multimedia technology allows excellent presentation in both video and audio modes, there is a clear danger that multimedia programmes may be used to substitute for interaction with other learners. There is still a need for human interaction and emotional support and above all else, they should beware of the tendency to substitute passive learning for active learning.

2.8 Design Issues

Boetcher (1998) tells us that the basic framework of a learning situation includes learners and a teacher in essentially a problem-solving situation. Students need to learn information to solve the problem, and they accomplish this by interacting with each other, the teacher, and course materials. As instructors we face these situations by analysing our students, ourselves, our resources, the "problem" or learning task, and what knowledge the students will need to deal with it. We are

always answering the pedagogical question: "What do I want my students to know, do, and believe as a result of the instructional experiences in each unit?" Then we have to figure out our teaching strategies, the exact content, and the right assessment method to detect learning. Broderick's (2001) description of instructional design provides a concise and encompassing definition of the essence and practice of instructional design:

> "Instructional Design is the art and science of creating an instructional environment and materials that will bring the learner from the state of not being able to accomplish certain tasks to the state of being able to accomplish those tasks. Instructional Design is based on theoretical and practical research in the areas of cognition, educational psychology, and problem solving". Broderick (2001)

Benjamin Bloom's 1956 taxonomy of intellectual behaviours was an important addition to instructional design literature. As early as 1962 when Robert Gagné published "Military Training and Principles of Learning" he demonstrated a concern for the different levels of learning. Later, he produced nine instructional events that have since been used as a basis for the design of instruction and the selection of appropriate media.

Gagne's nine events of instruction

1. Gaining attention

2. Informing the learner of the objective

3. Stimulating recall of prerequisite learning

4. Presenting new material

5. Providing learning guidance

6. Eliciting performance

7. Providing feedback about correctness

8. Assessing performance

9. Enhancing retention and recall

But why use Instructional Design (ID)? Siemens (2002) in an article on e-learning gives a number of valid reasons for using ID. It is a quality process that offers greatest value to online students through effective presentation of content and fostering of interaction. “The resulting benefits – reduced design costs, consistent look and feel, transparency, quality control, standardization – make investment in ID a simple decision”.

Gagné and Dick (1983) describe instructional-design theories as “an attempt to relate specified events of instruction to learning processes and learning outcomes”. It is the combination of the learning theory working with the instructional theory that produces a viable and effective design model. Reeves (1992) believes there has been a paradigm shift from instructionism to constructivism and that this has, in turn, reflected a change in methodologies from breaking down the project into single step tasks to a more holistic approach. Boyle (1997) believes this is partially due to advancements in technology (e.g. hypertext) and educational design. Based on research of adult learners by Dobrovolny (2006) it was found that learning starts with and is sustained by metacognition, which was defined as self-assessment and self-correction. Therefore, instructional designers need to include questions or self-checks, practice exercises, and/or simulations (interactivity) in all instruction.

2.9 Design Models

McGriff (2001) uses the analogy of the learning theories as the foundation and the instructional-design theories as the house built upon it. A variety of models for instructional system design proliferated the late 1970's and early 1980's: Gagné and Briggs, Branson, Dick and Carey, and Atkins, to name a few. Almost all design models are based on the generic ADDIE model which stands for:

- Analysis
- Design

- Development
- Implementation,
- Evaluation

We will now look at three well known design models, Dick & Carey (DC), Morrison, Ross & Kemp (MRK) and Alessi & Trollip.

Dick and Carey's Ten Step Model:

1. Assessing needs to identify goals.
2. Conducting instructional analysis.
3. Analysing learners and contexts.
4. Writing performance objectives.
5. Developing assessment instruments.
6. Developing instructional strategy.
7. Developing and selecting instructional materials.
8. Designing and conducting formative evaluation of instruction.
9. Revising instruction.
10. Conducting summative evaluation.

Morrison, Ross & Kemp's Nine Step Model:

1. Identify instructional design problems…specify goals.
2. Examine learner characteristics.
3. Identify subject content / Analyse task components.
4. State instructional objectives for the learners.
5. Sequence content to sustain logical learning.
6. Design instructional strategies for each learner to master goals.
7. Plan instructional delivery.
8. Develop evaluation instruments.
9. Select resources to support learning activities.

Akbulut (2004) discusses the Dick & Carey (DC) and the Morrison, Ross and KEMP (MRK) models. The DC model is rigid and cumbersome for the real-life instructional design situations. It follows a more behaviourist approach. On the other hand, the MRK model is a curvilinear ID model which communicates more interaction between the components of the model. Thus, the MRK model corresponds with a more flexible ID process. An interesting point with real-life application in the MRK model is that the model claims that not all nine elements are required for the instructional design process, whereas, the DC model claims that each component is critical and none should be skipped.

Alessi & Trollip's Model:

1. Determine needs and goals
2. Collect resources
3. Learn the content
4. Generate ideas
5. Design instruction
6. Flowchart the lesson
7. Storyboard displays on paper
8. Program the lesson
9. Produce supporting materials
10. Evaluate and revise

Alessi & Trollip (2001) define instruction as the facilitation of learning via any means, be it traditional classroom lecture or the creation of a learning environment. Also, Alessi and Trollip (2001) believe that the correct geometric model is a triangle, with constructivists, behaviourists and cognitivists each at one corner, thus allowing some flexibility in design modeling to suit a given learning

situation. Their model has ten steps for the development of a single lesson. They stress the importance of sequencing events and on-going evaluation and revision.

2.10 Human Computer Interaction

This is the term given to a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use. This interaction is between the environment, the user, the software and the hardware (Sumiga, 1992). The Yale Manual of Style, Shneiderman's Eight Golden Rules of Interface Design in Skaalid (1999) and Emuus (European Multimedia Usability Services) all look at issues of usability in multimedia software. They propose a list of usability principles for the design of a multimedia system:

- Provide a simple design
- Strive for consistency
- Provide informative feedback
- Minimise memory load
- Provide closure
- Provide shortcuts for frequent users
- Provide easy reversal of actions
- Provide good support to handle errors

Norman (cited in Debevc and Bele, 2008) asserts that a formative educational application should:

- be interactive and provide feedback,
- have specific goals,
- motivate, communicating a continuous sense of challenge,
- provide suitable tools, and
- avoid distractions and factors of nuisance interrupting the learning stream.

2.11 Blended Learning

According to Maisie (cited in Carman, 2005) “ people are not single-method learners, we are, as a species, blended learners. ” Driscoll (2001) defines blended learning as follows:

1. To combine or mix modes of web-based technology (e.g., live virtual classroom, self-paced instruction, collaborative learning, streaming video, audio, and text) to accomplish an educational goal.
2. To combine various pedagogical approaches (e.g., constructivism, behaviorism, cognitivism) to produce an optimal learning outcome with or without instructional technology.
3. To combine any form of instructional technology (e.g., videotape, CD-ROM, web-based training, film) with face-to-face instructor-led training.
4. To mix or combine instructional technology with actual job tasks in order to create a harmonious effect of learning and working.

Blended instruction is most commonly defined as the mix of traditional on-site instruction with any innovative learning technologies (Thorne, cited in Yoon and Lim, 2008). Mason (2005) tells us that blended learning blends different delivery modes and, in particular, online and face-to-face teaching. According to Hofmann and Miner (2008) blended learning is “typically one topic offered in numerous ways, or a hodgepodge of different training offerings under the same topical umbrella”. They also give as a rationale for blended learning the assertion that people learn differently, learning outcomes are achieved differently, and one approach cannot possibly fit all needs. Blended learning allows organizations to gradually move learners from traditional classrooms to e-learning in small steps, making change easier to accept. Driscoll gives two examples from her work with IBM’s Mindspan customers. The first involves a company, that has invested in a set of CD-ROM courses to teach a new desktop application, uses online office hours to supplement the CD-ROMs. Learners who want to add the human touch

can get help from a real person who can answer questions, help learners devise strategies for learning in a self-paced mode, or simply provide moral support. The second example uses a mentor/ coach as a tool. A manufacturer training service engineers in a five-day, face-to-face class uses online coaching as a way to extend the classroom experience. They found learners needed someone to talk to after the class who could help them with problems they encountered in the field. Using a coach, graduates of the face-to-face programme were able to ask questions and those questions enabled the coach (classroom instructor) to improve the face-to-face classes. Zemke (cited in Carman, 2005) reminds us that "there is not, and probably never will be, one great unified General Theory of Adult Learning that will solve all our problems". Carman proposes a construct based on appropriate blend of learning theories, such as those put forward by Keller, Gagné, Merrill, Clark and Gery.

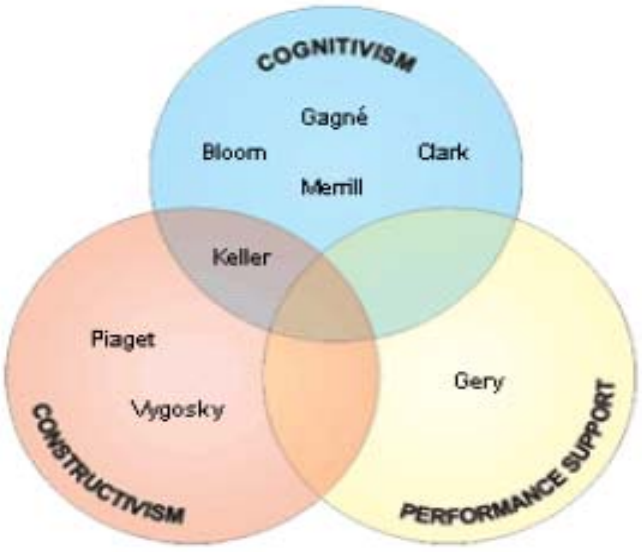


Figure 1: A Blend of Learning Theories

Five key ingredients emerge as important elements of a blended learning process:

1. **Live Events:** Synchronous, instructor-led learning events in which all learners participate at the same time. This is a main ingredient and can be driven by John Keller's ARCS Model of Motivation: Attention, Relevance, Confidence and Satisfaction.

2. **Online Content:** Learning experiences that the learner completes individually, at his own speed and on his own time, such as interactive, Internet-based or CD-ROM training.

3. **Collaboration:** Environments in which learners communicate with others, for example, e-mail, threaded discussions and online chat. Two types of collaboration produce effective results: peer-to-peer and peer-to-mentor.

4. **Assessment:** A measure of learners' knowledge. Pre-assessments can come before live or self-paced events, to determine prior knowledge, and post-assessments can occur following scheduled or online learning events, to measure learning transfer.

5. **Reference Materials:** On-the-job reference materials that enhance learning retention and transfer, including PDA downloads, and pdfs.

Dziuban et al. (cited in Cavus and Ibrahim, 2005) in a three year study at the University of Central Florida, report that blended courses have the potential to increase student outcomes while lowering attrition rates in comparison with equivalent fully online courses. Hodges (2004) introduces the notion of motivation as it relates to e-learning, both intrinsic and extrinsic, because as Dick and Carey (cited in Hodges, 2004) state " many instructors consider the motivation level of learners the most important factor in successful instruction."

Hodges concludes that relevance and meaningful feedback are the most reported successful motivators in an e-learning experience.

2.12 ECDL Programme

2.12.1 Introduction

The European Computer Driving License (ECDL) was conceived by the Finnish Computer Society in 1994. It is an international accreditation, run by the ECDL Foundation in Ireland since 1997. Outside of Europe the programme is known as the International Computer Driving Licence (ICDL). Almost seven million people are participating in the programme today in over 146 countries worldwide (Leahy and Dolan, 2008).

The European Computer Driving License (ECDL) Syllabus covers the key concepts of computing, its practical applications and their use in the workplace and society. It comprises seven modules, 6 practical and 1 theoretical, each of which must be passed in order to obtain the ECDL certificate. The modules are:

- Module 1 – Basic Concepts of IT
- Module 2 – Using a Computer and managing files
- Module 3 – Word Processing
- Module 4 – Spreadsheets
- Module 5 – Databases
- Module 6 – Presentations
- Module 7 – Information and Communication

The ECDL is intended to establish a standard for everyone who uses a computer in either a professional or personal capacity. It is a certificate that verifies competence in computer use, making the holder readily mobile within the Irish and international job market. The Irish programme is administered by ICS SKILLS under the auspices the Irish Computer Society (ICS). With a pass mark of 75% on all modules, graduate skills are at a high level. The ECDL is based on a single

agreed European syllabus and a standardized examination so as to achieve a common standard. A European Computer Driving License always certifies the same standard of competence, irrespective of a person's nationality, residence, education, age or sex. It is flexible, in that modules can be tackled in any order and at any convenient time within a three year period. However, the vast majority that complete do so within one year.

2.12.2 The Traditional Approach

The ECDL was introduced into the author's school as part of the Transition Year Programme in the year 2000. From the academic year 2000/2001 up to and including 2005/2006 we used the traditional method of delivering this programme. Training took place in a networked computer room with one computer per student. Each student had Microsoft Office installed on their machine and worked through each programme in conjunction with the teacher. Before each module students were given a checklist of tasks that they should be able to carry out. The teacher demonstrated the various tasks by way of a data projector and after much practice and sample testing the student sat an official module test chosen by another approved trainer, rather than his own teacher. In addition, an ECDL course book was used as a resource by the teacher. The test was paper based and a floppy disk was used to save the completed work, which included formatting text, using formulae or creating reports, depending on the module being tested.

2.12.3 The E-Learning Approach

In the academic year 2006/07 it was decided to use an automated training and testing system. There are three recognized courseware providers approved by ICS Skills. We chose Electric Paper which are a subsidiary of ThirdForce. The whole ECDL course is installed on the server. Each student logs onto Autotrack to train at his own pace. There are many drill-and -practice type exercises to reinforce learning. If and when a student has completed the module and satisfactorily completed the sample exercises, he accesses Autotest to attempt an automatically generated test. This test is corrected automatically and instantaneously. In addition, each candidate is given a CD-ROM which contains all the materials on Autotrack so he can study in his own time at home. The courseware is interactive and based on the see, hear, do and check concept. In the words of ThirdForce's literature " it has been designed to stimulate motivation and raise completion and pass rates….. incorporating pre- and post- learning evaluations along with an optional tracking facility".

2.12.4 Evaluation of the ECDL Programme

Wong et al. (2007) document an attempt by the University of Southampton to deliver the ECDL to 500 of their staff over an eighteen month period by way of a demand-led, self-directed learning and testing total solution. Flexible learning methods were allied to a flexible accreditation scheme, with face-to-face sessions planned only for student induction and invigilated tests. Practice tests that were similar in content and presentation to real tests were provided to assist in examination preparation. These indicated readiness for tests, in terms of both skills and confidence. Students had access to a dedicated web-based learning portal and testing portal. A tutor-led pre ECDL course was provided for learners who lacked confidence in ICT skills. There was a 'phone around' or a regular call to each student by central support to affirm an individual's progress and boost morale. The strengths of the programme were:

- enthusiasm to learn (with courseware)
- desire for affirmation (with practice tests)
- motivation for testing (with real tests)
- desire for reward (through accreditation)

By the end of the project, three thousand three hundred and fifty four practice tests had been run, averaging about ten tests per learner. There were only 807 tests successfully passed, with a further 189 failed, out of an intended figure of 500 * 7 = 3500 possible tests. The total solution was elusive mainly attributed to technical problems with testware and systems failures, which in turn affected student confidence and motivation.

Using two learning management systems (LMS), eCampus and Moodle, Debevc and Bele (2008) carried out testing into the usability of the ECDL course content among unemployed adults in Slovenia in 2006. A blended method of instruction was utilised which included tutor-led training in a computer room and e-learning via eCampus or Moodle. eCampus enables the use of web-based pedagogical tools as scaffolds for self-regulated learning (SRL), such as collaborative and communication tools, content creation and delivery tools, administrative tools and assessment tools. Key SRL processes are implemented, such as goal setting, self-monitoring, self-evaluating, task strategies, help seeking and time management, that affect students' achievements and motivational beliefs. The learning portal is individually adjusted to the user, making personalisation possible. Learning with the help of eCampus is an active process where the strategy of "learning by doing" leads the student to cognitively approach and work through the e-learning content and to create links between experiences and both new and existing knowledge. The learning content is interactive, multimedia-based, and adjusted to the different learning styles of students. Their activity is further stimulated by simultaneous on-line questions, where the student receives feedback on his or her understanding of the subject and may be given tips for further learning. eCampus enables an interactive on-line evaluation of knowledge

before, during, and after the learning process. Taking SUMI (Software Usability Measurement Inventory) usability testing into account, we can conclude that eCampus is more successful than the Moodle-system, particularly with respect to the categories of "efficiency" and "affect". This might indicate that the e-learning content in eCampus was better-designed than the content in the Moodle-system.

