AN EVALUATION OF AN INSTRUCTOR-LED AND SELF-MANAGED COMPUTER SOFTWARE TRAINING COURSE

by

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SUMMARY

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This study aimed to assess the effectiveness of an instructor-led and a self-managed computer training course. A sample of forty nine (n=49) previously disadvantaged South African adult learners was used. Half the sample was randomly assigned to the instructor-led course, while the other half was assigned to the self-managed course.

Data dealing with the course content and design, subject demographics, previous computer experience, preferred learning style, and learning potential was collected prior to each course. After the course, the ability to create key outcomes using the learned software was assessed, as well as subject perceptions of the course and various support and performance system factors. The results showed that there was no significant difference between the performance on the competence assessment of the students from the two groups. The data did, however, indicate a stronger preference for the self-managed approach. A number of limitations to the study were also noted.

Key terms: Learning style; Age; Computer efficacy; Gender; Educational level; Prior computer use/exposure; Learning potential; Instructional design.

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CHAPTER 1: OVERVIEW

1.1 INTRODUCTION

This research project focuses on the evaluation of an instructor-led and self-managed software training course. In this chapter, the overview will be presented, referring to the changing demands on computer training providers, and the background, rationale, aims, and the scope of the study.

1.2 CHANGING DEMANDS ON COMPUTER SOFTWARE TRAINING PROVIDERS

The concept of work has changed fundamentally since the Industrial era (Howard, 1995). With the rapid movement into the Informational Age (Capra, 1997), organisational processes are increasingly beginning to be supported by computer technology (e.g. communication and information-sharing being done through intranets, groupware and e-mail). Organisational structure and culture is also changing to align with these new processes (Drucker, 1988), resulting in adaptive, boundary-less organisations with limited role hierarchies and a greater focus on teamwork (Schein, 1990).

Howard (1995) notes that work is becoming increasingly cognitive, requiring more cerebral skills. Technology is replacing work that focuses on manual labour or data collection (e.g. clerks), and so work is shifting more to the interpretation of data and the making of decisions based on this interpretation (Drucker, 1988). This shift means that workers need to be able to offer organisations effective problem-solving and analytical skills (Howard, 1995), and the ability to utilise the technology available to source information and communicate effectively.

1.2.1 Global trends regarding training

In a longitudinal study (1998 to 2000) of more than 400 organisations from 47 countries outside the United States, plus 500 companies from within the United States, Van Buren and King (2000) noted the following global trends (see Appendix 1 for graphic details):

- The largest percentage of training expenditures in most regions are going towards information technology skills training, managerial/supervisory skills training, and technical processes and procedures training. In particular, computer-related training is on the increase.
- There is an overall increase in the amounts of spending on training.
- There is an overall increase in the proportions of people trained.
- There is an overall increase in the use of external training providers.
- There is an overall decrease in the use of instructor-led training and an increase in the adoption of learning technologies and other self-managed delivery methods.

In addition to this study, a team of researchers from the American Society for Training and Development (1999) highlighted seven megatrends likely to affect the Human Resource Development profession in the next five years. Of these, the following trends apply to the delivery of training:

- **Changing learner demographics**. This includes changing ages of populations, the disintegration of the nuclear family, peaks and valleys in educational achievement, increasing cultural diversity in societies and an increasing economic gap between the haves and have nots.
- **Exploding technology expenditures**. In the US alone, technology expenditures have grown from 5% of total capital spending in 1970 to nearly 50% in 1999. At a corporate level, there is nearly one personal computer per 1.3 employees. Technology-driven training is also being adopted so quickly that by 2002, it is predicted to account for 55% of all corporate training.

- **Globalization**. Information technology has created new opportunities in the way business is conducted, especially the opportunity to participate in the global economy. More and more, organisations will be demanding consistent, multilingual training that is accessible globally.

1.2.2 Increasing organisational demands

Organisations trying to survive in this complex world, continue to spend billions of dollars in an attempt to maintain employees' skill levels. However, this spending on training is done grudgingly, and organisations are becoming more demanding when it comes to computer-related training. According to Kirrane (1992), many are tired of seeing their employees being trained on computer software and emerging none the wiser. Key demands emerging from organisations include:

- The performance of employees must improve significantly as a result of the learning investment. How the learning is achieved is not important; that there is significant improvement in performance is.
- Employees need to be provided with the knowledge and skills that will enable them to produce effective outputs (e.g. documents, spreadsheets or slides).
- After the learning experience, employees need to be provided with support that is readily available and very easy to access. If not, people will resort to disturbing their work colleagues or keeping quiet and simplifying their outputs (i.e. using minimal functionality to perform their jobs). Both result in increasing the time it takes to produce required outputs.
- Employees need to be able to learn when it is convenient for them. This means they may need to learn an hour a day, or everything in one go.
- The costs of providing employees with computer skills should be as low as possible.
- The training solution offered must comply with legislative requirements.

These demands can be summed up as follows: Organisations want their employees to be able to perform their jobs more effectively, at the lowest possible cost. These costs include the above-the-line training costs (e.g. training facilities and materials), as well as the below-the-line costs (e.g. opportunity cost of the time taken to achieve required performance levels; post-training support; performance errors while learning).