Calzarossa et al. (2004) assessed the impact of the ECDL programme in fifty Italian universities. The wide diversity of educational systems employed in Italian Universities prevented the transfer of practices from one environment to another. Three methods of delivery were used, classroom teaching with tutor and students, self-learning and a blended learning (combining classroom and self- learning). Each university typically adopted more than one method. The analysis showed that 32 universities adopted some form of blended learning, whereas classroom teaching and self-learning have been chosen by 26 and 28 universities, respectively. The analysis has also shown that 11 out of 20 universities that chose only one teaching method relied on blended learning. Another interesting result deals with the presence of tutors to support the teaching activities. 50% of the universities employed tutors as an aid for students during the whole ECDL learning process. This is particularly important because of the increasing presence of self-learning either used in isolation or in combination with classroom teaching. Haynes et al. (2004) found that when the academic staff at a new university were offered the ECDL to improve their IT skills, the majority chose an online programme, but, they also needed tutor support and encouragement.
There is very little documented research on the quality of the ECDL programme. A thorough search of the University of Limerick’s online library database and Google Scholar failed to find any additional independent research.

Chapter 3 Methodology

3.1 Introduction

In this chapter I will revisit the problem, discuss how it was investigated and say why a particular research methodology was chosen. The chapter begins with a statement of the research question and the research setting. An historical background to action research is given as well as a definition and a justification for its use. The action research process is explained and some limitations discussed. Ethical issues and research are then discussed after which we look at the research tools used in this study. The importance of reliability, validity and triangulation are explored as well as the criteria that were used in this study. Finally, there is a timeline given for the completion of the study.

3.2 Statement of Problem: Research Question

The purpose of this study is to find best practice for delivering a computer based training programme to a transition year group, and, in so doing, explore ways of improving learning and teaching competencies.

My hypothesis is that learning competencies were greater with the old system of training for ECDL, as opposed to the new Autotrack system. In the old system the teacher demonstrated how to carry out the various tasks. He was a facilitator, guide and collaborator and the computer was a tool in the constructivist setting. The students had to physically carry out the tasks and the modular tests required that tasks were followed through from start to finish. Even though marks are generally comparable between the two systems, old and new, the actual level of competence has been questioned. From the author's observations, as an experienced ECDL tutor and tester, having taught in excess of four hundred and

fifty students over the past eight years , it appeared that students from the '**old**' system had a greater competence in the use of MS Office applications than students of the '**new**' system.

3.3 The Research Setting

The research for this study was carried out with a group of twenty four transition year students at an all boys secondary school during the academic year 2008-2009. The students were undertaking the ECDL which is compulsory for those following the Transition Year programme at the school. The group were timetabled for five forty minute periods per week, two double periods and one single. All the classes took place in the school computer room where each student had access to their own computer, the Autotrack and Autotest programmes, Microsoft Office and a set of headphones. There are seven modules in the ECDL course, but, we have used only three for the purposes of this study, namely, MS Word, MS Excel and MS Access. This is a limitation of the study but these three modules are most representative of the ECDL in terms of understanding and effort required. For example, once the menus on MS Word are mastered the menus on MS Excel and MS Access are almost identical.

The study is based on a comparative analysis between two groups of twelve students from within the same transition year group. Both groups [A and B] followed the ECDL programme using Autotrack, but, there was a taught segment using the '**old**' system within each module which was tested the '**old**' way.
These two groups make up comparable data sets. The class was divided into two groups of equal ability. We used the results of the Junior Certificate examinations as a comparator. The class completed their Junior Certificate examinations in June 2008. The class was also given a Wide-Span reading test (1972 Edition) to

produce a raw reading age to further classify the students. This took account of the fact that some students may have had problems understanding the questions.

Group B did their training and testing on Word using Autotrack and Autotest [the '**new**' system] at their own pace. Meanwhile, Group A started the same module using the '**old**' system. They studied a section of the module and were tested accordingly. They then proceeded with the **'new'** system, completed the module and were tested using the **'new'** system. An analysis of results was then undertaken to compare scores. This process was applied to the three modules mentioned. For the Excel module Group A used only the '**new**' system while Group B used both '**old**' and **'new'**. Group A again used only the '**new**' system for the Access module and Group B used both '**old**' and **'new'**. My role within the class was both as an instructor and action researcher.

To validate findings there was a focus group of approximately seven students chosen who met after result analysis had taken place. This focus group met on completion of each of the three modules. These were reflective sessions. They discussed matters arising and problems encountered and compared the '**old**' system with the '**new**'.

To provide further validation, the findings were triangulated by an independent observer- a critical friend. This observer is a colleague who is also an experienced ECDL tutor and tester.

3.4 Action Research

3.4.1 An Historical Background

According to Masters (1995) and McNiff (2008) action research originated with Kurt Lewin in the USA in the 1930's . His (1946) paper on '*Action research and minority issues*' became a classic. He described action research as proceeding in a spiral of steps, each of which is made up of planning, action and the evaluation of the result of action. Action research was quickly taken up as a methodology for social change, especially in education. Corey's (1953) work *Action Research to Improve School Practices* signalled its establishment within the social sciences. McKernan (1991) cited in Hansen & Borden (2006) reported that action research was employed as a "general strategy" to address multifaceted social problems in the school systems. However the use of scientific designs employing quantitative methodologies in laboratory settings was still advocated as a more effective approach. But, by the 1970's the pendulum had swung back in favour of action research as an effective way to bridge the gap between theory and practice. It first came to prominence in the UK in that decade. The teacher-researcher movement was inspired by the work of Stenhouse (1975) and the Humanities Curriculum Project. Two centres of action research developed, the Centre for Action Research in Education (CARE) at East Anglia, while at the University of Bath Jack Whitehead developed a different form of action research that placed the individual practitioner at the centre of their own enquiry.

3.4.2 Defining Action Research

According to Cohen et al. (2007) action research can be used in almost any setting where a problem involving people, tasks and procedures cries out for solution, or where some change of feature results in a more desirable outcome. In terms of solving problems in the world of education, there is one form of research that is pre-eminently suited to solving those problems where there "is some discrepancy between an educational practice and the expectations in terms of which the practice was undertaken" (Carr & Kemmis, 1986). This form of research is action-research. Action-research is a form of problem solving based on increasing knowledge through observation and reflection, then following this with a deliberate intervention intended to improve practice. Educational action-research can be said to be "any inquiry teachers undertake to understand and improve their own practice" (McCutcheon & Jung 1990 pg. 144). Action research is designed to bridge the gap between research and practice (Somekh,1995 cited in Cohen et al. ibid.,pg. 298). Also cited in Cohen et al. (ibid.) Kemmis and McTaggart(1992) remind us that action research is research by particular people on their own work, to help them improve what they do, including how they work with and for others.

A definition of educational action-research was formulated by The Australian National Invitational Conference on Action-Research held at Deakin University in 1981.

> "Educational action-research is a term used to describe a family of activities in curriculum development, professional development, school improvement programmes, and systems planning and policy development. These activities have in common the identification of strategies of planned action which are implemented, and then systematically submitted to observation, reflection and change. Participants in the action being considered are intricately involved with all of these activities." (ERDC 1981)

The idea of self reflection is central. McNiff (2002) states that Action research is an enquiry conducted by the self into the self and is a form of self evaluation.
Because action research is done by the practitioner, it is often referred to as practitioner based research; and because it involves one thinking about and reflecting on one's work, it can also be called a form of self-reflective practice.
When you produce a research report, it shows how you have carried out a systematic investigation into your own behaviour, and the reasons for that behaviour. The report shows the process you have gone through in order to achieve a better understanding of yourself, so that you can continue developing yourself and your work. It begins with an idea that you develop. The research process is the developmental process of following through the idea, seeing how it develops, and continually checking whether it is in line with what you wish to happen.

> "The aim is to encourage you, a practitioner, to ask critical questions about your own practice, and find the answers for yourself. No one else can give you answers. Other people can comment and advise, but only you can say what is right for you and your situation". McNiff (2002)

There are four basic themes within all the definitions of action research:

- Empowerment of participants
- Collaboration through participation
- Acquisition of knowledge
- Social change

3.4.3 The Action Research process

Lewin (1946; 1948) cited in Cohen et al. (2007) codified the action research process into four main stages:

- Planning
- Acting
- Observing
- Reflecting

McKernan(1991) cited in Cohen et al. (2007) suggests that Lewin's model is a series of spirals, each of which incorporates a cycle of analysis, reconnaissance, intervention, implementation of the plan and evaluation of the effectiveness of the intervention.

Whitehead (1989, 2007) talks about action research as starting from the simple question of 'How do I improve my practice?'. He speaks in terms of creating your living educational theory and in doing so, he poses the following questions:

1. What do I want to improve?

2. Why do I feel that something could be improved in what I am doing? (This is concerned with what really matters to me in terms of the values that give meaning and purpose in my life. These are the explanatory principles that explain why I do what I do.)

3. What could I do that might improve what I am doing? (Imagining possibilities and choosing one of them to act on in an action plan)

4. As I am acting, what data will I collect to enable me to judge my educational influence in my professional context as I answer my question?

5. As I evaluate the educational influences of my actions in my own learning and the learning of others who might be willing to help me to strengthen the validity of my explanation of my learning about my influence.

The basic action principle underpinning action research involves identifying a problematic issue, imagining a possible solution, trying it out, evaluating it (did it work?), and changing practice in the light of the evaluation. The question 'How do I improve my work?' contains a social intent. The intention is that one person improves their work for their own benefit and the benefit of others. New knowledge can most effectively be generated through dialogue with others who are equally interested in the process of learning. The dialogue is always a dialogue of equals. No one tells another what to do in action enquiries; we all share and value one another's learning. McNiff (2002) outlines the basic steps of an action research process which constitute an action plan:

- We review our current practice.
- Identify an aspect that we want to investigate
- Imagine a way forward
- Try it out, and take stock of what happens
- We modify what we are doing in the light of what we have found and continue working in this new way (try another option if the new way of working is not right)
- Monitor what we do
- Review and evaluate the modified action

McNiff (2008) argues that the set of questions enables action researchers to offer their explanations for their practice, in the form of their living educational theories, and to articulate the originality, significance and rigour of their action research.

3.4.4 Justifying Action Research

One of the reasons given by McNiff (2008) for the popularity of action research is its common-sense approach to real-life dilemmas. And, she reminds us that this methodology is highly rigorous. Avison et al.(1999) recommend action research because " this particular qualitative research method is unique in the way that it associates research and practice, so research informs practice and practice informs research synergistically". It is also pointed out by Avison et al. that, unlike case study research, the emphasis in action research is more on what practitionres do than what they say they do. Cohen et al. (2007) talks about action research as a significant vehicle for empowering teachers. It is a flexible, situationally responsive methodology that offers rigour, authenticity and voice. As a research device it combines six notions:

- A straightforward cycle of identifying a problem, planning an intervention, implementing the intervention, evaluating the outcome.
- Reflective practice
- Political emancipation
- Critical theory
- Professional development
- Participatory practitioner research

3.4.5 Limitations of Action Research

A limitation highlighted by both Baskerville (1999) and McNiff (2008) is the lack of generally agreed criteria for evaluating the quality of action research among the community of practioner researchers. McNiff has further concerns about the need for academic staffs to demonstrate the validity of their work as educators [therein lies their credentials as legitimators], the need to engage critically with their own thinking and how this can lead to institutional, social and economic sustainability. Potential barriers to implementing effective action research, such as role ambiguity, role conflict and political barriers are highlighted by Hansen & Borden (2006). Radford (2007) argues that complexity theory draws attention to the fact that there are too many variables within classrooms or school systems to allow for the identification of generalized 'best practice' strategies. This means that educational events are much less predictable and far less under the control of particular elements of action research. John Elliott (2004) cited in Radford (ibid.) talks about the schism between the 'standards driven' and the 'pedagogical driven' models of action research; the latter one viewing teaching in terms of 'artristry' and acknowledging the complexity of pedagogical practice that tries to accommodate the diverse needs of learners in specific classroom situations.

3.5 Ethics

One has to consider how the research purposes, contents, methods, reporting and outcomes abide by ethical principles and practices. The researcher has responsibilities to the research community not to jeopardize the reputation of the research community nor to undermine opportunities for further research. Their research subjects are also their responsibility. Regarding school-based research projects Cohen et al. (ibid.) p.77 summarises the responsibilities of a researcher

as gleaned from the literature on the subject. Here are some of the most pertinent principles:

- Research must be conducted rigorously and correctly
- Do not jeopardize future research(ers)
- Maintain the integrity and autonomy of research
- Gain fully informed consent where appropriate (students, parents, principal)
- Decide whether overt or covert research is required
- Ensure beneficence
- Ensure anonymity/ confidentiality/non-traceability

For this study, permission was initially sought from the school Principal to carry out my research. The Principal has been very supportive of the ECDL programme in the school since its introduction in 2000. The ECDL programme is a major selling point for the Transition Year Programme and he encourages any initiative that might improve its delivery. Permission was granted.

The students and their parents/ guardians were then consulted. This consultation consisted of a discussion with the students themselves, explaining the purpose of the research and their role in it. Assurances were given regarding confidentiality and a student's right to withdraw from the process if he so wished was assured. A cover letter was sent to each parent/ guardian as well as a consent form which was signed by all parties involved (See Appendix A and B).

3.6 Action Research Tools

Both Cohen et al. (ibid.), Robson (2002), Sarantakos (2005) and O'Brien (1998) list a variety of research instruments that can be used in action research: assessments, questionnaires, diaries, interviews, research journal, data collection and analysis, focus group discussions, structured and unstructured interviews and observational data.

3.6.1 Assessments

"A criterion-referenced test requires the student to fulfill a set of criteria, a predefined and absolute standard or outcome." (Cunningham, 1998) Such a test provides the researcher with information about exactly what a student has learned, what he or she can do. The ECDL modular tests are criterion referenced tests. Their intention is to indicate whether students have achieved a given set of criteria in Microsoft Word, Excel, Access etc. The NCCA website talks in terms of "formative, diagnostic and summative assessments being part and parcel of the Irish education system at post-primary level." In my study I have two types of test. There is the official ECDL summative test which is given at the end of a module and is designed to measure achievement or mastery of a software application. There is also the test which is generated by the tutor during the Word, Excel and Access modules and which is formative in the sense that it monitors a student's progress, and diagnostic in that it tries to expose specific areas of difficulty and strength. Concerns over the validity and reliability of this test are assured because the material is taken from the official ECDL bank of tests.

3.6.2 Observation

Robson (p. 310, 2002) claims that what people do may differ from what they say they do, and observation provides a reality check in this regard. As a technique, it is a direct means of getting at 'real life' in the real world. Direct observation in the field permits a lack of artificiality which is rare with other techniques. Cohen et al. (ibid.) note that the distinctive feature of observation is that it offers an investigator the opportunity to gather 'live' data from naturally occurring situations. This can yield more valid or authentic data. Patton (1990) cited in Cohen et al. (ibid.) suggests that observational data should enable the researcher to enter and understand the situation that is being described.

There are two principal types of observation – participant observation and non-participant observation. According to Robson (p.314, ibid.) "a key feature of participant observation is that the observer seeks to become some kind of member of the observed group." It is essentially qualitative in nature. My colleague and fellow ECDL tutor took on the role of participant observer during the focus group discussions. The fact that he is an observer was made clear to the students from the start. While the pure observer typically uses an observation instrument of some kind, the participant observer is the instrument. Concern has been expressed (Gittelson et al. (1997) cited in Robson (ibid.) about the extent to which an observer affects the situation under observation. But, because our students are so accustomed to the presence of myself and my colleague, and, due to the independent learning involved with the software being used, they carry on as if we were not there. In this study observation is being used to complement or validate data obtained by other means (Sarantakos, 2005).

3.6.3 Questionnaires

Wilson and McLean (1994) cited in Cohen et al. (ibid.) suggest that a questionnaire is a widely used and useful instrument for collecting survey information, providing structured data that is comparatively straightforward to analyse. Czaja and Blair (1996) cited in Robson (ibid.) suggest that questionnaires should be designed to help achieve the goals of the research or to answer the research questions. Robson (ibid.) adapts a checklist from various sources to help avoid problems in question wording. These include:

- Keep the language simple
- Keep the questions short
- Avoid leading questions
- Remove ambiguity
- Use personal wording if you want the respondents' own feelings

I gave an initial questionnaire at the beginning of the process to gauge student attitudes to and previous experience of the ECDL programme. I then conducted a post-ECDL questionnaire whose primary objective was to obtain students' views on the way in which each of the three ECDL modules was taught and on ways to improve both teaching and learning. I piloted a draft questionnaire with a small number of students from another transition year class also studying the ECDL, and then amended some of the questions before conducting it formally. For the questionnaire at the end of the research cycle I used a semi-structured one with a combination of both open and closed questions because of my small sample size. I used the summated or Likert scale to formulate questions of the *strongly agree…agree…undecided* category due to the greater subtlety of response which is inbuilt. I was anxious to elicit suggestions from the students and to capture recommendations and I felt that the semi-structured one was most appropriate in this regard. Cohen et al. (ibid, p.321) says of the semi-structured questionnaire that "there is a clear structure, sequence and focus, but the format

is open-ended, enabling respondents to reply in their own terms". I also created a questionnaire for my critical friend at the end of the process to confirm his observations.

3.6.4 Focus Group Discussions

Focus groups are, in general, defined as group discussions organized to explore a set of specific issues or to confirm a hypothesis (Greenbaum, 1993; Krueger,1994; Stewart & Shamdasani, 1990) cited in chiu (2003). Robson (2002) refers to it as a group interview on a specific topic, which is where the 'focus' comes from. Johnson (1996) cited in Robson (ibid.) argues that focus group discussions have considerable potential to raise consciousness and empower participants.

In both conventional research and participation action research (PAR) focus groups are tools for generating knowledge that informs practice.

The goal of participation action research is not only to understand the predicaments of the participants but also to bring about change by actively involving them in the formulation of solutions to address the problems identified. However, before participants can suggest how things can be improved they need to become critically aware of the problems they face. The researcher who conducts focus groups with such a purpose in mind should be sensitive to opportunities for raising awareness. Rather than merely gleaning information from participants, the researcher will create dialogue to induce critical thinking among participants as they recall their experiences. From this perspective, facilitating experiential knowing can be seen as a pre-condition for facilitating critical awareness.

In my study we had a focus group discussion after the completion of each of the three modules, namely, MSWord, MSExcel and MSAccess. We then had a general focus group discussion to see whether attitudes to the ECDL had changed over the course of the study. There was an average of seven students, myself and my colleague at the modular discussions, while my colleague was unable to attend the last or general discussion.

3.6.5 Critical Friend

Costa and Kallick (1993) cited in Swaffield (2002) have described a 'critical friend' as :

> "…a trusted person who asks provocative questions, provides data to be examined through another lens, and offers critiques of a person's work as a friend. A critical friend takes the time to fully understand the context of the work presented and the outcomes that the person or group is working toward. The friend is an advocate for the success of that work". (p50)

Again, McNiff (2002, p.24) defines a critical friend as "someone whose opinion you value and who is able to critique your work and help you see it in a new light". For this study I asked my fellow ECDL tutor and teaching colleague who has over twenty years teaching experience and is a qualified and practicing ECDL tutor since the year 2000. He has experience of the both '**old**' and **'new'** systems. His role was to act as participant observer at each of the three focus group discussions that took place after Modules one, two and three. In addition, I conducted a questionnaire with my critical friend at the end of the process.

3.7 Reliability, Validity and Triangulation

Reliability of data is concerned with such matters as consistency, precision, repeatability. Reliability of data can be affected by such things as the opportunities available to the researcher to introduce bias into the data collection process and the level of standardization brought into data collection.
Joppe (2000) cited in Golafshani (2003) defines reliability as:

> "The extent to which results are consistent over time and 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".

Embodied in this definition is the idea of replicability or repeatability of results or observations.
Validity refers to the extent to which the data one collects gives a true measurement of "social reality"; what is really happening in society.
Joppe (2000) cited in Golafshani (ibid.) provides the following explanation for validity

> "Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull's eye" of your research object?"

But Golafshani argues that these definitions pertain to quantitative research only and that in the qualitative research paradigm some of these concepts are inadequate. Golafshani concludes that reliability and validity are conceptualized as trustworthiness, rigour and quality in the qualitative paradigm. Lincoln and Guba (cited in Zhang, 2006) propose credibility, transferability, dependability and confirmability as the natural equivalent to internal validity, external validity, reliability and objectivity. The whole point of looking at validity is to create a strong argument, not to provide absolute proof (Francisco et al. 2001). The way to

achieve validity and reliability from the qualitative researchers' perspectives is by using triangulation (Denzin, 1978).

Triangulation is broadly defined by Denzin in Jick (1979) as "the combination of methodologies in the study of the same phenomenon." Firestone (1987) makes the point that qualitative and quantitative methods present the reader with different kinds of information that, when triangulated, help to gain greater confidence in one's conclusions. It is largely a vehicle for cross validation when two or more distinct methods are found to be congruent and yield comparable data. For example, the effectiveness of our ECDL training and testing package can be judged using assessment scores, student questionnaires, observation and focus group discussions. Webb (1966, p.3) cited in Bryman (1984) suggested that:

> " once a proposition has been confirmed by two or more independent measurement processes, the uncertainty of its interpretation is greatly reduced. The most persuasive evidence comes through a triangulation of measurement processes."

Jick (1979) concludes that triangulation has vital strengths and encourages productive research. It heightens qualitative methods to their deserved prominence while, simultaneously, demonstrating that quantitative methods can and should be used in complementary fashion. For example, a study in the United Kingdom by Hughes et al. (1997) of the consumption of "designer drinks" by young people employed both structured interviews and focus groups. The two sets of data were mutually confirming in that they showed a clear pattern of age differences in attitudes towards these types of alcoholic drinks.

3.8 Criteria

"Criteria are the standards we use to make judgements" (McNiff, 2002). In action research, criteria are set in terms of the values that inform practice. One's values become one's criteria.

There are five 'families' of criteria, known as the Development Assistance Committee (DAC) criteria that are commonly applied to evaluations. They are relevance, efficiency, effectiveness, impact and sustainability. (EU, OECD, 2008). These criteria are adopted by the European Union and the OECD as principles for delivering effective aid. The DAC Evaluation Quality Standards identify the key pillars needed for a quality evaluation process and product.

Some of the evaluation principles include impartiality, independence, credibility and usefulness.

For the purposes of this study I chose to use only one of the above criteria as defined in the DAC list of criteria, namely effectiveness.

> "Effectiveness is about the extent to which the intervention's objectives were achieved, or are expected to be achieved, taking into account their relative importance". (OECD,2008)

I chose the effectiveness criterion only because I wished to explore the effectiveness of the **'new'** training and testing system as compared to the **'old'** system and also because of the size of my study which involved only twenty four subjects. This study examined the effectiveness of the learning process and its outcomes. In my case, this consisted of automatically generated modular tests over three modules, the 'blended' approach to the teaching and learning of the same three modules and the evaluation of this approach through mini assessments of each module.

3.9 Timeline

Development of Proposal [October-November]

I have had concerns about the effectiveness of the automated training and testing programme that was introduced into the school three years ago. I discussed these concerns with my fellow ECDL tutor and teaching colleague. It was decided that this might be an area that could be explored and maybe improved upon. I then started a review of available literature and came up with a research question in consultation with my tutor.

Step 2 [November-December]

I started the process by conducting a reading test with my class of twenty four students, the Wide-Span reading test, to get a raw reading age for each one. Next I analysed the Junior Certificate Examinations results of the group from September 2008. The results determined the composition of the two groups which were the subject of this study. The students were divided into two groups, A and B, of approximate equal ability. I gave a short, simple questionnaire to gauge student attitudes to and previous experience of the ECDL programme (See Appendix C).

The students were now ready to begin Module 3 and the process of action research began. Group B began the module using the Autotrack system, working at their own time and pace. Group A was given tuition the traditional way, using the teacher as instructor, Microsoft Word and a data projector. Only a section of the module material was covered and they were tested on this after two weeks of tuition (See Appendix D). This group then proceeded to study the module using Autotrack just as the first group had done. The first assessments, automated and

manual, took place in December. Due to timetabling difficulties the first focus group discussion (See Appendix J) did not take place until January. My critical friend attended the focus group discussions as an observer.

Step 3 [January-March]

The students were now accustomed to the training and they proceeded with module 4, Excel, in the same fashion. However, this time Group A started with Autotrack and proceeded onto Autotest. Group B started with tuition on a section of Excel and completed a test on this material (See Appendix E) after which they started on Autotrack. There was a time issue as some of the students took longer than others to complete a module or failed a test and had to repeat. The results of assessments, the feedback from focus groups (See Appendix K) and my critical friend were gathered and assimilated. The feedback gathered at the focus group discussions was written in point form on a whiteboard and the students validated this before it was transcribed.

Step 4 [April-May]

At this stage, both Group A and Group B had experienced the '**old**' system and the **'new'** system of tuition. Because of time restrictions only one group could progress to Module 5, Access using the '**old**' system. The school timetable dictated that Group B started on the traditional method (See Appendix F) before proceeding to the Auto system with Group A using the Autotrack and Autotest system. The data from the different sources was reviewed and analysed. Feedback from students (See Appendix L) and my critical friend was again gathered. I conducted an extra focus group discussion with a small number of students to discern their general attitudes to the ECDL course (See Appendix M). During the last week of the academic year I conducted a post ECDL questionnaire with all twenty four students in the class (See Appendix N).The purpose of this questionnaire was to confirm previous findings and to look for new perspectives and suggestions about how best to improve the delivery of the ECDL course.

The final action research tool used in this study was a questionnaire for my critical friend in order to bring together his observations and take note of his recommendations on how to improve the delivery of the ECDL course (See Appendix O).

There are screenshots of the Autotrack and Microsoft applications in appendices G to I.

Chapter 4: Research Findings

4.1 Introduction

In this chapter the findings of the research which I have undertaken will be presented. The findings are divided into seven sections each corresponding to a phase in the research process. The first section deals with the base-line or starting point for the students involved in this action research project and is based on a questionnaire. The second section is concerned with training and testing. Sections three and four deal with focus group discussions. Section five deals with a post-ECDL questionnaire. Section six discusses the observations and questionnaire responses of a critical friend while the last section is a summary of the key findings from the different data collection methods. There will be a brief summary of findings at the end of sections two to five inclusive.

4.2 Background and Base-Line

The ECDL programme is compulsory for all Transition Year students. The pass mark for each Autotest is seventy five percent. There are thirty six questions to answer on each test.

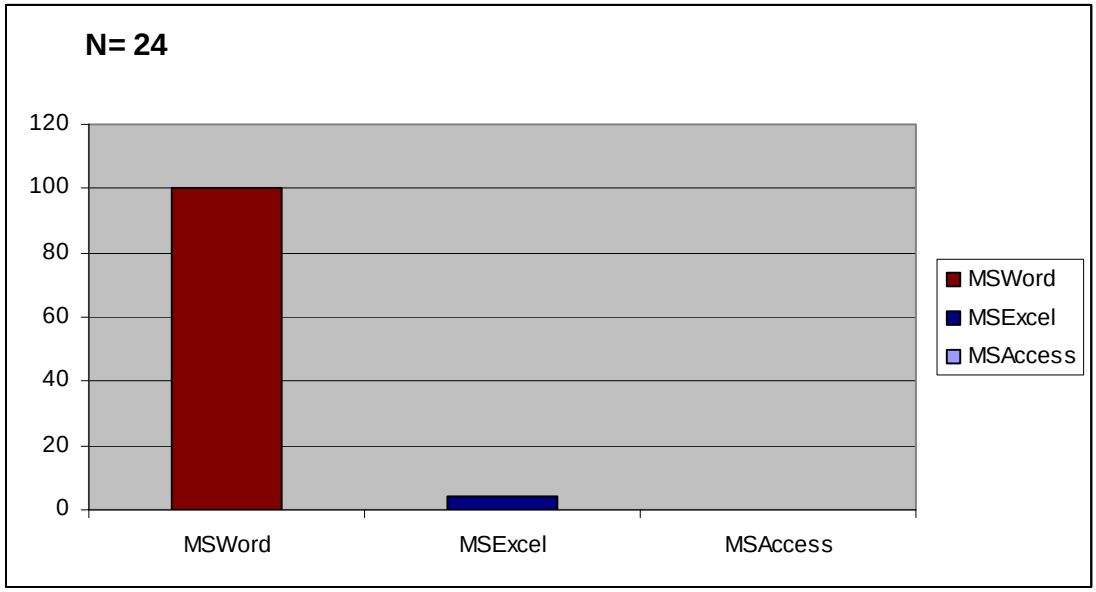
Before beginning the ECDL I carried out a short questionnaire (See Appendix C) on the twenty four students regarding their attitudes to and previous knowledge of the programme content. The findings were as follows:

- Twenty three out of the twenty four students or 96 percent said if given the choice they would still choose to study the ECDL.
- Asked to give reasons why they were studying the ECDL, 100 percent of the students said they wanted the qualification to put on their curriculum

- The question regarding any previous experience of using Microsoft Office programmes yielded the following:
    - All twenty four students had some experience of MSWord
    - Only one student had experience of MSExcel
    - No student had experience of using MSAccess (Figure 1)

Figure 1

Percentage Distribution of Students by Previous Knowledge of MS Office



4.3 Manual and Automatic Training and Testing

We will look at the results of the ECDL, starting with module three, MSWord.
Group **A** were given a manual test on that part of the module for which they received tuition (See Appendix D). All twelve students passed the test with an average score of 82 percent. The minimum score was 70 percent and the maximum score was 100 percent. In the Autotest, all twelve students passed with an average score of 81 percent. The minimum score was 75 percent and the maximum score was 92 percent. However, it must be noted that three students took two attempts to pass the test and a fourth student took three attempts. The minimum score achieved on Autotest was 56 percent.
Group **B** only used Autotrack and Autotest. All twelve students passed the test with an average score of 82 percent. The minimum score was 75 percent and the maximum score was 92 percent. In this case, five students took two attempts to pass the test and a sixth student took three attempts. The minimum score achieved on Autotest was 28 percent.
In summary, Group **A** and Group **B** students had Autotest averages of 81 percent and 82 percent respectively. The minimum scores were 56 and 28 percent respectively. However, 75 percent of Group **A** passed Autotest on the first attempt, while only 50 percent of Group **B** passed on their first attempt.

We will now look at the results of module four, MSExcel. Group **B** were given a manual test on that part of the module for which they received tuition(See Appendix E). All twelve students passed the test with an average score of 82 percent. The minimum score was 70 percent and the maximum score was 100 percent. In the Autotest, all twelve students passed with an average score of 85 percent. The minimum score was 78 percent and the maximum score was ninety two percent. However, it must be noted that two students took two attempts to pass the test and four students took three attempts. The minimum score achieved on Autotest was 56 percent.

Group **A** only used Autotrack and Autotest. All twelve students passed the test with an average score of 83 percent. The minimum score was 75 percent and the maximum score was 92 percent. In this case, seven students took two attempts to pass the test, two students took three attempts and one student took four attempts. The minimum score achieved on Autotest was 58 percent.

To summarise, Group **B** and Group **A** students had Autotest averages of 85 percent and 83 percent respectively. The minimum scores were 56 and 58 percent respectively. However, 50 percent of Group **B** passed Autotest on the first attempt, while only 17 percent of Group **A** passed on their first attempt.

The results for module five, MSAccess were as follows. Again, Group **B** were given a manual test on that part of the module for which they received tuition (See Appendix F). All twelve students passed the test with an average score of 90 percent. The minimum score was 70 percent and the maximum score was 100 percent. In the Autotest, all twelve students passed with an average score of 83 percent. The minimum score was 75 percent and the maximum score was 92 percent. It must be noted that all students passed the test on their first attempt. The minimum score achieved on Autotest was 75 percent.