1.2.3 New learner characteristics and requirements

Not only are organisational demands changing, but so are the demands of learners. Caudron (2000) points out that two types of learner are emerging, and labels them the traditional learner and the non-traditional learner. The traditional learners still make up the majority of learners throughout the world, although the numbers of new non-traditional learners are growing rapidly, particularly among adults in the developed nations. Each group has different characteristics and requirements, and training providers need to determine which group they are targeting before they begin their instructional design. Caudron (2000) summarises the characteristics and requirements of the two groups as follows:

TABLE 1.1: LEARNER CHARACTERISTICS

Traditional learners	Non-traditional learners
❑ Need motivation; prefer having training scheduled for them	❑ Highly motivated; want to learn
❑ Seldom raise questions. Usually have little real-world experience to connect to training content	❑ Raise questions in class and seek opportunities to analyze content in terms of personal or professional experiences. Need to connect class materials to real-world experiences

Traditional learners	Non-traditional learners
❑ Tolerate bureaucracy well	❑ Have a low tolerance for bureaucracy
❑ Resist participation; prefer to be told what to do and how to do it	❑ Want to participate; dislike being talked at; value discussion and projects
❑ Aim more toward the future; don't expect to apply immediately what they learn in training	❑ Show concern with immediate problems and their solutions
❑ Are interested in good grades	❑ Primarily interested in content and its relevance to career and personal life
❑ Tend to be idealistic	❑ Tend to be practical
❑ Have a restricted world view	❑ Have considerable knowledge
❑ Want to know the answer and tend to see things one way, right or wrong	❑ Understand most problems have several answers of relative value; tend to evaluate various alternatives and question one "correct" answer
❑ Impatient with the world; want things to happen overnight	❑ Have patience with the world; understand that change takes time
❑ Accept information they're given	❑ Can and will verify information given in training
❑ Have few specific expectations; tend to take what's presented	❑ Often have preconceived expectations of training that the instructor should try to identify if possible. If the training isn't what the participants expected, they consider it to be a failure

According to Caudron (2000), non-traditional learners are becoming more common in developed economies, where education levels and exposure to training are high and job demands require people learn constantly. In the developing countries (e.g. South Africa), the numbers of non-traditional learners are on the rise, although the large majority of the

adult population remain in the traditional learner category. Training providers in South Africa are therefore caught in a difficult position. On the one hand they need to continue to offer learning solutions designed for the traditional learners, while also offering the increasing non-traditional learner population solutions that satisfy their unique learning requirements.

1.2.4 Changing criteria for training evaluation

Organisations are becoming far more discerning when it comes to the assessment of the effectiveness of any training initiative (Kirrane, 1992). Where before, training courses were deemed a success if learners reported that they enjoyed the course and felt that they had learned from it; now organizations demand proof that the training has indeed resulted in improved performance back at the workplace.

Beard (1993) notes that there is recognition of a very general and widespread "transfer problem" in computer training. Garavaglia (1993) estimated that no more than 10% of the money spent on training resulted in positive transfer to the job (i.e. post-training performance). Singley and Andersen (cited in Garavaglia, 1993) state that "the problem of transfer is perhaps the fundamental education question".

Transfer is defined as the application of knowledge and skills acquired in one setting to other situations (Ellis, 1984). Positive transfer is defined as the degree to which trainees effectively apply the knowledge, skills, and attitudes gained in a training context to the job.

To prove transfer of learning to performance, according to the new guidelines provided by the South African Qualifications Authority (2000), training providers need to prove learner competence. This competence is the ability to demonstrate in a work-related context the learning outcomes identified by the course (i.e. the person must have shown

they are capable of performing the learning outcomes in a non-simulated context). If competence can be proven, then one can claim the training course to be effective.

According to Kirkpatrick (1996), however, there is more to course effectiveness than a single competence assessment. Kirkpatrick notes that rather than assessing course effectiveness on one level, it should be assessed at four different levels. These include:

- Level 1 (Reaction): How much did the participants enjoy what they were learning and the instructional methods used?
- Level 2 (Learning): Are the participants able to demonstrate the newly acquired skills and knowledge?
- Level 3 (Behavior): Are the participants able to transfer their newly acquired skills and knowledge into resolving job-related performance tasks?
- Level 4 (Results): Has the improvement in job-related performance translated to improved organisational performance?

The first two levels (i.e. Reaction and Learning), according to Kirkpatrick (1996), are influenced by factors such as learner characteristics, instructional strategies and techniques, and delivery medium. It is therefore important that the training course provided to assist learners in building their skills and knowledge is both designed and delivered in such a way that learners find the process enjoyable and effective (i.e. they are able to develop the required skills and knowledge).

The final two levels (i.e. Behavior and Results), according to Kirkpatrick (1996), are more influenced by the alignment of the job/task requirements with the newly developed skills and knowledge. Kirkpatrick highlights that it is this aspect of the learning intervention that most training providers neglect, viewing their role as complete once the skills and knowledge have been obtained. The behavior level is the level where competence is assessed, yet this, according to Kirkpatrick, should be taken one step

further (i.e. to ensure that competence translates to improved performance of the organization).

According to Bassi and Van Buren (1999), approximately 72% of training courses evaluate at the reaction level, 31% at the learning level, 11% at the behavior level and 6% at the results level. This highlights how few courses are able to prove a link between training and improved performance.

Bassi and Van Buren (1999) highlight that more and more organizations are demanding that training providers assess all four levels. Only then will they be viewed as effective. This places training providers in a difficult position, as they are forced to address a number of non-skill related factors that may influence the performance of their learners back at the workplace. Training is therefore no longer simply the provision of a training course. It has now been expanded to entail all factors that influence performance back at the workstation (i.e. a learning and performance intervention).

1.2.5 Lack of a single accepted learning theory

Not only are learners changing and course effectiveness criteria expanding, but training providers are also faced with a lack of a single accepted learning theory on which to base learning that they offer.

The concept of learning has challenged theorists for centuries. Socrates, 400 years before the birth of Christ, stated that knowledge is only perception; something that is not a transferable commodity and for which communication is not a conveyance (Benjafield, 1996). Yet billions of dollars are spent every year in trying to transfer knowledge to employees throughout the world. This knowledge transfer is normally tackled through formal training courses, each based on different learning theories and assumptions. The

effectiveness of these courses remains contentious, and no single learning theory appears to reflect all learning situations and experiences.