Group **A** only used Autotrack and Autotest. All twelve students passed the test with an average score of 78 percent. The minimum score was 75 percent and the maximum score was 86 percent. In this case, three students took two attempts to pass the test. The minimum score achieved on Autotest was 67 percent.

To sum up, Group **B** and Group **A** students had Autotest averages of 83 percent and 78 percent respectively. The minimum scores were 75 and 67 percent respectively. However, 100 percent of Group **B** passed Autotest on the first attempt, while 75 percent of Group **A** passed on their first attempt.

4.4 Modular Focus Group Discussions

There was a focus group discussion at the end of each of the three modules to validate the findings from the module tests. There was an average of seven students from both Group A and B as well as myself and my teaching colleague (critical friend).

4.4.1 Focus Group Discussion on MSWord

There were seven students present at this focus group discussion. A series of questions were posed to the students for discussion (See Appendix J). All of the students found the Autotrack training programme an interesting and novel way to learn new computer skills. All of the students agreed that it was both easy to navigate and understand Autotrack. Some of the students found that the various topics were explained properly but certain topics posed major problems for students. Mail merge, in particular, some felt, was not explained properly and students found questions on this topic impossible to do in Autotest. Comments such as

“I haven’t a clue” and “ I found that really hard” summed up the frustrations of some students. Three of the students had done some training in the MSWord application and had received tuition on mail merge. For these students this topic was not as difficult, though none of them was entirely comfortable with it. The same three students also found that actually opening the Word application on their workstations and using it was much more rewarding than just using Autotrack.

All seven students had difficulties with tabs or tabulation. They all agreed that this topic was not explained sufficiently to allow a student to carry out different types of tabulation on a document.

While discussing Autotest, they all agreed that getting immediate results and feedback was a great motivation and incentive to use the programme. It was also

noted that being allowed to skip questions and going back to them later was really beneficial. No student had a problem understanding questions and they all agreed that the questions did reflect what was covered in Autotrack.

Suggestions for improvements included using more than one voice to narrate Autotrack so as to break the monotonity of listening to the same narrator for the whole module. Certain topics like mail merge and tabulation required more explanation and the three students who had used MSWord felt that hands-on experience of the application was essential to really understanding it. They felt that using Word in Autotrack and Autotest was somehow artificial. I jotted down the points made by the students on a whiteboard, confirmed that these were the points and later copied them onto a laptop.

4.4.2 Focus Group Discussion on MSExcel

Due to a sports fixture there were only six students present, three from Group **A** and three from Group **B** plus myself and my critical friend. None of these students had attended the first focus group discussion. A series of questions were posed to the students for discussion (see Appendix K).

As in the MSWord focus group discussion, all the students agreed that Autotrack was easy to navigate and understand. Some of the students found that most topics were explained properly but there were problems relating to some formulae. Although the simple formulae such as Sum, Average Maximum and Minimum were easy to grasp, there were difficulties concerning the IF and Variable functions. The three students who had covered some of the formulae while using the **'old'** system admitted that they were "comfortable" with them because they had been given the chance to practice them in MSExcel, and that included the IF function. The Variable function was not covered. The other three students said that they were "happy enough" with their knowledge of the simple formulae but found the IF and Variable functions too difficult to understand. As a result, they could not attempt any question on Autotest relating to these two

functions. Two of the students said that they got a little confused with the different types of charts that are part of MSExcel.

The students were unanimous in their agreement that Autotest was a quick and efficient means of testing and producing results. Neither the wording of the questions nor the nature of the questions raised any concerns. From the interaction during our discussion all the students concurred that hands-on use of MSExcel would be beneficial and would help users understand better some of the more difficult topics previously mentioned.

As in the previous discussion I took down the points made by the students on a whiteboard, confirmed that these were the points and later copied them onto a laptop.

4.4.3 Focus Group Discussion on MSAccess

Eight students attended, four from Group A and four from Group B. Five of the students had attended previous focus group discussions and all eight had experience of both the '**old**' and **'new'** systems. Myself and my critical friend also attended. A series of questions were posed to the students for discussion (see Appendix L). Due to the students' familiarity with the focus group discussions and the experience gained using both systems, the discussion got to specifics fairly quickly. Most of the students were now nearing the completion of the ECDL and had a lot of experience using both Autotrack and Autotest. There was agreement about the convenience of Autotrack and Autotest, the fact that a record is kept by Autotrack of one's progress in training and testing and the immediate feedback on completion of a test. However, there were strong reservations expressed about the lack of real-life experience in the actual application, MSAccess. All of the students had used manual training and testing and they were adamant that this was an essential part of the training process. Students stated that using the actual application was more "real" and they believed that they were more likely to remember how to use the application later on as a result. A few students even

noted that you cannot use the help option while in Autotest mode whereas it is available in the actual application. A topic which posed problems for all students in MSAccess were relationships as none of them could understand their relevance or how they really worked. The modification of queries and changing between the datasheet and the design views also posed problems for some.

The main suggestion regarding improvements in Autotrack was to incorporate use of the actual application in the training process. This would include more teacher input where he or she would demonstrate some of the more difficult concepts using a data projector and who would create specific exercises to help students understand these concepts. The availability of help in Autotest was the only suggested improvement in that application.

As in the previous discussion I took down the points made by the students on a whiteboard, confirmed that these were the points and later copied them onto a laptop.

In summary, each of the three focus group discussions revealed areas of concern in the modules MSWord, MSExcel and MSAccess. Mail merge in MSWord, formulae in MSExcel and relationships in MSAccess were the topics that caused most trouble for students. The students who were given hands-on tuition using the '**old**' system felt that this was advantageous to their understanding of some difficult topics and it helped when undertaking Autotest. All the students who were given in-application tuition agreed that, although they enjoyed the benefits of Autotrack and Autotest, the hands-on experience was essential.

4.5 General Focus Group Discussion Re Attitudes to ECDL

There was a general focus group discussion concerning attitudes to the ECDL which was attended by myself and seven students. All seven students had attended at least one previous focus group discussion. My critical friend was unavailable. A series of questions were posed to the students for discussion (See Appendix M).

In response to the question about why a student studied the ECDL course there was a variety of answers. A number of students said that it would have been a waste of money not to complete the course while all mentioned the importance of having a qualification to add to their curriculum vitae. One student offered that it might be beneficial when going on to third level education while three thought that the skills picked up might be useful for Leaving Certificate project work.

All the students agreed that their knowledge of computers and computing had increased. Attitudes towards the ECDL course have also changed. All agreed that they now felt more confident about their abilities with computer applications. One student said that he had to use MSExcel while doing work experience in an accountant's office and the knowledge he acquired while undertaking the ECDL really boosted his confidence in the workplace. Another student got work experience in the store of a motor accessory company. He got first hand experience of using a database similar to MSAccess and it was only then that the relevance of the ECDL clicked with him. In response to whether one's motivation for studying the ECDL had changed during the course of the year, an interesting point was made by two students. Their motivation to complete each module came from competing with fellow students to see who would finish Autotrack and pass a modular test first.

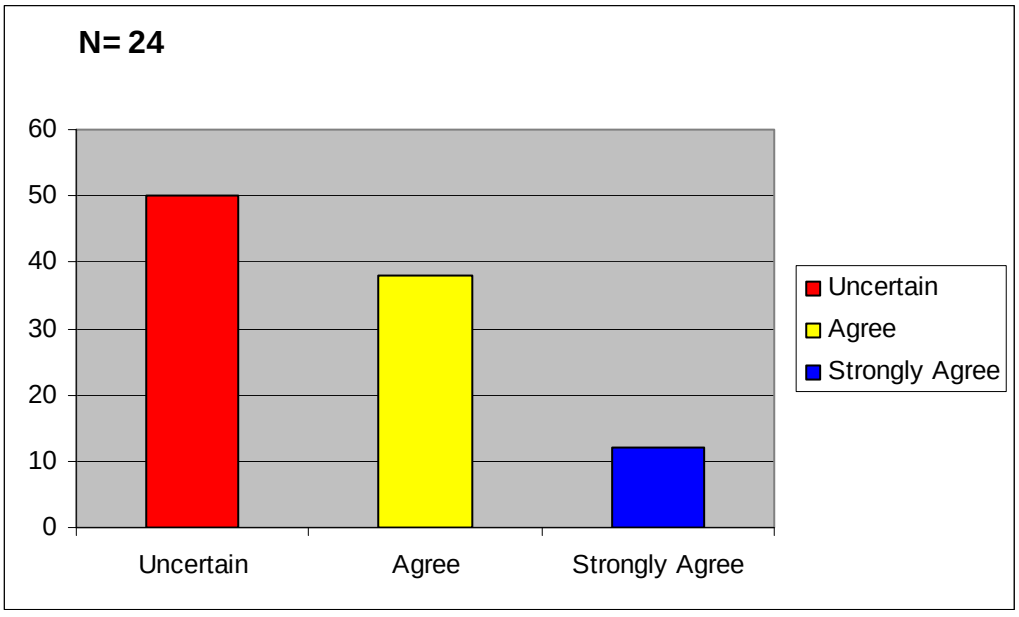
4.6 Post ECDL Questionnaire

During the last week of May 2009, which was the last week of the academic year, I conducted a questionnaire with all twenty four students in the class. The purpose of the questionnaire was to confirm previous findings and to look for new perspectives and suggestions about how best to improve the delivery of the ECDL course (see Appendix N).

In answer to the statement that the Autotrack system is a satisfactory way of studying the ECDL, 50 percent of students were uncertain, 38 percent agreed while 12 percent strongly agreed (figure 2).

Figure 2

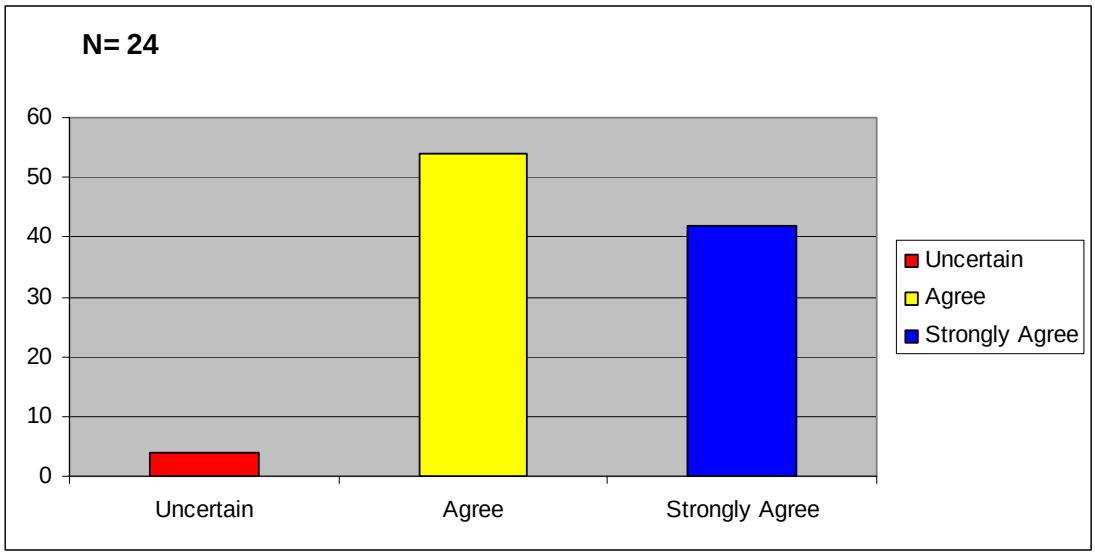
Percentage Distribution of Students by Perceived Satisfaction with Autotrack



In answer to the statement that the Autotest system is a satisfactory way of assessing the ECDL, only 4 percent were uncertain, 54 percent agreed while 42 percent strongly agreed (figure 3).

Figure 3

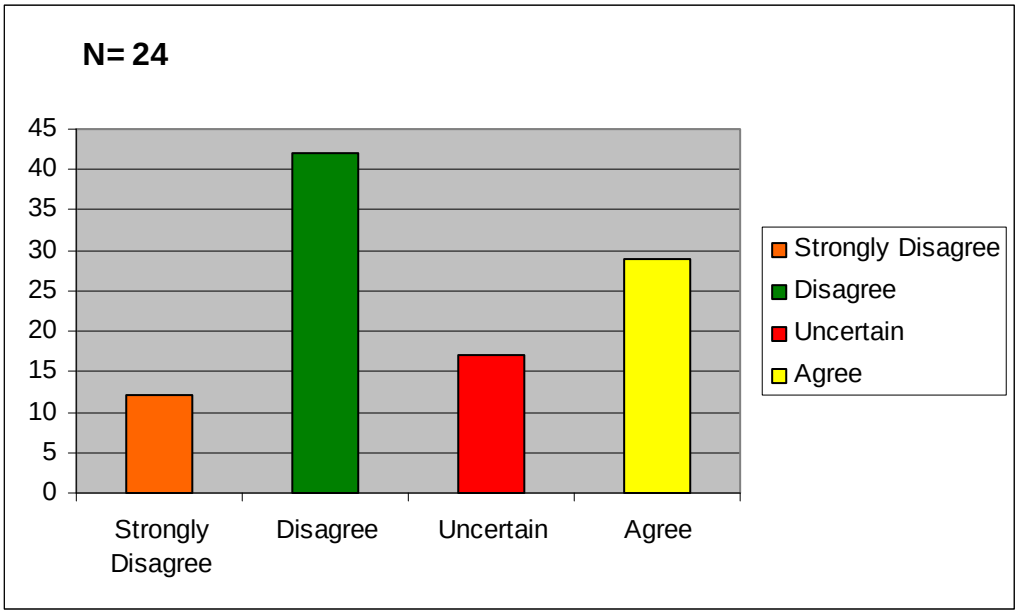
Percentage Distribution of Students by Perceived Satisfaction with Autotest



In answer to the statement that the Autotrack system is an enjoyable way of studying the ECDL, 12 percent strongly disagreed, 42 percent disagreed, 17 percent were uncertain while 29 percent agreed (figure 4).

Figure 4

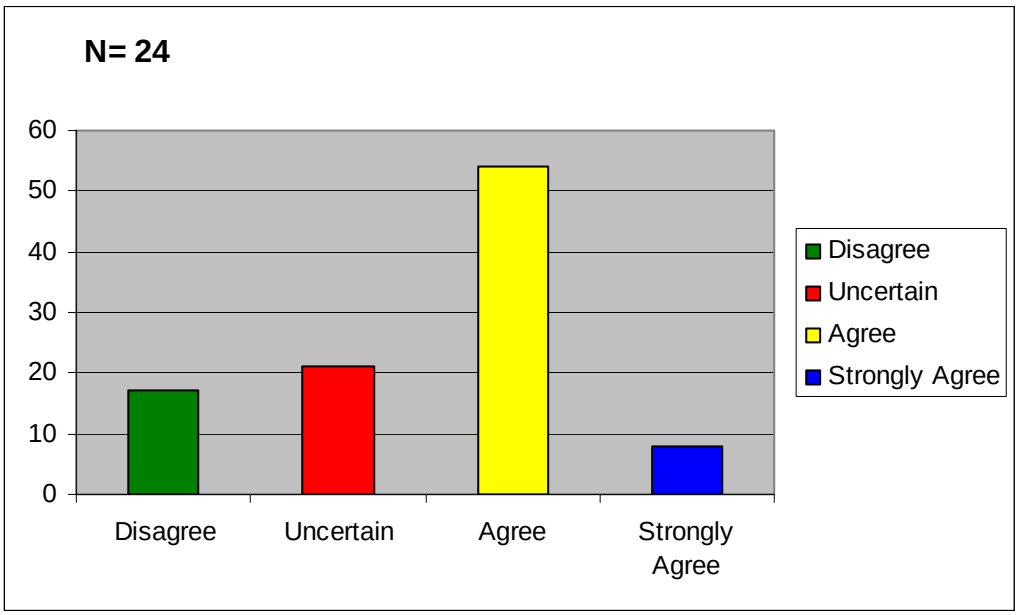
Percentage Distribution of Students by Perceived Enjoyment of Autotrack



In answer to the statement that the Autotest system is an enjoyable way of assessing the ECDL, 17 percent disagreed, 21 percent were uncertain, 54 percent agreed while 8 percent strongly agreed (figure 5).

Figure 5

Percentage Distribution of Students by Perceived Enjoyment of Autotest



Some of the aspects of Autotrack that students found helpful include its interactivity, the fact that everything is explained by the narrator, that everything is explained fairly well, that a record is kept of your progress, that it is at your own pace, that there is an assessment at the end of each section, that there is a repeat button and there is a CD version to use at home.

There were more aspects of Autotrack that students did not find helpful. These included the narrator's voice which was described as boring, monotonous and even annoying.

Some topics were not explained properly. Areas such as mail merge in MSWord, formulae in MSExcel, queries and relationships in MSAccess were mentioned by

most students. Students cited the lack of a help function and the artificial nature of the programme. Some complained that the sections were too long to maintain interest and most objected to the fact that a question was marked wrong unless you did it “their way”. They felt that the programme could be more interactive.

Some of the aspects of Autotest that students found helpful include the fact that you can skip a question and come back to it later on. You can redo a question if you are unsure before you make a final submission. Every student praised the fact that a test is available when you feel ready to try one, results are instantaneous and if you fail a test there is immediate feedback in terms of which questions were incorrect. Students found the Autotest programme more realistic than Autotrack. Most students liked the practice feature, the navigation is easy and the tests generally reflect what is covered in Autotrack.

A couple of students mentioned the merits of the tests being independent of the teacher.

There were fewer aspects of Autotest that students found unhelpful. The fact that Autotest is a simulation, and as a result, all the options to answer a question were not available, was seen as a negative. Other negatives included no audio and the time limit involved. A major concern was that you cannot see your answer before you submit. If, for example, you carry out some formatting, you cannot see the resultant formatting before submitting your answer.

The following were some of the suggested improvements to Autotrack:

- Have more than one narrator and be able to fast forward narrator
- Make it more realistic by using the actual application on own computer
- Make it more interactive

The following were some of the suggested improvements to Autotest:

- Allow user access to the help function
- Give the user more options inside Autotest as found inside the application
- Add audio to the programme

All the students were happy with the role of the teacher in training and testing. They all mentioned the benefits of using the data projector to demonstrate certain topics and the fact that the teacher was available to help at all times. There were suggestions as to how the teacher might be more helpful to the students:

- Demonstrate topics in the actual application via the data projector
- Give more time to explaining some difficult topics
- Go around the class to offer more one-on-one help
- Put more pressure on students to finish modules

The responses to the final question regarding suggested ways, apart from Autotrack and Autotest, to improve the system in which the ECDL course is taught and tested threw up similar answers to the previous question. These included:

- Demonstrate topics in the actual application via the data projector
- Do the course on an actual computer rather than on a simulator
- Provide more one-on-one help
- Make a textbook available to students which covers the entire course

In summary, while there was some dissatisfaction expressed with both Autotrack and Autotest, the most serious reservations related to Autotrack. There was a 50 percent satisfaction rating with Autotrack while there was a 96 percent satisfaction rating with Autotest. 62 percent agreed or strongly agreed that Autotest was enjoyable while only 29 percent of students agreed that Autotrack was enjoyable. The self-pacing and interactivity of autotrack were praised, but, there were topics which were not explained properly and there was no help function. The immediate feedback of results was a major positive of Autotest, whereas its simulation format was a major negative. Suggested improvements to Autotrack included the use of in-application training, while a similar improvement was proposed for Autotest. As

regards the role of the teacher, the demonstration of the more difficult topics was suggested as was the provision of more one-on-one help.

4.7 Observations and Questionnaire of a Critical Friend

The critical friend attended the three modular focus group discussions as an observer and also completed a questionnaire at the end of the study.

4.7.1 Observations of the Critical Friend

Autotrack:

Positives

The programme lends itself to the Transition Year.
It can be done at one's own pace and in one's own time.
Due to more frequent absences during Transition year the students can pick up where they left off without disturbing other students as a good record is kept of progress.
Each student has their own CD version of the course so they can catch up at home.

Negatives

It is only a simulated version of MS Word, Excel and Access.
Access to the actual application would be more realistic for the student i.e. if you had an actual document to work on it would be easier to teach and learn.
It can be monotonous going through the lessons and assessments with only one voice to listen to.
Some of the sharper students could actually pass a module test if they only did the assessments at the end of each section.

Autotest:

Positives

Immediate feedback of results for student
Question analysis is clear
Language of questions is clear and comprehensible
Excellent administration and record facility

Negatives

You cannot view the outcome of your work to see if the formatting has worked. In other words, you cannot confirm what you have done before pressing the Submit button.
You have no actual document to work with. It is only a simulation.
It is too rigid in terms of spelling and case sensitivity, unlike the manual method
It doesn't allow you to use shortcuts in some instances but does not warn you about this. In such an instance the question is marked fail.
Some question analysis is too vague to allow the teacher explain what the student has done wrong.

Specific Areas of Difficulty in the Modules

Word

In Mail merge there is no scope to carry out a complete mail merge either in Autotrack or Autotest. It is difficult to master the concept from lessons in Autotrack.

Tabs is a difficult topic for students to master in simulated form.

Excel

Formulas are beyond most students.

Access

Relationships are too difficult for students to understand.

Modifying queries is difficult.

For reports, the ordering of items is difficult.

4.7.2 Questionnaire of the Critical Friend

This questionnaire validates the commentary by the critical friend in his observations (See Appendix O).He agreed that both Autotrack and Autotest were satisfactory, but, with some reservations. Here is a summary of the responses from both observations and questionnaire.

- Autotrack can be studied at one's own pace and in own time
- Autotrack provides a change from teacher centred activity
- Autotrack allows only a simulated version of MS Office applications
- Autotrack can be monotonous
- Autotest provides instant feedback for the student
- Autotest provides an excellent administration and record facility
- Autotest does assess the skills of the student
- Autotest has no live document and as a result the student cannot see the editing he has done
- Autotest does not allow some shortcuts functions to be used
- The student can work independently of the teacher
- Some students work better in a structured lesson situation
- Students' attention span is not conducive to the Autotrack system
- There is no scope for partially correct answers as in the manual system
- Delivery of the course could be improved by a combination of the computer based training (Autotrack) in conjunction with structured lessons.
- Delivery of the course should take individual student difficulties into account.
- Specific areas of difficulty were highlighted in MSWord, MSExcel and MSAccess.

4.8 Summary of Key Findings

I will conclude this chapter with a summary of the key findings arising from the various methods used in my data collection.

- Manual training combined with Autotrack has improved results in Autotest (p.65-66)
- Manual training combined with Autotrack has improved the success rate in Autotest (p.65-66)
- In-application tuition is essential to get a full understanding of difficult topics (p.68)
- All students agreed that they felt more confident about their abilities with computer applications on completion of the three designated modules (p.71)
- Students found the Autotest programme more realistic than Autotrack (p.68)
- There was a 96 percent satisfaction rating with Autotest while 50 percent of students were satisfied with Autotrack (p.72-73)
- 62 percent of students felt that Autotest was an enjoyable way to assess ECDL while only 29 percent of students found Autotrack an enjoyable way to study the ECDL. (p.74-75)
- Delivery of the course could be improved by a combination of the computer based training (Autotrack) in conjunction with structured lessons (p.77)

Chapter 5 Discussion of Findings

5.1 Introduction

The purpose of this study was to contrast two methods of delivering a computer based training programme to a transition year group, and, in so doing, explore ways of improving learning and teaching competencies.

The study objectives were as follows:

- To establish students' attitudes to and knowledge of the ECDL Programme before its delivery
- To compare the competence of transition year students in selected modules of the ECDL programme arising from the Autotrack/ Autotest and manual delivery methods
- To identify improved learning practices based primarily on the experience and views of the students
- To recommend improvements in delivery of the ECDL

This chapter will discuss each of the above objectives in light of the study findings as presented in the previous chapter.

5.2 Attitudes to and Previous Knowledge of the ECDL

Although there is a compulsion on all transition students to undertake the ECDL, the attitude to the course was very positive among the students surveyed. They were most conscious of the academic qualification that was available on the successful completion of the course. As transition year students, this is one of the few formal qualifications that they can achieve. In addition, a sizeable majority saw this as an opportunity to improve their computer skills.

With regards to prior knowledge or experience of the Microsoft Office programmes, only MSWord was familiar to students. This experience came from their own personal circumstances or from doing class or project work in the lead up to the Junior Certificate Examinations. The literature confirms that the use of computers in education is seen as beneficial and that technology use is ultimately good (Gibson, 2001). Chung and Reigeluth (cited in O'Reilly, 1997) suggest networked "instruction encourages exploration and allows for different starting points among learners, as well as maximising their preferred learning style".

5.3 Comparing Student Competence in Manual and Automatic Training and Testing

When comparing student competence in manual and automatic training and testing, the results indicate that students who were exposed to both manual and automatic training achieved better results than those who underwent automatic training alone. This combination of manual and automatic training is labelled 'blended learning' as defined by Driscoll (2001).

To elaborate, apart from the percentage score for MSWord being slightly greater for the Autotrack-only group, the results of the other two modules, MSExcel and MSAccess, demonstrated a higher score for the blended learners.
On further analysis, the gap between the two systems of training widens. The blended learners had a much higher first time pass rate in Autotest than the Autotrack-only groups. Within this finding it is interesting to note that the first time pass rate fluctuated from 75 percent (MSWord) to 50 percent (MSExcel) and up to 100 percent (MSAccess). This would suggest specific learning difficulties with certain aspects of both MSWord and MSExcel.

As highlighted by the literature on experiential learning (Rogers, 1969; Kolb,1984; Jackson & Prosser,1989) this would support the view that hands-on use of applications is a more effective way of learning than using simulations. In addition, Vygotsky's (1978) proposed use of scaffolding with the guidance of the teacher concurs with this use of blended learning. Also, Krezel (cited in Laff, 2007) claims that classroom training is still needed and that simulations can only take you so far. It is interesting to note that the minimum percentage mark achieved by the students improved over the duration of the course, from 28 percent in MSWord to 67 percent in MSAccess. This would lead us to believe that familiarity with the course and active engagement with it made learning most effective (Roschelle et al. 2001).

Another interesting observation based on the results of automatic testing is that the lack of manual training had minimal effect on the results of the most 'able' students. There was one group who followed Autotrack only for each of the three modules. The average scores for the top 25 percent of students in these groups were only slightly lower than the averages for the top 25 percent of students who had done some manual training prior to Autotrack and Autotest.

On the other hand, the average scores for the bottom 25 percent of students who used Autotrack only were lower than the students who had done some manual

training prior to Autotrack and Autotest. Also, it must be borne in mind that on average the Autotrack-only group took at least two attempts to achieve the pass mark of 75 percent in each of the three tests. This is despite the fact that several authors have suggested that participants at the low end of the performance scale tend to benefit more from multimedia delivery than do participants at the high end of the scale (Consoli, et al., 1995; Issa, Cox, & Killingsworth, 1999 cited in Coleman et al. 2001).

Caution is urged with regards to computers in education. Muir-Herzig (2003), while acknowledging that technology can facilitate the knowledge-constructed classroom, has some reservations. She warns against the action 'of teaching to the test' whereby schools and teachers are limiting instruction to drill and practice in order to meet the set standards on standardized tests. McDermott (1993) likewise claims that a computer task completed successfully does not ensure that a skill can be transferred to other environments.

5.4 Identifying Improved Learning Practices based on the Experience and Views of Students

According to O'Reilly (1997) Computer Aided Instruction (CAI) uses the drill and practice approach to learning which allows for self-paced instruction and the emphasis is taken from the teacher as instructor/ controller. Also Bruner (1966, 1973) emphasises the importance of the learner being able to control the pace, direction, and content of learning. This degree of learner control is at the heart of constructivism. These features of Autotrack were highlighted and appreciated by all of the students, both in the focus group discussions and in the post ECDL questionnaire. The fact that a student could resume Autotrack and find exactly where he had left off on the previous occasion, and also have a record of his progress in terms of assessments, was considered a major advantage by all the surveyed students.

Initially, for all the students involved in the study, this was a novel and innovative way of learning and they seemed to genuinely enjoy the experience of learning without much intervention from the teacher. Gregoire et al. (cited in Gibson, 2001) reported that new technologies permit teachers to avail themselves of new information sources, facilitate collaboration among teachers and others, and when used appropriately, “result in a shift in teacher role to guide or mentor who interacts with students more than in a traditional environment.” This was the situation until students started to encounter problems with individual modules or with the Autotrack programme itself. Once the manual training commenced most students saw its merits and welcomed the intervention of the teacher to fill in the gaps in knowledge left by Autotrack.

Drawing from the work of Piaget and Brunner, Merrill (cited in O’Reilly,1997) stated that knowledge is constructed from experience and that learning is a personal interpretation of the world, it is experiential, collaborative and authentic. With regards to Autotrack, the lack of authenticity .of the programme was of major concern to students. The focus group discussion concerning attitudes to the ECDL as well as the post ECDL questionnaire revealed that only 50 percent of students were satisfied with Autotrack while only 29 percent agreed that Autotrack was an enjoyable way of studying the ECDL. On closer examination, students spoke about the artificiality of Autotrack, its lack of authenticity and suggested that there should be access to the actual application such as MSWord to make it more ‘real’. This lack of in-application training was also a problem raised with Autotest. Although there was unanimous agreement that Autotest was an effective testing instrument, its lack of in-application capability limited its success.

It became very obvious from the responses of students that the ‘**old**’ or manual system of training still has an important part to play in the training process. From the time that the manual aspect of training was introduced the students saw the need for some teacher intervention to explain some difficult parts of the course.

According to Laff (2007) in the Information Technology field, instructor-led training remains the preferred method for many applications. Cavanaugh (cited in Lehtinen, 2003) found that studies in which interactive technology was used as a supplementary method, linked to face-to-face teaching, resulted in positive achievement effects.

These findings would also tie in with the ideas on learning of Roschelle et al. (2001) who stated that 'learning is most effective when four fundamental characteristics are present':

5. Active engagement
6. Participation in groups
7. Frequent interaction and feedback
8. Connections to real-world contexts.

5.5 Recommended Improvements in Delivery of the ECDL

As a result of the feedback from both students and the critical friend a number of recommended improvements have been put forward.

- Delivery of the course could be improved by a combination of computer based training (Autotrack) in conjunction with structured, traditional lessons
- The use of the data projector and the relevant software application should be used to demonstrate the more difficult topics

- Both Autotrack and Autotest should incorporate the use of live documents so that the teaching and learning environment is more authentic and realistic
- Delivery of the course should take individual student difficulties into account

- Even though the present course is self-paced, some students need to be pressured to make progress

These recommended improvements confirm what the literature has found regarding the role of ICT in improving teaching and learning. Higgins (2004) claims that more substantial gains by students are achieved when the use of ICT is planned, structured and integrated effectively.

Lehtinen (2003) tells us that the effects of ICT depend not only on the equipment, but also, above all, on the pedagogical implementation of technology. Thus, the pedagogical approaches used are, in many cases, more important than the technical features of the applied technology.

The ICT Impact Report (2006) which was a review of studies of ICT impact on schools in Europe reports that in the case of the Norwegian pilot project students assume greater responsibility for their own learning when they use ICT,
working more independently and effectively.

Finally, Gibson (2001) sums up by claiming that 'the most effective learning environment is that in which the teacher, the facilitator, the guide, the instructor is capable of selecting from a wide variety, the most appropriate strategy to accomplish the learning objectives designed to benefit the individual learner and to satisfy individual learning needs'. He further adds that 'when considering styles of teaching and learning, the central question for all educators is what should drive the process of learning – the preferences of the teacher or the needs of individual learners'.

Chapter 6 Conclusions and Recommendations

6.1 Introduction

This chapter provides a set of conclusions that have been drawn primarily from the discussion presented in Chapter 5. These conclusions are based on the literature reviewed and the study findings as well as the long experience of the author in delivery of e-learning programmes and ICT in general. The conclusions will be followed by a list of recommendations regarding future developments in the sector.