Although most theorists appear to agree, given a few subtle variances, on the concept of learning, few agree on the process of learning. As Hilgard and Bower (1966, p6) state, "While it is extremely difficult to formulate a satisfactory definition of learning so as to include all the activities and processes which we wish to include and eliminate all those which we wish to exclude, the difficulty does not prove to be embarrassing because it is not a source of controversy as it is between theories. The controversy is over fact and interpretation, not over definition".

The common denominator of all the definitions reviewed (Knowles, 1978; Staddon, 1984; LeFrancois, 1995) is that learning involves the relatively permanent change in behaviour. Unless one can detect a change in behaviour, it can therefore be assumed that learning has not taken place.

What causes this change, however, appears to be a lot more contentious. Countless learning theories have been derived, with little consensus. LeFrancois (1995) states that these learning theories are simply attempts to systematise and organise the observations, hypotheses, hunches, laws, principles and guesses that have been made about human behaviour. Yet as Gagne (1966) points out, learning is not a phenomenon that can be explained by simple theories, despite the intellectual appeal that such theories have.

One area where there does appear to be some consensus between the various schools of learning theory is the view that motivation to change one's behaviour is a necessary criterion for learning. Where this motivation comes from is, however, widely debated.

The behaviourist school would argue that one is motivated to change one's behaviour by the consequences that apply (Rachlin, 1970; Staddon, 1984). If the consequences of

improving one's performance are viewed as good, the person will learn and thereby change his/her behaviour. If the consequences are bad, they will tend to behave as before. This concept is used extensively in many instructor-led classrooms, where instructors hand out gifts, compliments and certificates in an attempt to generate positive consequences. On the other hand, the lack of consequences has also been pointed out to be a key reason for poor results obtained from many self-driven learning interventions.

The cognitive school of thought would suggest that motivation to change one's behaviour is more driven by cognitive dissonance i.e. it is all in the mind (Anderson, 1995; Coon, 1989). When new information does not match currently held models or schema, then the person is motivated to resolve this disparity.

The humanists, however, would argue that motivation is in fact intrinsic, and that people are by their very nature driven to improve themselves and self-actualise (Royce & Leendert, 1981; Coon, 1989). Learning, therefore, will occur as long as the person is given the opportunity to challenge their thinking and perceptions (i.e. it simply needs to be facilitated).

Whatever the cause for motivation to learn, it still remains a common element of all learning theories. In addition to motivation, Knowles (1978) points out that the learner requires the ability to learn. Without ability, the learner can possess all the motivation in the world to learn but will not be able to operationalise that desire. This view is not supported by the behaviourist school. However, the cognitivists and humanists would tend to agree.

Training providers are therefore left in a quandry as to which learning theory to apply to software learning. Knowles (1978) notes that, depending on the learner, the subject, the delivery medium and the countless variables present in the macro and micro system in which the learning experience takes place, different learning theories will apply (i.e. there

is no one theory that has all the answers). One is therefore left with the option of selecting one theory of learning and basing the entire learning design on that theory, or alternatively opting to select the theory that applies to the specific situation at hand.

1.2.6 The training challenge

For training to survive in the 21st century, training providers are going to have to show that their initiatives result in a performance improvement, not just in rave reviews from the learners (Robinson & Robinson, 1995). Organisations want to see causal links between training and performance. If not, training budgets will be slashed in favour of initiatives that achieve this objective.

Rothwell and Kazanas (1998), point out, that for training initiatives to rise to this challenge, they need to focus on a number of key areas:

- **The theoretical framework**. This impacts heavily on how the learning instruction is designed, delivered and assessed (Knowles, 1978), and needs to be appropriate for the learning objectives in mind.
- **The instructional design**. This, according to Kemp (1985) is a key determinant in the effectiveness of any learning initiative. The instructional design requires detailed analysis of the characteristics of the target audience and their learning requirements. This analysis then enables the appropriate selection of content and instructional strategies to meet these requirements (Jonassen, 1990).
- **The delivery method**. Selecting the delivery medium impacts on the dominant senses (e.g. auditory, visual, tactile) used to receive the information (Kirrane, 1992). It also normally impacts on the control that the learner has over the pace and flow of information provided.
- **The course assessment**. Too often, training courses are evaluated on the reactions of learners, or on a general demonstration of learning within the training environment

(Shelton & Alliger, 1993). Few are able to prove that learners are in fact able to perform more effectively, something organisations are demanding more and more.

- **The post-training support**. Learning is not a static process, rather one that continues as an ongoing process (Kolb, 1984). Learners therefore need to be provided with ongoing access to information and feedback in order to empower them to continue their learning on the job (Beard, 1993).
- **The work environment**. Learners return from training and have to transfer their learning into performance within this environment. There are, however, a number of factors that will limit their ability to do this (Capra, 1997). These factors need to be addressed if learning is to translate into desired performance outcomes (Rummler and Brache, 1995).

Training providers are therefore challenged to create learning solutions as opposed to training courses. These solutions need to address a multitude of variables that impact on the person's ability to learn, and to then transfer that learning into improved performance.

1.3 BACKGROUND TO THE STUDY

A South African-based learning design organisation specialising in the design of learning solutions for computer software, currently offers their clients the option of two specific learning methods; one instructor-led, the other self-managed. Generic courses in desktop software (e.g. Windows 95, Word 97, Excel 97, and PowerPoint 97) are offered using these two approaches. Clients to date have been given the option of either method, depending on their particular needs and preferences. This has increased sales in the short-term, as clients who have strong preferences for either delivery method have been catered for.

The cost of offering two delivery methods for every course, however, is proving too great and the organisation needs to focus on one of the two delivery methods. Although

instructor-led training is still the most popular, the company wishes to base the decision on learning effectiveness rather than current client perceptions.