6.2 Conclusions

Based on the discussion of the four objectives in the previous chapter which were themselves developed from the findings and guided by the literature the study concludes that:

1. There is an overwhelmingly positive attitude among students to ICT and to the use of technology in teaching and learning
2. The use of blended teaching methods for the ECDL course is more effective than the use of Autotrack alone
3. The hands-on use of live applications is a more effective way of learning than using simulated programmes like Autotrack on its own
4. The hands-on use of live applications integrated with Autotest is a more effective way of testing than using Autotest alone
5. Familiarity with course content and practice improves test results

6. The most able student performs well regardless of automatic or manual training
7. The less able student performs better with blended teaching methods
8. All students appreciate the independent learning afforded by Autotrack which is self-paced and keeps a record of one's progress
9. Teacher intervention in the teaching and learning process is appreciated when he/ she takes on the role of guide or mentor
10. Teacher intervention is most effective when individual student needs are satisfied

6.3 Recommendations

Here are a number of recommendations which I suggest would benefit the delivery of the ECDL course and also benefit the students undertaking the course:

- That the Irish Computer Society (ICS) who administer the ECDL in Ireland take a more active role in delivering the course in terms of advising test centres and course tutors on best pedagogical practice
- That the ICS might encourage course providers like Electric Paper to include in their courseware access to live applications.
- That the course tutor adjusts his or her teaching methods to take account of individual student needs
- That the course tutor takes a more careful approach to the less able student in terms of noting particular difficulties he or she may encounter

Blank Page

Bibliography

Adams, A.M. (2003) *Pedagogical Underpinnings of Computer-Based Learning* Journal of Advanced Nursing Volume 46, pp 5-12 Blackwell Publishing Ltd.

AKbulut, Y. (No Date) *Implications of Two well-known models for Instructional Designers in Distance Education: Dick-Carey Versus Morrison- Ross-Kemp*

Aldrich, F., Rogers, Y., Scaife M.(1998) '*Getting to grips with "interactivity": Helping teachers assess the educational value of CD-ROMS'* British Journal of Educational Technology Vol 29 No.4

Alessi, S. and Trollip, S. Multimedia for Learning, ALLYN & BACON, 2001

Altun, A. et al. (2008) *Use of a Content Management System for Blended Learning: Perceptions of Pre-Service Teachers* [Internet] Available at: http://tojde.anadolu.edu.tr/tojde32/articles/article_11.htm [accessed 27 Dec. 2008]

Avison, D. (1999) *Action Research* Communications of the ACM January 1999 Volume 42 No. 1

Balanskat et al. (2006) *The ICT Impact Report :A review of studies of ICT impact on schools in Europe* European Schoolnet

Becta (2007) *Quality Principles for Digital Learning Resources* [Internet] Available at: http://www.becta.org.uk/partners/qualityprinciples [accessed 10 Dec. 2008]

Bevan, N. (no date) *International Standards for HCI and Usability* International Journal Of Human Computer Studies Vol. 55(4) pp 533-552

Bostock, S. ( ) *Learning Technology: A checklist for evaluating computer based learning software* [Internet] Available at: http://www.keele.ac.uk/depts/aa/landt/lt/docs/evaluationchecklist1.html [accessed 10 Dec. 2008]

Bransford et al, (1999) *How People Learn: Brain, Mind, Experience, and School* Commission on Behaviourial and Social Sciences and Education

Boeree, G.C.(No Date) '*B.F. Skinner* ' [Internet] Available at: http://webspace.ship.edu/cgboer/skinner.html [accessed 10 Dec. 2008]

Brown, C. (2001) '*Behaviourism: Skinner and Dennett'* [Internet] Available at: http://www.trinity.edu/cbrown/mind/behaviorism.html [accessed 10 Dec. 2008]

Bruner, J (1991) *The Narrative Construction of Reality*
Critical Inquiry, Vol. 18, No. 1. Autumn, 1991, pp. 1-21.

Byram, A. (1984) *The Debate about Quantitative and Qualitative Research: A Question of Method or Epistemology?*
The British Journal of Sociology, Vol, 35, No. 1 March 1984, pp75-92

Byram, A. (2004) *Social Research Methods* (2nd edition) Oxford University Press, New York

Byram, A. (No date) *Triangulation* Department of Social Sciences, Loughborough University

Brydon-Miller, M. and Maguire, P. (2009) *Participatory Action Research: Contributions to the Development of Practitioner Inquiry in Education*
Educational Action Research Vol. 17, No. 1 March 2009 pp 79-93

Calzarossa, M. C. et al. (2004) *The ECDL Certification of ICT Usage skills in the Italian Universities* [Internet] Available at: http://linkinghub.elsevier.com/retrieve/pii/S0360131505001430 [accessed 7 Jan. 2009]

Camstra, B. *AI in Computer-Based Training*
British Journal of Educational Technology Vol. 39, No. 2, 2008 pp 297-303

Carman, J. M. (2005) *Blended Learning Design: Five Key Ingredients*
[Internet] Available at: http://www.agilantlearning.com/pdf/Blended%20Learning%20Design.pdf
[accessed 30 Dec. 2008]

Carnevale, D. (2002) *Online Students Don't fare as Well as Classroom Counterparts* [internet] Available at: http://chronicle.com/free/2002/02/2002022501u.htm [accessed 7 Jan.2002]

Cavus, N. and Ibrahim, D. (2005) *Is Blended Learning the Solution to Web-Based Distant Engineering Education* [Internet] Available at: http://eric.ed.gov/ERICWebPortal/recordDetail?accno=ED500189
[accessed 5 Jan. 2005]

Chou, L., McClintock, R., Moretti, F and Nix, D.H. (1993) '*Technology and Education: New wine in new bottles Choosing pasts and imagining educational futures'* New Lab for Teaching and Learning.

Clarkson, B., Newhouse, P., Trinidad, S.(2002*) Quality Pedagogy and Effective Learning with Information and Communications Technologies (ICT): a Review of the Literature*

Csapo, N. (2002) *Certification of Computer Literacy* [Internet] Available at: http://web.ebscohost.com.proxy.lib.ul.ie/ehost/delivery?vid=13&hid=102&sid [accessed 5 Feb. 2009]

Cohen, L. Manion, L. Morrison, K. (2007) *Research Methods in Education (6th edition)* Routledge, London and New York

Cronjé, J. (2006) *Paradigms Regained: Toward Integrating Objectivism and Constructivism in Instructional Design and the learning Sciences* [Internet] Available at: http://www.springerlink.com/index/F5R71244333N2816.pdf [accessed 5 Dec.2008]

Cuban,L., Kirkpatrick, H.,Peck, C. (2002) *Techno-Promoter Dreams, Student Realities* [Internet] Available at: http://cw.marianuniversity.edu/rstucky/PDF/Techno-PromoterDreams,Student%20Realities.pdf [accessed 28 Nov. 2008]

Oppenheimer, T. (1997) The Computer Delusion [interenet] Available at: *http://innovations.oise.utoronto.ca/~jhewitt/ctl1602/papers/Oppenheimer%201997.pdf* [accessed 21 Dec. 2008]

Debevc, M. et al. (2008) *Usability Testing of E-Learning Content as used in two Learning Management Systems* [Internet] Available at: http://www.eurodl.org/materials/contrib/2008/Debevc_Bele.htm [accessed 7 Jan.2009]

Delfino, M. and Persico, D. (2007) *Online or Face-to-Face? Experimenting with Different Techniques in Teacher Training*
Journal of Computer Assisted Learning Vol. 23, pp351-365

Department of Education and Science (2008) *ICT in Schools* DES Inspectorate

Desai, M.S. et al. (2005) *E-Learning: Paradigm Shift in Education*
Education Vol.129, No.2

Dobrovolny, J. (2006) *How Adults Learn from Self-Paced, Technology-Based Corporate Training: New Focus for Learners, New Focus for Designers* Distance Education Vol. 27, No. 2, August 2006, pp 155-170

Driscoll, M. (2001) *Blended Learning: Let's Get Beyond the Hype* [Internet] Available at: http://www.geocities.com/calcheh88/PDF/3372680960blended_learning.pdf [accessed 30 Dec. 2008]

Driscoll, M. (2002) *How People Learn (and What Technology might have to do with it)* [Internet] Available at: http://www.ericfacility.net/ericdigests/ed470032.html [accessed 30 Dec. 2008]

Drury, C.J.(1995) *Implementing Change in Education: the integration of Information Technology into Irish Post-Primary Schools.* (M.Sc. Thesis, University of Leicester, (1990) [Internet] Available at: http://indigo.ie/cjdrury/thesis [accessed 10 Dec. 2008]

Edelenbos, J. and Van Buuren, A. (2005) *The Learning Evaluation: A Theoretical and Empirical Exploration* Evaluation Review Vol. 29 No. 6 December 2005 pp 591-612

Eklund, J. (2006) *Cognitive Models for Structuring Hypermedia and Implications for Learning from the World-Wide Web* This article was accessed on the UL Cohort 5 student CD

Emuus (1999) *Multimedia usability guidelines and usability oriented design process* [Internet] Available at: http://www.ucc.ie/hfrg/emuus/wp3doc.htm [accessed 10 Dec. 2008]

European Union (2008*) Families of evaluation criteria* [Internet] Available at: http://ec.europa.eu/europeaid/evaluation/methodology/methods/mth_ccr_en.htm [accessed on 7 April 2009]

Flavell, J. (1996) *Psychological Science* Vol. 7, No. 4, July 1996

Firestone, W.A. (1987) *Meaning in Method: The Rhetoric of Quantitative and Qualitative Research* Educational Researcher October 1987

Forrester, D., Jantzie N., (1998) '*Learning Theories*' [Internet] Available at: http://www.acs.acalgary.ca/~gnjantzie/learning_theories.htm [accessed 10 Dec. 2008]

Francisco, V. et al. (2001) *Key Issues in Evaluation: Quantitative and Qualitative Methods and Research Design* [Internet] Available at: http://hpp.sagepub.com/cgi/content/abstract/2/1/20 [accessed 11 Nov. 2008]

Gardner, H. (1990) *Intelligence in Seven Steps* 'Intelligence Connections' (1991).

Gibson, I.W. (2001) '*At the Intersection of Technology and Pedagogy: considering styles of learning and teaching'*
Journal of Information Technology for Teacher Education, Vol. 10, Nos 1&2, 2001.

Golafshani, N. (2003) *Understanding Reliability and Validity in Qualitative Research*
The Qualitative Report Volume 8 Number 4 December 2003 597-607

Hansen, M. and Borden, M. (2006) *Using action Research to support Academic Program Improvement* New Directions for Institutional Research No. 130 Summer 2006

Hansen, R. (2000) *The Role of Experience Learning: Giving Meaning and Authenticity to the Learning Process* [Internet] Available at: http://scholar.lib.vt.edu/ejournals/JTE/v11n2/hansen.html [accessed 5 May 2009]

Herbert, S. (2004) *Lessons from Assessment: Experiences of a Cross-Cultural unit of Work in Science*
Journal of Evaluation and Research in Education, Vol. 18, No. 3, 2004

Higgins, S. (2004) *Does ICT improve Teaching and Learning in Schools?*
User Review of British Educational Research Association

Hofmann, J. and Miner, N. (2008) *Real Blended Learning Stands up*
[Internet] Available at: http://www.albyers.com/pubs/NSTA__Transformative_PD_vs9_11%2014%
[accessed 5 Jan.2009]

Hodges, C.B. (2004) *Designing to Motivate: Motivational Techniques to Incorporate in E-Learning Experiences*
The Journal of Interactive Online Learning Vol. 2, No.3,Winter 2004

Hofstede, G. (2004) *Cultures and Organizations: Software of the Mind*
McGraw-Hill

Hoover, W.A. (2003) *The Practice Implications of Constructivism* [Internet] Available at: http://www.sedl.org/pubs/sedletter/v09n03/welcome.html
[accessed 28 Nov.2008]

Howard, S. (1997) Trade-off Decision making in User Interface Design
Behaviour & information Technology, 1997,Vol.16, No. 2, 98-109

Jackson, M.W. and Prosser M. T. (1989) *Studies in Higher Education 1470-174X,* Volume 14, Issue 1, 1989, Pages 55 – 68

Jaworski, B. (1993) *Constructivism and Teaching – The Socio-Cultural Context* [Internet] Available at: http://www.grout.demon.co.uk/barbara/chreods.htm
[accessed 5 Dec.2008]

Jick, T.D. (1979) *Mixing Qualitative and Quantitative Methods: Triangulation in Action Administrative Science Quarterly Vol. 24, No. 4 Dec. 1979*

Jonassen, D and Reeves, T. (no date) *Technology as Cognitive Tools: Learners as Designers* [Internet] Available at: *http://itech1.coe.uga.edu/itforum/paper1/paper1.html* [accessed 10 Dec. 2008]

Kearsley, G. and Shneiderman, B. *(1999) Engagement Theory: A Framework for Technology-based Teaching and Learning [Internet] Available at:* http://home.sprynet.com/~gkearsley/engage.htm *[accessed 2 Dec. 2008]*

Kolb et al. (1999) *Experiential Learning Theory: Previous Research and New Directions* [Internet] Available at: http://books.google.com/books?hl=en&lr=&id=mVMWBSZd4Y0C&oi=fnd&pg=RA1PA227&dq=Kolb+et+al.+(1999)+Experiential+Learning+Theory:+Previous+Research+and+New+Directions+++&ots=jHnCrjs7g8&sig=E2atZmTGhVbBDTdHngtl-xdwlFs [accessed 12 Nov. 2008]

Kosakowski, J (1996) *The Benefits of Information Technology*

This article was accessed on the UL Cohort 5 student CD [accessed 30 Dec. 2008]

Krathwohl, D. (1998) *Methods of Educational and Social Science Research: an Integrated Approach* (2nd edition) Addison-Wesley Publishers

Kruse, K.(No Date) *Introduction to Instructional Design and the ADDIE Model* [Internet] Available at: http://www.e-learngguru.com/articles/art2_1.htm [Accessed 12 December 2008]

Kuittinen, M. (1998) *'Criteria for evaluating CAI applications'* Pergamon Computers and Education 31 (1998) 1-16

Laff, M. (2007) *Some IT Training Remains Traditional* [internet] Available at: http://megc104.edublogs.org/files/2008/09/research-paper-mch.doc [accessed 27 Dec. 2008]

Leigh, D. (No Date) *A Brief History of Instructional Design Web* This article was accessed on the UL Cohort 5 student CD [accessed 30 Dec. 2008]

Lehtinen, E. (2003) *Computer-supported Collaborative Learning: An Approach to powerful learning environments* Available at: http://www.tml.tkk.fi/Opinnot/T-110.556/2003/Materiaali/EditedLehtinenCSCL.pdf

Li, Q. (2007) *Student and Teacher Views About Technology: A Tale of Two Cities?* Journal of Research on Technology in Education, *39*(4), 377–397

Livesey, C. (No Date*)* *A Resource-Based Learning approach* Module One: Theory and Methods [Internet] Available at: www. Sociology.org.uk [Accessed 20 Feb. 2009]

Lynch, P. (2002) '*Yale Style Manual'* [Internet] http://www.webstyle.com [accessed 10 Dec. 2008]

Luik, P. (2007) *Characteristics of Drills related to Development of Skills* Journal of Computer Assisted Learning Vol. 23, pp56-68

Mason, R. (2005) *Blended Learning*
Education, Communication and Information Vol.5, No. 3, November 2005

Masters, J. (1995) *The History of action Research* [Internet] Available at: http://www.behs.cchs.usyd.edu.au/arow/Reader/rmasters.htm [Accessed 8 Feb.2009]

Mayer, M. (2003) *How do Learners Learn?* [Internet] Available at: http://www.sedl.org/pubs/sedletter/v09n03/welcome.html
[accessed 7 Jan. 2009]

Mayer, R. (1999) *Multimedia Learning*

Mayring, P. (2000) *Qualitative Content Analysis* Volume 1, No. 2 June 2000

McDermott, L. (1993) '*How we teach and how students learn — A mismatch?*' American Journal of Physics, Vol. 61, No. 4

McDowell et al. (2008) *Evaluating Assessment Strategies through Collaborative Evidence-based Practice: Can one tool fit all?*
Innovations in Education and Teaching International Vol. 45, No. 2, May 2008
Pp 143-153