In addition to streamlining their products by identifying the more effective learning method, the organisation also needs to address a key factor specific to the South African market. This relates to legislated Affirmative Action recruitment and development policies. Organisations implementing these Affirmative Action recruitment and development policies are increasingly requiring the organisation to prove that their training courses address the specific needs of their previously disadvantaged employees. To date, most of the learners exposed to the organisation's training courses have been from the previously advantaged community within South Africa. The organisation is therefore unsure of the effectiveness of their courses with the previously disadvantaged group.

Finally, like all training providers, the organisation needs to find ways of ensuring that people who complete their courses actually improve their performance using the specific computer software. One way the company has done this is to assess learning based on performance outcomes. Another way is by providing post-training support in the form of quick-reference cards. These cards appear to be well received, although this is not based on any research. It is more based on general feedback from the training managers.

The challenges facing this specific organisation used for the present research project are therefore as follows:

- They have no research to base their selection of either learning approach (i.e. the instructor-led vs the self-managed approach).
- Their generic training courses were designed and piloted on predominantly white, literate adults. They therefore do not know whether their current training courses are appropriate to meet the needs of the previously disadvantaged target population.

- They are not sure whether their post-training support is effective in supporting learning and performance after the completion of the course.
- They are not sure if there are other factors impacting negatively on people who learn using their courses that they can do something about.

1.4 RATIONALE FOR THE STUDY

The challenges and issues facing the organisation described above are by no means uncommon, and reflect those facing all computer software training providers in South Africa.

Given these challenges and issues, the primary research question of this study is:

"Which of the two training courses, the instructor-led or the self-managed, is more effective in teaching the sample of students the key skills and knowledge they required to complete key spreadsheet-related tasks using the software Microsoft Excel 97?"

Additional research questions include:

- "If there is a difference in course effectiveness, what are the reasons for this difference?"
- "Are the quick-reference learning cards effective in supporting learning after the course is complete, and/or should the company look at additional ways of providing support?"
- "Are there any other factors that may be impacting the learner's ability to perform effectively after they have completed one of the training courses?"

1.5 AIM OF THE STUDY

The aims of the study are as follows:

1.5.1 General aim

The general aim of this study is to determine which of the two specifically designed training courses, the instructor-led or the self-managed, is more effective in teaching the sample of students the key skills and knowledge they required to complete key spreadsheet-related tasks using the software Microsoft Excel 97.

1.5.2 Specific aims

This research has the following specific aims:

(a) To review, from literature, theories that apply to the learning of specific spreadsheeting computer software skills and knowledge.

(b) To review, from literature, the different factors that impact on the effectiveness of a training course designed to teach people computer software-related skills and knowledge.

(c) To determine which of the two specifically designed training courses, the instructor-led or the self-managed, is more effective in teaching the sample of students the key skills and knowledge they required to create and manipulate a number of different spreadsheets using the software Microsoft Excel 97.

(d) To identify and discuss, if one training course is found to be more effective than the other, the factors that may be responsible.

(e) To provide recommendations of additional ways of improving learning using the specifically designed instructor-led and self-managed courses, and to identify possible areas for further research.

1.6 THE THEORETICAL FRAMEWORK FOR THIS STUDY

Lee (1987) points out that an "appropriate theory" is one which is used by the educator, even though it is known to have inadequacies in terms of the scientific supporting evidence underlying it and even though it is known to offer a simplified view of reality, because it is perceived as a useful way of encouraging insights which will be helpful when coping with practical situations.

The choice of appropriate theory, according to Knowles (1978), rests on two factors, namely the complexity of the learning task and the level of the individual's ability.

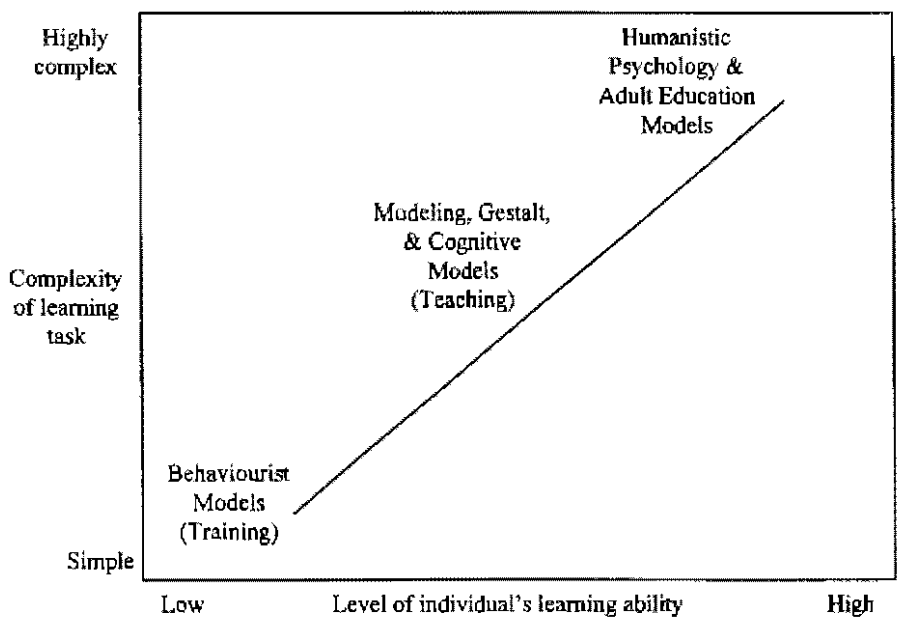

Figure 1.1: Theory application model
Source: Knowles (1978)

The complexity of using Excel 97 to create various spreadsheets was viewed by the researcher as a medium to highly complex task. The ability of the learners, however, was viewed as average. It was therefore decided that the most appropriate framework to base the assessment of the software courses was to use the Cognitivist approach to learning.