McGriff, (No date) *McGriff Knowledge Base* [Internet] Available at: http://www.personal.psu.edu/faculty/s/j/sjm256/portfolio/kbase/Theories [accessed 10 Dec. 2008]

MacKenzie, N. and Knipe, S. (2006) *Research Dilemmas: Paradigms, Methods and Methodology* Issues in Educational Research, Vol. 16, 2006

McNiff, J. (2002) *Action Research for Professional Development*
[Internet] Available at: http://www.jeanmcniff.com/booklet1.html
[Accessed 6 Feb. 2009]

McNiff, J. (2008) *Action Research, Transformational Influences: Pasts, Presents and Futures* [Internet] Available at: http://bedsatbath.co.uk/carpp/publications/pdf/handbook_of_action_research.pdf
[Accessed 6 Feb. 2009]

Molloy,C, (2005) *ICT at the back of the class* [online] Accessed 6 Nov. 2007

Murphy, E. (1997) *Characteristics of Constructivist Learning and Teaching* [Internet] Available at: http://www.stemnet.nf.ca/~elmurphy/emurphy/cle3.html [Accessed 28 Dec. 2008]

Nanjappa, A. and Grant, M. (no date) *Constructing on Constructivism: The Role of Technology* [Internet] Available at: http://ejite.isu.edu/Volume2No1/nanjappa.htm [accessed 20 Dec. 2008]

NCTE (2001) '*Evaluating Software: a Teacher's Guide'*

Ngeow, K. (1998) *Enhancing Student thinking through Collaborative Learning* [Internet] Available at: http://www.ericfacility.net/databases/eric_digests/ed422586.html [Accessed 28 Dec.2008]

Oakley, A. (2004) *The Researcher's Agenda for Evidence*
Evaluation and Research in Education Vol.18, No. 1 & 2, 2004

O'Donnell, S. (No date) *The ECDL in Ireland: Impact study*
[Internet] Available at: http://www.cipd.co.uk/NR/rdonlyres/13FAD3DF-4153-4B3D-8041-F8B4CE8B047C/0/eLearning.pdf
[accessed 5 Jan.2008]

OECD (2008) *DAC Evaluation Quality Standards* [Internet] Available at: www.oecd.org/dataoecd/51/7/38686953.pdf [accessed on 7 April 2009]

OECD (2001) *'Learning to Change' ICT in Schools*

Oliver, M. and Trigwell, K. (2005) *Can 'Blended Learning' Be Redeemed?*
E-Learning, Vol. 2, No. 1,2005

Oliver, R. (2002) *Winning the toss and electing to bat: maximising the opportunities of online learning* [internet] Available at: *http://elrond.scca.ecu.edu.au/oliver/2002/isl.pdf* [accessed 3 Feb. 2009]

O'Reilly J. (1997*)* *'An introduction to learning theories applied to Computer Based Learning and Training'* This article was accessed on the UL Cohort 5 student CD

Preston, C. et al. (no date) *ECDL for Educators: A Formative Evaluation of ICT Skills Training in Context* Mirandanet International Research Centre [Internet] Available at: www.mirandanet.ac.uk [accessed 7 Jan. 2009]

Radford, M. (2007) *Action Research and the Challenge of Complexity* Cambridge Journal of Education Vol. 37, No. 2, June 2007, pp 263-278

Ramage, T. R. (2002) *The "No Significant Difference" Phenomenon: A Literature Review* [Internet] Available at: http://www.usq.edu.au/electpub/e-jist/docs/html2002/ramage.html [accessed 28 Dec.2008]

Reeves, C. (1998) *The Impact of Media and Technology in Schools* [Internet] Available at: http://www.athensacademy.org/instruct/media_tech/reeves0.html [Accessed 28 Dec. 2008]

Reeves, T. (1992) *Effective Dimensions of Interactive Learning Systems. Finding the future* TTE'92 Proceedings of the Information Technology for Training and Education Conference. Lucia, 1992 , 99-113.

Reeves, T. (1996) *Instructional Technology Forum* [internet] Available at: http://www.listserv.uga.edu [Accessed 28 Dec. 2008]

Robertson, B. et al. (2007) *Cognitive Tools: From Emerging Perspectives on Learning, Teaching and Technology* [Internet] Available at: http://projects.coe.uga.edu/eplitt/index.php?title=Cognitive_Tools

Robson, C. (2002) *Real World Research* (2nd edition) Blackwell Publishing

Rolfe, G. (2004) *Validity, Trustworthiness and Rigour: Quality and the Idea of Qualitative Research* Journal of advanced Nursing Vol. 53(3), pp 304-310

Roschelle, J. et al. (2001) *Changing How and What Children Learn in School with Computer Based Technologies* [internet] Available at: http://ctl.sri.com/Publications/downloads/PackardchChangingLearning.pdf [Accessed 22 Dec. 2008]

Rush, T. (2001) *European Computer Driving License Case Study* [internet] Available at: http://timrushlearning.co.uk/ecdl-casestudy.html [accessed 7 Jan. 2009]

Sarantakos, S. (2005) *Social Research* (3rd edition) Palgrave MacMillan

Shanks, P. (2005) '*The value of Multimedia in Learning'* Adobe Design Centre

Siemens,G. (2002) *Instructional Design in Elearning* [Internet] Available at: http://www.elearnspace.org [accessed 6 May 2007]

Sims, R. (1997) *Interactive learning as an "emerging " technology: A reassessment of interactive and instructional design strategies* [Internet] Available at: http:// www.ascilte.org.au/ajet/ajet13/sims.html [accessed 10 Dec. 2008]

Sims, R. (2008) *Rethinking (E)Learning: A Manifesto for Connected Generations*Distance Education Vol. 29, No. 2 August 2008, pp153-164

Sinko, S and Lehtinen, E (1999) *The challenges of ICT in Finnish education* [Internet] Available at: http://www.sitra.fi/Julkaisut/sitra227.pdf [accessed 20 August 2009]

Skaalid, B. (1999) '*Web Design for Instruction'* [internet] Available at: http://www.usask.ca/education/coursework/skaalid/theory/interface.htm [accessed 30 Dec.2008)

Skinner, B.F. (1950) '*Are Theories of Learning necessary?'* Psychological Review 57, 193-216.

Snelson, C. (2006) *Virtual Design Based Research* Academic Exchange Quarterly Winter 2006 Vol. 19, Issue 4

Squires, D., Preece, J., (1996) '*Usability and Learning: Evaluating the Potential of Educational Software'*
Pergamon : Computers and Education Vol.27, No. 1 pp. 15-22

Strommen, E.F., and Lincoln B,. (1992) '*Constructivism, Technology, and the Future of Classroom Learning'* Institute for learning technologies, Columbia University [internet] Available at: http://www.elearnspace.org/Articles/Instructional Design.htm [Accessed 10 Dec. 2008]

Thanasoulas, D.(2001) *Constructivist Learning* [Internet] Available at: http://www3.telus.net/linguisticissues/constructivist.html

Valde, G. A. (1997). *Promoting student participation and learning through the use of weekly writing assignments*
Journal on Excellence in College Teaching, 8 (3), 67-76.

Wang, Q. (2008) *A Generic Model for Guiding the Integration of ICT into Teaching and Learning* [Internet] Available at: http://giftpoemwriter.com/blog/wp-content/uploads/2009/05/thesis.doc
[accessed 9 Dec. 2008]

Wong, D. et al. (2007) *Demand-Led E-Learning and the Elusive Total Solution*
British Journal of Educational Technology Vol. 38 No. 1 2007

Yoon, W.Y. and Lim, D.H. (2008) *Team Learning performance and Collaboration between Online and Blended Learning Delivery Groups*
[Internet] Available at: http://digitalcommons.unl.edu/dissertations/
[accessed 30 Dec.2009]

Zhang, Y. (2006) *Content Analysis: Qualitative, Thematic* [internet] Available at: http://www.ils.unc.edu/yanz/content%20analysis.pdf [accessed 5 March 2009]

Blank Page

Appendix A

Information Sheet For Parent/ Guardian

Dear Parent/ Guardian,

As part of a MA thesis in Digital Media with the University of Limerick, I am investigating ways of improving the teaching of the ECDL course which includes the software programmes Autotrack and Autotest. The research will involve a number of short assessments, questionnaires, group discussions and some observations by one of my colleagues who is also an ECDL trainer and tester. The research will take place between November 2008 and May 2009.

There will be complete confidentiality. No student nor the school itself will be identified at any stage. The data and information collected will only be accessible to my tutor and myself. I have discussed this study with the students and explained their role in it.

I would really appreciate it if you would allow your son to take part in this study. His participation will only enhance his learning of the ECDL course. If your son feels uncomfortable at any time he may withdraw from the study. Please read the attached consent form, sign it and let your son sign it. Thank you.

Yours Sincerely,

_____.

Tom Hogan.

Appendix B

Consent Form For Parent/ Guardian

I am giving my son _____ permission to take part in a study conducted by Tom Hogan as part of a research thesis with the University of Limerick.

I understand that my son will do some short assessments, fill in some questionnaires, take part in group discussions and have his participation in group discussion observed by his class teacher and by one other ECDL teacher. I also understand that my son's name and the school name will not be revealed. I may withdraw my son's participation at any time.

Signature of Parent/ Guardian

_____.

Signature of Student

_____.

Signature of Teacher

_____.

Appendix C

Pre- ECDL Questionnaire

Please tick appropriate box ☑

November 2008 N = 24

1. Did you choose to study the ECDL course?

Yes ☐ No ☐

2. Why are you studying the ECDL course ? List reasons.

_____
_____
_____
_____

3. If you had the choice, would you study the ECDL?

Yes ☐ No ☐

4. Did you have any previous experience of using any Microsoft Office programmes?

Yes ☐ No ☐

Please list any programmes you may have used.

_____
_____
_____
_____

Appendix D

Microsoft Word Manual Test

Mail Merge:

1) Create a form letter. [step 1]
2) Select all the text and change to another font.
3) Change the line spacing in the first paragraph of the form letter to 1.5 and save.
4) Apply automatic hyphenation to the document.
5) Go to Tools….Mail Merge.
6) Follow the steps [step 2 to 6]
7) Type a list of addressees and save.
8) Insert greeting line + address block onto your form letter.
9) Preview your letters.
10) Complete the merge.

Appendix E

Microsoft Excel Manual Test

1. Enter a formula in ***cell B8*** to calculate the sum of the ***cell range B3 : B6***
2. Copy the formula in ***cell B8*** to the ***cell range C8 : E8*** and save.
3. Enter a formula in ***cell F6*** with an absolute cell reference (for one cell only), that divides ***cell E6*** by ***cell E12***. Copy the formula in ***cell F6*** to the ***cell range F7 : F11***
4. Enter a formula in ***cell B13*** that subtracts ***cell B12*** from ***cell B11***. Copy the formula in ***cell B13*** to the ***cell range C13 : E13***
5. Enter a formula in ***cell B11*** to calculate the maximum cost of the ***cell range B3 : B6*** . Copy the formula in ***cell B11*** to the ***cell range C11 : E11***
6. Enter a formula in ***cell B12*** to calculate the minimum cost of the ***cell range B3 : B6***. Copy the formula in ***cell B12*** to the ***cell range C12 : E12***
7. Enter a formula in ***cell B9*** to calculate the average cost of the ***cell range B3 : B6***. Copy the formula in ***cell B9*** to the ***cell range C9 : E9***
8. Enter a formula in ***cell B10*** to calculate the number of costs in the ***cell range B3 : B6***. Copy the formula in ***cell B10*** to the ***cell range C10 : E10***
9. Enter a formula in ***cell B14*** that displays the text ***Yes*** if the number in ***cell B12*** is greater than ***250*** and otherwise displays the text ***No***
10. Copy the formula in ***B14*** across ***C14 : E14***

Appendix F

Microsoft Access Manual Test

The following test for Module 5, *Database,* is based on working with a database called **Books**. In the test you will create a small table and enter some data, establish a simple relationship between two tables, design queries that will extract data from the database, and create simple forms and reports.

1. Open the **Books** database from your Candidate Disk.
2. Create a new table with the 3 fields and their properties as shown below.

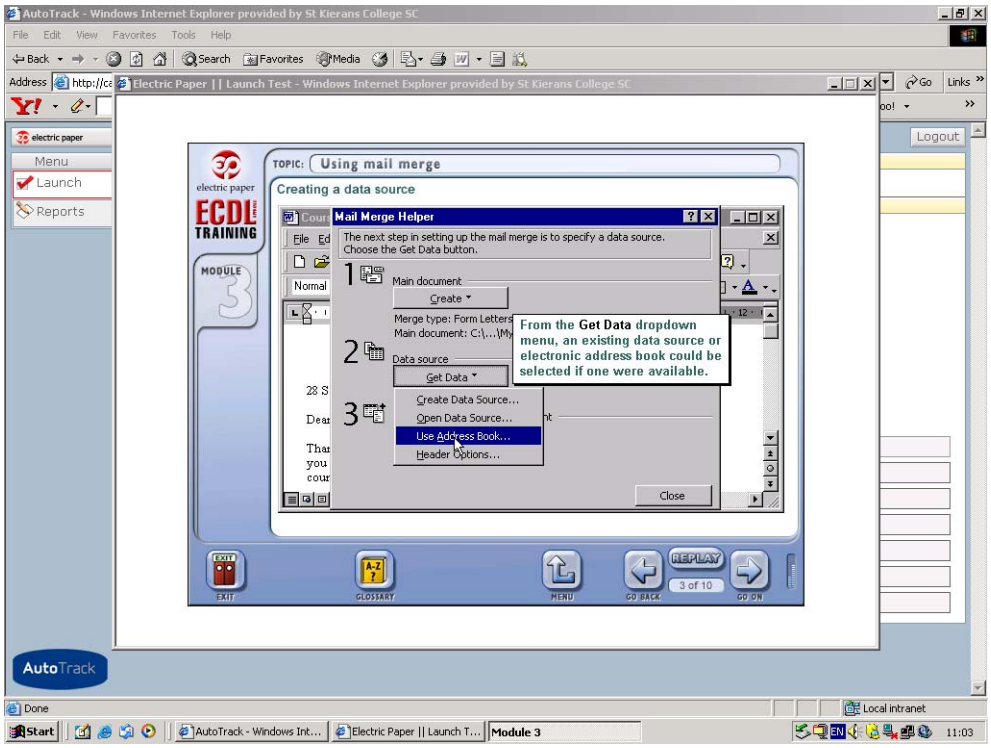
Field Name	Data Type	Field Size or Format
Book ID	AutoNumber	Long Integer
Book Title	Text	50
Category	Text	25

3. Set the **Book ID** field as the primary key.
4. In the **Authors** table delete the Last Name **Keane** and replace with the last name **Brown**.
5. Using the **Book ID** field from the **Authors** table and **Publisher ID** field from the **Publisher** table, create a one-to-many relationship between each table.
6. Apply referential integrity to the relationship created in Question 5.
7. Delete the relationship between the **Authors** and **Distributor** tables. Save and close the relationship window.
8. Open the **Distributors** table and sort the table by the Last Name field in ascending order. Save and close the **Distributors** table.
9. Using the Last Name field from the **Authors** table and the Last Name field from the **Distributors** table, create a query that will show all those who distributed **Rowling's** book. Save the query as **Rowling**. Close the query.
10. Create a report using the **Book title**, **publisher** and **year of publication** fields from the **Publishers** table. Save the report as **Pub**.