1.7 DEFINITION OF COURSE EFFECTIVENESS

To assess the effectiveness of any training course, all 4 levels of Kirkpatrick's (1996) model should be taken into consideration. However, in this study, this was not possible for the following reasons:

- The sample population was only able to spend one morning with the researcher, so there was not enough time to assess the level of skills and knowledge, as well as their ability to apply these skills and knowledge to job-related tasks.
- The researcher was not able to access the learner's organisational environments as each learner came from a different organisation around the country. A number of learners also attended the course for personal development reasons, and the skills and knowledge did not necessarily apply to their specific jobs.

Given these constraints, the effectiveness of the instructor-led and self-managed software training courses was primarily based on the assessment of whether the learners were able to apply the newly acquired skills and knowledge to various spreadsheeting tasks (i.e. Level 3), and the course rating by the subjects (Level 1). The skill and knowledge level (Level 2) was not assessed, as the recall of system steps and spreadsheeting concepts was viewed as less important (given the above constraints) than assessing whether learners could actually apply these skills and knowledge to work-related tasks. In addition, the system steps were provided to each subject as a learning and performance support, which to a large degree made assessing this knowledge superfluous.

So, for the purposes of this study, the more effective training course is defined as the course that:

- Receives the most positive reaction (Level 1).
- Obtains the best average competence assessment scores (Level 3).

1.8 OVERVIEW OF THE RESEARCH DESIGN

This study involved the provision of either an instructor-led or a self-managed Excel 97 Fundamentals training course to two sample groups of previously disadvantaged South African students. These sample groups were attending an Information Technology Fundamentals course run by the Witwatersrand Business School, and were given the option of attending an Excel 97 Fundamentals course as an optional extra. The students were unaware of which method of instruction they would be receiving (i.e. instructor-led or self-managed). Prior to the course, each subject completed a questionnaire relating to demographic details and an assessment of their learning style. They were also required to complete a learning potential test. Upon completion of the course, each student was then given a final competence assessment to determine the level of skill and knowledge acquisition derived from the training course. They were also required to rate various aspects of the course, as well as provide, at a later stage, an assessment of the effectiveness of the post-training support. The competence assessment scores obtained by each sample group were then compared, as were the learner characteristics and various other aspects of each training course.

1.9 OVERVIEW OF THE CHAPTERS

The balance of this study will consist of 5 chapters. Chapters 2 and 3 will complete phase 1 of the study, that being the theoretical overview and literature review.

Chapter 2 will be a literature review of the Cognitivist approach to learning. The review will focus, in particular, on how people learn, what they learn, the personal factors that influence learning, and the implications to instructional design and delivery.

Chapter 3 will focus more specifically on research findings relating to the learning of computer software. In addition, a description of the different learning approaches used for software training will be provided.

Phase 2 of the study, that dealing with the empirical study, will also consist of three chapters. The first of these, Chapter 4, will set out the method of the investigation and will describe specifically the strategy used for the research and the elements making up this strategy. Chapter 5 will cover the results of the study. These results will be divided up into the quantitative and qualitative data. Finally, Chapter 6 will review the study with a discussion of the results, followed by conclusions and recommendations.

1.10 SUMMARY

In this chapter, the changing demands of global software training was discussed. Global trends were reviewed, as well as changing organisational demands and new learner characteristics and requirements. The lack of a single accepted learning theory was then highlighted, with a brief review of the different views held by the various schools of learning theory. The challenge to training going into the 21st century was then discussed, followed by a background overview of the study. The rationale of the study then followed, along with the aims of the study. Thereafter, a description of how course effectiveness will be defined for this study was provided, as well as a brief overview of the research design and the report chapters.

CHAPTER 2: A COGNITIVE PERSPECTIVE OF LEARNING

2.1 INTRODUCTION

In this chapter, a brief review of the Cognitivist approach to learning is undertaken. This includes reviewing how people learn; what they learn; the personal factors influencing learning and the implications to instructional design and development.

2.2 THE COGNITIVIST APPROACH TO LEARNING

Cognitive psychology refers to all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered and used (Neisser, 1967). Reed (1972) notes that there are a number of important assumptions one needs to make when viewing learning from a cognitive perspective:

- Cognition begins with our contact with the external world.
- Our representation of the world is not a passive registration of our physical surroundings but an active construction that may involve both reduction and elaboration. We therefore can only attend to a small part of the physical stimulation that surrounds us, and only a small part of what we attend to can be remembered.
- We store and recover information in memory, although what is stored may not necessarily be recovered.
- The information we are able to perceive, store and then recover needs to be used effectively to make decisions and solve problems.

As Bruning, Schraw and Ronning (1999) point out, learning from a cognitive perspective is seen as a constructive as opposed to receptive process. It is the product of the interaction among what learners already know, the information they encounter, and what

they do as they learn. In a sense, learning can be thought of as created out of learners' points of view, their knowledge, their approaches to learning, and the information they encounter. It is not so much knowledge and skill acquisition as it is the *construction of meaning* by the learner (Prawat, 1996).

The key themes, according to Bruning, Schraw and Ronning (1999) running through cognitive theories on learning are as follows:

- The way in which the learner structures their knowledge directs perception and attention, permits comprehension and guides recall.
- The learner's prior knowledge and repertoire of processing strategies play an important role in how meaning is constructed.
- The more knowledge students have about their own thinking, the greater their ability to use this awareness to regulate their own cognitive processes. This is reflected in their ability to remember, learn and solve problems.
- Motivation and beliefs direct learning and influence whether activities are attempted, completed, and repeated.
- Social interaction impacts on cognitive development. Social-cognitive activities, such as well-managed cooperative learning and classroom discussions, stimulate learners to clarify, elaborate, reorganize and reconceptualise information (King, 1991). Peer interaction gives students the opportunity to encounter ideas and perceptions that differ from their own, and new knowledge can be constructed out of these exchanges.
- The context in which information is perceived, processed and stored influences the nature of the knowledge, strategies, and expertise. Events are inherently situational, occurring in contexts that include other events and taking some or even much of their meaning from those contexts (Zimmerman, 1995).

These themes influence how people are seen to learn, what they learn, and what factors influence their learning.

2.3 HOW PEOPLE LEARN

There are a number of cognitive theories on how people learn, many based on the metaphor of man as an information processor, just like a computer. This metaphor gave rise to a number of Information Processing Models (Reed, 1972), each trying to clarify the different memory systems, the encoding processes and the retrieval processes. An example of such a model is provided in Figure 2.1.

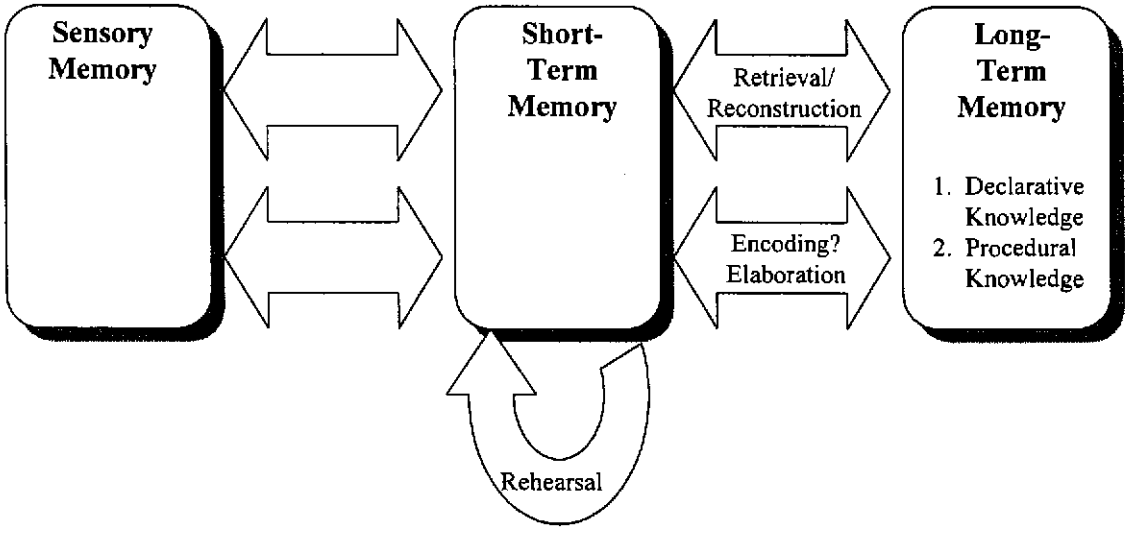

Figure 2.1: Information processing model
Source: Brunning, Schraw and Ronning (1999)

The main assumptions of the various Information Processing Models (Bruning, Schraw and Ronning, 1999; Neisser, 1967; Reed, 1972) include the following:

- Memory systems are functionally separate.
- Attention (i.e. mental energy to perceive, think, and understand) is limited, although this limited processing capacity can be stretched by using capacity-saving strategies such as chunking, categorization, and elaboration.

- Processes are both controlled and automatic (e.g. driving a car). Controlled processing can be allocated to higher-level tasks (e.g. constructing inferences when reading) only when basic cognitive processes (e.g. decoding words) are automated.
- Information processing is more than just translating information from physical stimuli to a symbolic mental representation. Meaning is constructed on the basis of prior knowledge and the context in which the task occurs. Even though the construction of meaning is supported by all components of the information processing system, much of it takes place in short-term memory. Once meaning is constructed and forwarded to long-term memory, much of the original form of information is lost.
- When recalling information from long-term memory, learners are forced to fill in the gaps to make meaning of the recalled information.

2.3.1 Memory systems

The memory systems described by the model provided in Figure 2.1 are sensory, short-term (or working) and long-term memory.

(a) The sensory system

The sensory memory is a system that briefly holds stimuli in sensory registers so that perceptual analyses can occur before that information is lost. The first step in this process is **perception**, which enables the person to detect incoming perceptual stimuli by allocating attention to them. There are limits to the amount of information that can be perceived at any one time. According to Sperling (1960), visual registers hold about 7 to 9 pieces of information for about 0.5 second, while auditory registers hold about 5 to7 pieces of information for up to 4 seconds. This indicates that there may be real benefits presenting information both visually and auditorially.

The perceived stimulus must then be transformed and briefly stored. Next a body of prior knowledge needs to be available to make sense of this stimulus. This process is called **pattern recognition**, and enables the person to associate perceptual information with a recognizable pattern. Finally some decision has to be made regarding its meaning. This process is referred to as **assignment of meaning**. The assignment of meaning, according to Marr (1985) depends on 3 things:

- The nature of the stimuli.
- Our background knowledge (e.g. if a person is not Chinese, then a Chinese letter will have less meaning to the individual than it would to a Chinese person).
- The context in which we encounter the stimuli, as the contextual information helps us search our background knowledge more efficiently.

(b) The short-term memory

Once the stimuli are perceived and recognised, they are forwarded to short-term memory for additional processing. Short-term memory refers to the place where information is processed for meaning (Reed, 1972). Like sensory memory, it is limited with respect to capacity and duration. Miller (1956) argues that the information processing is constrained by a severe bottleneck in the memory system. Under most circumstances, people hold no more than seven or so chunks (meaningful units of information) at a time. Importantly though, short-term memory is sensitive to the number of chunks, not their size. This allows for learners to use effective strategies, such as chunking, to maximise the storage capability (Bruning, Schraw & Ronning, 1999).

(c) The long-term memory

Once information has then been stored and processed in short-term memory, it can then be passed on to long-term memory. According to Bruning, Schraw and Ronning (1999), cognitive theorists have identified five building blocks of cognition in long-term memory.