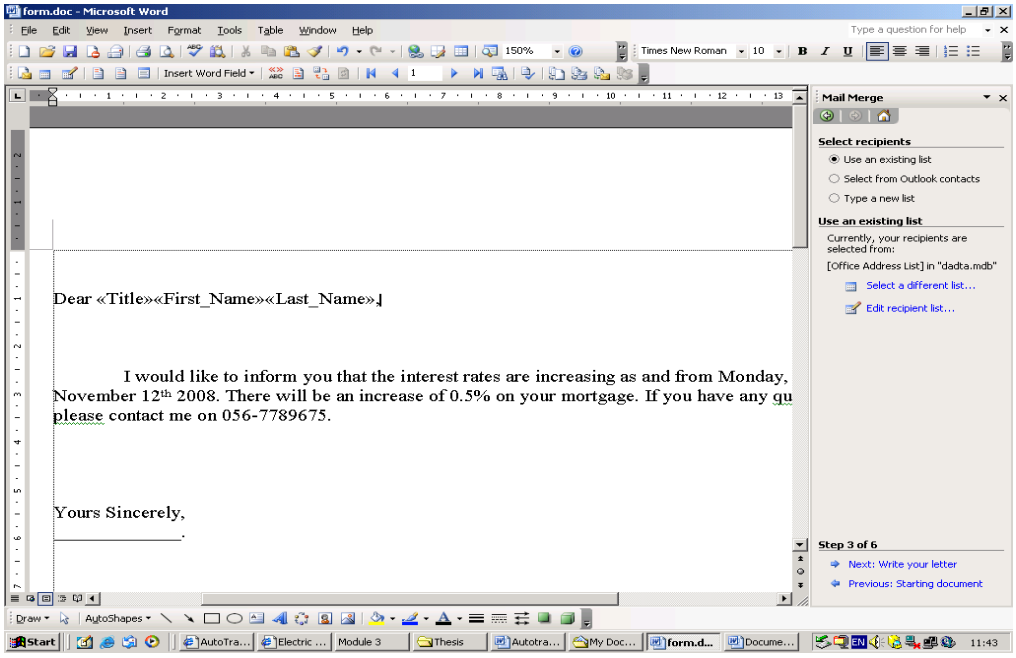
Appendix G

Screenshots of Microsoft Word

A Screenshot of Autotrack [Module 3_ Word]



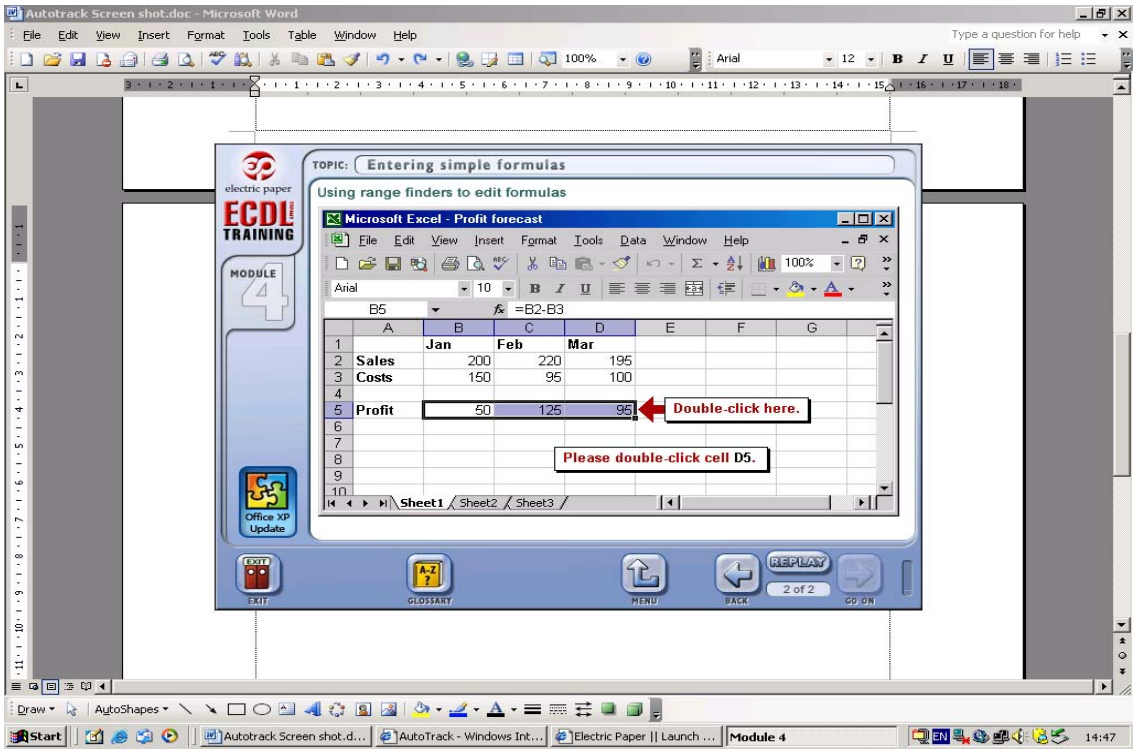
A Screenshot of Module 3: Actual Word Application



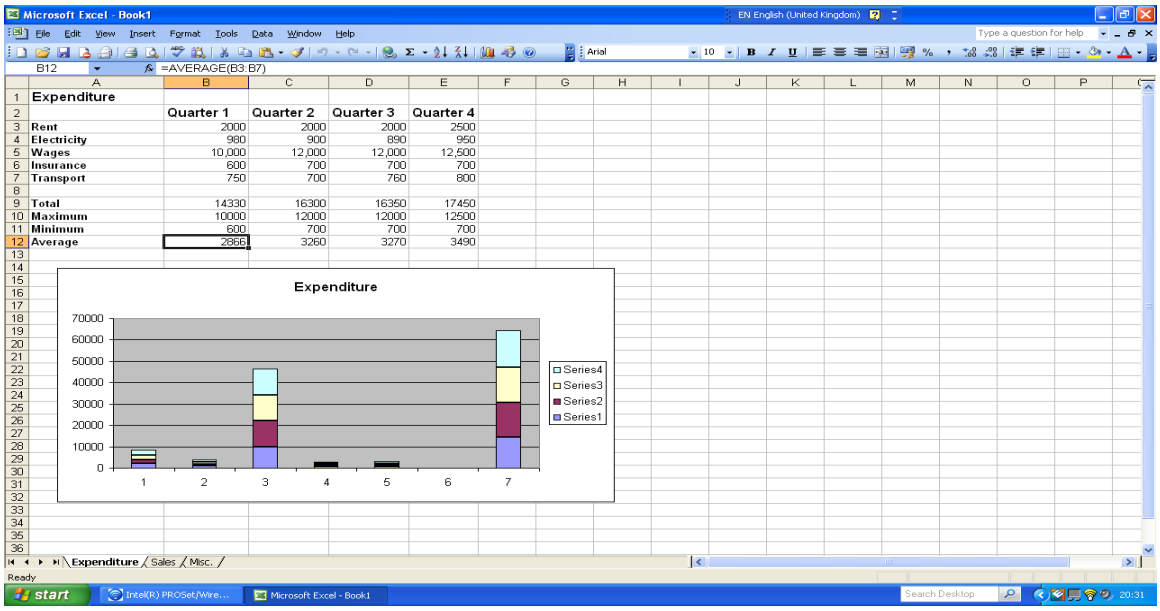
Appendix H

Screenshots of Microsoft Excel

A Screenshot of Autotrack [Module 4: Excel]



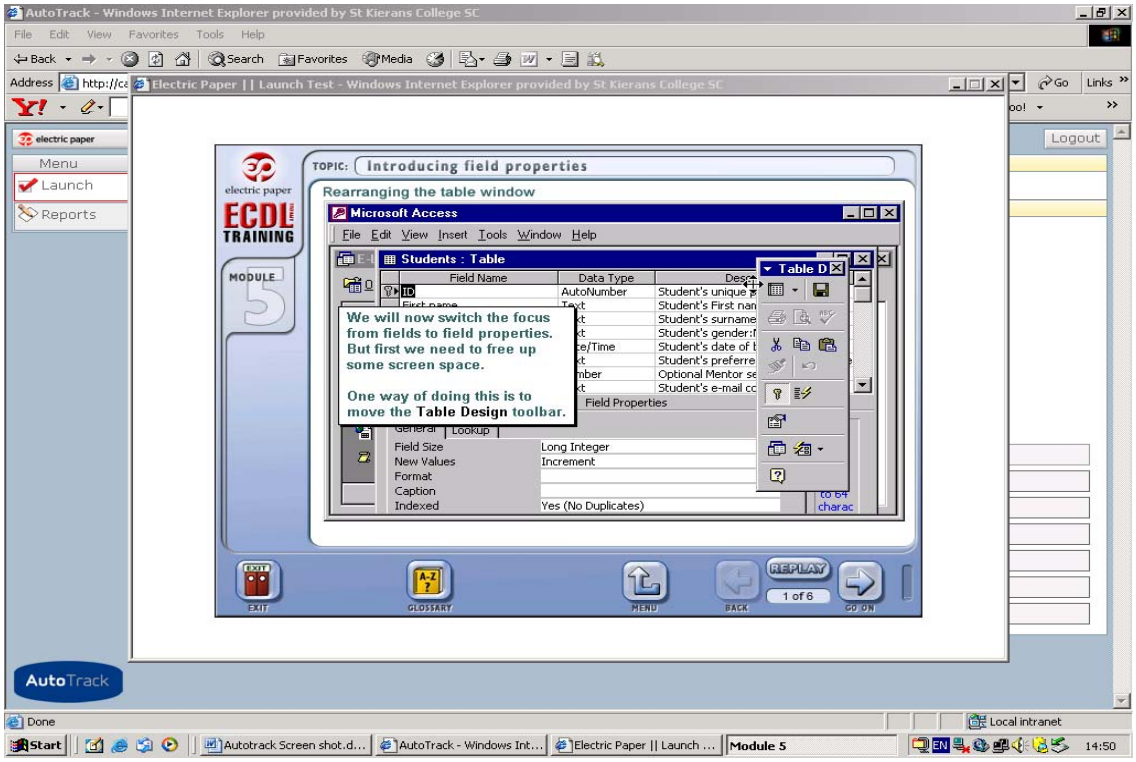
A Screenshot of Module 4: Actual Excel Application



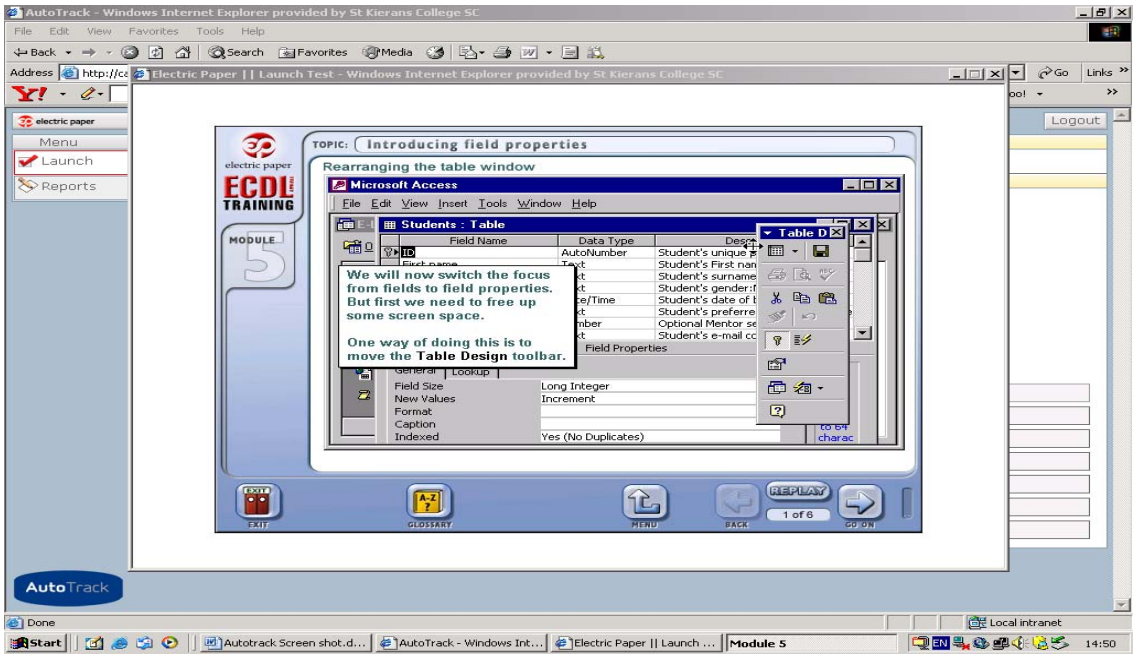
Appendix I

Screenshots of Microsoft Access

A Screenshot of Autotrack [Module 5: Access]



A Screenshot of Module 5: Actual Access Application



Appendix J

Focus Group Discussion Sheet 1 [MSWord]

January 16th 2009

Questions Posed:

How did you find the Autotrack programme?

Was it easy to navigate ?
Was it easy to understand?
Were the topics explained properly ? Explain…

Did you find it easier to understand topics when you opened Ms Word?

How did you find the Autotest system?

Were the questions easy to understand?

Did the questions reflect what was covered in Autotrack ?

Any suggestions ??

Appendix K

Focus Group Discussion Sheet 2 [MSExcel]

March 6th 2009

Questions Posed:

How did you find Autotrack ?

Was it easy to navigate ?
Was it easy to understand?
Were all topics explained properly ? Explain…

Did you find it easier to understand topics when you opened Ms Excel?

How did you find the Autotest system?

Were the questions easy to understand?

Did the questions reflect what was covered in Autotrack ?

Any suggestions ??

Appendix L

Focus Group Discussion Sheet 3 [MSAccess]

May 8th 2009

Questions Posed:

How did you find Autotrack ?

Was it easy to navigate ?
Was it easy to understand?
Were all topics explained properly ? Explain…

Did you find it easier to understand topics when you opened Ms Access ?

How did you find the Autotest system?
Were the questions easy to understand?
Did the questions reflect what was covered in Autotrack ?

Any suggestions on how to improve Autotrack and/ or Autotest ?

Appendix M

General Focus Group re: Attitudes to ECDL

May 15th 2009

Questions Posed:

Why did you study the ECDL course?
Did you have prior knowledge of the ECDL course?
If yes, has your knowledge increased?
Has your attitude to the ECDL stayed the same or has it changed since you started?
Has your motivation for studying the ECDL changed over the course of the course?

Appendix N

Post ECDL Questionnaire

Please tick appropriate box ☑

May 2009 N = 24

1. The Autotrack system is a satisfactory way of studying the ECDL.

Strongly disagree ☐ Disagree ☐ Uncertain ☐ Agree ☐ Strongly agree ☐

2. The Autotest system is a satisfactory way of assessing the ECDL.

Strongly disagree ☐ Disagree ☐ Uncertain ☐ Agree ☐ Strongly agree ☐

3. The Autotrack system is an enjoyable way of studying the ECDL.

Strongly disagree ☐ Disagree ☐ Uncertain ☐ Agree ☐ Strongly agree ☐

4. The Autotest system is an enjoyable way of assessing the ECDL.

Strongly disagree ☐ Disagree ☐ Uncertain ☐ Agree ☐ Strongly agree ☐

5. List two aspects of Autotrack that you found helpful while studying the ECDL

_____
_____
_____

6. List two aspects of Autotrack that you **did not** find helpful.

_____
_____
_____

7. List two aspects of Autotest that you found helpful while studying the ECDL.

_____
_____
_____
_____

8. List two aspects of Autotest that you **did not** find helpful.

_____
_____
_____
_____

9. Please suggest two ways that you think might improve the Autotrack system of training.

_____
_____
_____
_____

10. Please suggest two ways that you think might improve the Autotest system of testing.

_____
_____
_____
_____

11. Were you happy with the role of the teacher in the training and testing ?

Yes ☐ No ☐

Please explain _____
_____
_____

Please suggest ways that the teacher might be more helpful to students.

_____
_____
_____
_____

12. Please suggest ways [apart from Autotrack and Autotest] that might improve the system in which the ECDL course is taught and tested.

_____
_____
_____

Thank you for co-operation.

Appendix O

Critical Friend Questionnaire

Please tick appropriate box ☐ ✓

May 2009 N = 1

1. The Autotrack system is a satisfactory way of studying the ECDL.

Strongly disagree ☐ Disagree ☐ Uncertain ☐ Agree ☐
Strongly agree ☐

2. The Autotest system is a satisfactory way of assessing the ECDL.

Strongly disagree ☐ Disagree ☐ Uncertain ☐ Agree ☐
Strongly agree ☐

3. List three positives of Autotrack, if possible.

4. List three negatives of Autotrack, if possible.

5. List three positives of Autotest, if possible.

6. List three negatives of Autotest, if possible.

7. Please suggest two ways that you think might improve the Autotrack system of training.

8. Please suggest two ways that you think might improve the Autotest system of testing.

9. Please suggest ways that the teacher might improve his teaching.

10. Please suggest ways that you think might improve the delivery of this course.

Thank you for you co-operation.