These concepts have common features, but each one represents a somewhat different view of how best to conceptualise the information stored in memory. These building blocks are:

- **Concepts**: These are the mental structures by which people represent meaningful categories (Bruning, Schraw & Ronning, 1999). Particular objects are grouped together on the basis of perceived similarities e.g. fruit or furniture.
- **Propositions**: These are the smallest unit of meaning that can stand as a separate assertion e.g. splitting a large paragraph into phrases of meaning (Andersen, 1981).
- **Schemata**: These are complex representations that control the encoding, storage and retrieval of information. Some schemata represent our knowledge about objects; others represent knowledge about events, sequences of events, actions, and sequences of actions (Rumelhart, 1980). The appropriate context of information is critical.
- **Productions**: These are condition/action or if/then rules that state an action to be performed and the conditions under which that action should be taken e.g. if the car is locked, insert the key into the lock. In general, productions have the capability of triggering an action automatically. If the conditions exist, then the action will occur (Andersen, 1981).
- **Scripts**: These provide the underlying mental frameworks for procedural knowledge (Schank & Abelson, 1977). They are schemata representations for events e.g. the process you follow when eating out would be to enter, sit down, order, eat, pay, and then leave.

2.3.2 Encoding processes

Encoding is the process involved in placing information into long-term memory. How people process to-be-remembered information impacts on how well they remember it. In particular, the way they rehearse information influences the quality of their memory (Bruning, Schraw & Ronning, 1999).

There are different ways in which learners can encode information. These include:

- **Maintenance rehearsal**: This is the direct recycling of information in order to keep it active in short-term memory e.g. memorizing a telephone number (Craik, 1979).
- **Elaborative rehearsal**: This is any form of rehearsal in which to-be-remembered information is relating to other information e.g. breaking the word familiar into syllables "fam; i; liar" and relate each one to something you know (Craik, 1979).
- **Mediation**: This involves tying difficult to remember items to something more meaningful e.g. to memorise the strange word "ris-kir" you would tie it to the word "race-car" (Montegue, Adams & Kiess, 1966).
- **Imagery**: Tying the word to an image improves retrieval. Interesting findings relating to imaging include:
  - Easily imaged words tend to be remembered more readily than hard-to-image words (Paivio, 1986).
  - There appear to be individual differences among students in their ability to image information (Ahsen, 1987).
  - The best images are bizarre, colourful and strange (Bruning, Schraw & Ronning, 1999).
- **Mnemonics**: These are memory strategies that include the use of sayings, rhymes (e.g. one is a bun, two is a shoe), and gestures (e.g. the right hand rule in physics).

2.3.3 Retrieval processes

Retrieval is the process of accessing and placing into consciousness information from long-term memory (Bruning, Schraw & Ronning, 1999). Retrieval is more than playing back an event from memory; it is the ability to use ideas and general knowledge to construct a reasonable response. It is a process that cannot be divorced from the encoding process, as an individual's ability to remember information is related strongly to their ability to encode it in a meaningful fashion. According to Tulving and Osler (1968), remembering is enhanced when conditions at retrieval match those present at encoding.

When a close match occurs, contextual cues may help individuals perform an efficient search of memory. When cues differ substantially, an efficient search of memory may be impossible. This is supported by Rabinowitz and Craik (1986) who note that verbal material self-generated at the time of encoding is better remembered than material that students merely read at encoding.

Some key findings about the retrieval process include:

- Retrieval is state dependant. People who learn something when they are, for example, sad recall more of the information when they are in a similar state of sadness (Owens, 1993).
- Learning increases when students generate their own context for meaning. Learning improves when students make, rather than take, meaning e.g. generating an antonym to the word "stop" will improve the memory for the word "go" (Bruning, Schraw & Ronning, 1999).
- Retrieval is fallible i.e. it is subject to error (Greene, 1992). This is due to all the spaces left by the encoding process.

2.3.4 Influence of information processing on instruction

According to Bruning, Schraw and Ronning (1999), the Informational Processing Models highlight the following when it comes to instruction:

- Instruction needs to focus the students on the important aspects and relate explanations to prior knowledge.
- Students need time to practice extensively so that more processes can be automated, and limited cognitive resources freed up.
- Perception and attention are guided by prior knowledge. Instruction therefore needs to match activities with prior level of knowledge.
- Resources and data limitations constrain learning. Some tasks may be too demanding for some students to master all at once because they lack the cognitive resources.

Also when too much information is expected to be learned in too little time, certain learners will struggle.

- Students need to be shown how to organize new information into meaningful "chunks", and how to proceduralise their knowledge through practice.
- Students understand what they read, hear, and see through filters of their experiences in their families and cultures. Prior knowledge therefore influences how they perceive certain information.
- Provide opportunities for students to use both verbal and imaginal coding (i.e. words and images).
- Testing conditions should match learning conditions.
- Use instructional strategies that promote elaboration. Encourage students to construct meaning based on their own knowledge, goals and uses of information.
- Allow students to make, rather than take, meaning.

2.4 WHAT PEOPLE LEARN

According to cognitive theorists, knowledge can be defined in different ways. At times knowledge relates to facts, at times procedures, and other times to an understanding of how one learns (Reed, 1972).

2.4.1 Knowledge of facts

Declarative knowledge, according to Bruning, Schraw and Ronning (1999) is factual knowledge and needs to be divided into two categories, namely semantic memory and episodic memory. Semantic memory is memory of general concepts and principles and their associations e.g. word meaning, geographic locations and chemical formulae; while episodic memory refers to the storage and retrieval of personally dated autobiographical experiences e.g. recalling childhood experiences.

2.4.2 Knowledge of procedures

Procedural knowledge, on the other hand, involves knowing how to perform certain activities (Bruning, Schraw & Ronning, 1999). For example, the process you follow to format font in Excel 97. This knowledge relates far more to the application of facts than to the facts themselves.

2.4.3 Knowledge of one's own thought processes

Metacognition refers to knowledge people have about their own thought processes (Reed, 1972). Brown (cited in Bruning, Schraw & Ronning, 1999) notes that metacognition includes two related dimensions; knowledge of cognition (i.e. what we know about our own cognition) and regulation of cognition. Regulation of cognition typically includes three components, namely planning (i.e. the selection of appropriate strategies and the allocation of resources); regulation (i.e. monitoring and self-testing skills necessary to control learning) and evaluation (i.e. appraising the products and regulatory processes of one's learning).

According to Bruning, Schraw and Ronning (1999), the more a person knows about their own thought processes, the more capable they are of selecting the most effective encoding and retrieval processes and strategies. Using this concept, Pressley and Schneider (1997) have developed 5 criteria to describe a good strategy user. These people appear to have:

- A broad repertoire of strategies.
- Metacognitive knowledge of why, when, and where to use strategies.
- A broad knowledge base.
- The ability to ignore distractions.
- The ability to automate the above four processes.

2.4.4 Influence on instruction

Identifying that people either learn declarative or procedural knowledge, or metacognitive knowledge, influences how we should design and deliver instruction. According to Bruning, Schraw and Ronning (1999), this includes the need to:

- Test knowledge correctly (e.g. declarative knowledge with multiple-choice questions) and procedural knowledge with essay type or application questions).
- Make strategy instruction a priority, and to encouraged students to work out how they learn, and to develop their metacognitive knowledge.

2.5 PERSONAL FACTORS INFLUENCING LEARNING

According to various cognitive theorists, there are a number of important personal factors that impact on a person's ability to learn.

2.5.1 Belief in one's own ability to learn and perform

According to Bandura's (1977) Social Cognitive Theory, learning is the result of the interaction between personal factors, behavioural factors and environmental factors. Of the personal factors, Bandura highlights self-efficacy as a key factor affecting learning, especially in response to behavioural and environmental stimuli.

Self-efficacy, according to Bandura (1977), is the degree to which an individual possesses confidence in his/her ability to achieve a goal. This should not be confused with general self-esteem, as it is a judgement of one's ability to perform a task only within a specific domain. High self-efficacy in one setting does not guarantee high self-efficacy in another.

Bruning, Schraw and Ronning (1999) point out that judgements of self-efficacy differ along three dimensions related to performance:

- **Level of task difficulty**. Even students with high self-efficacy in computers may be reluctant to take a masters course because they may believe the level of expertise is much higher than they are used to, or they may lack required prior knowledge or strategies.
- **Generality**. This is your ability to generalize efficacy across domains e.g. if you can perform effectively in one area and then believe you can therefore perform effectively in a number of other areas.
- **Strength**. Weak perceptions of self-efficacy are more susceptible to disconfirming evidence (observing someone else fail at the task) or to poor performance. Strong senses of self-efficacy result in perseverance, even in the light of disconfirming evidence or poor performance.

2.5.2 Expectations of behavioural consequences

A second key personal factor highlighted by Bandura (1977) is outcome expectancy. This is the perceived relationship between performing a task successfully and receiving a specific outcome as a consequence of that performance. These expectations influence the motivation to learn new skills and knowledge (Knowles, 1978), although this motivation may come from within or from external environmental factors. Intrinsic motivation refers to the behaviours that are engaged in for one's own sake e.g. for personal interest or the joy of doing it. Extrinsic motivation refers to behaviours that are performed to achieve some externally prized consequence, not out of interest or a personal desire for mastery (Deci, Vallerand, Pelletier & Ryan, 1991).

2.5.3 Belief in autonomy and control

According to Deci and Ryan (1985), behaviours are either self-determined (chosen for intrinsic reasons) or controlling (engaged in because of internal or external pressure to conform to a set standard), and that the perceived autonomy and control a student has over their learning environment has a greater impact on learning than ensuring that the various motivational factors are in place.

The distinction between autonomous and controlled actions is important because the degree of perceived choice determines one's behavioural response within a particular context (Deci & Ryan, 1985). To be autonomous, a behaviour must be self-determined and chosen without pressure. In contrast, a controlled behaviour may be chosen, but it will never be self-determined.

2.5.4 Beliefs about intelligence and knowledge

Implicit beliefs are tacit assumptions about how some phenomenon works (Bruning, Schraw & Ronning, 1999). They have been found to impact on the willingness of learners to use strategies while learning (Ames & Archer, 1988) and to affect how people think and reason (Ryan, 1984). The two key areas of implicit belief that have been studied are those involving the beliefs around one's own intelligence, and of one's knowledge.

(a) Beliefs about intelligence

Dweck and Leggett (1988) point out that most individuals can be characterized by one of the following: they believe that intelligence is changeable and improves incrementally (incremental theory), or they believe that intelligence is fixed and unchangeable (entity theory). These beliefs are independent of the person's true intellectual ability, yet holding either belief appears to have important consequences for personal academic goals.

Incremental beliefs give rise to the development of learning goals, in which individuals seek to *improve* their competence. Entity beliefs give rise to performance goals in which individuals seek to *prove* their competence. These beliefs also affect efficacy, with students having strong learning goals being more efficacious and more inclined to ask for help from teachers and other students (Ames & Archer, 1988). Performance-oriented students view failure as a consequence of low ability, task difficulty and poor teacher-student interactions; hence are less likely to ask questions.

(b) Beliefs about knowledge

Beliefs about knowledge, or epistemological beliefs, influence how a person approaches learning (Bruning, Schraw & Ronning, 1999). According to Schommer (1990), the beliefs that people hold about knowledge can be viewed across four dimensions, namely:

- **Simple knowledge**: Belief that knowledge is discrete and unambiguous.
- **Certain knowledge**: Belief that knowledge is constant.
- **Fixed ability**: Belief that one's ability to learn is inborn and cannot be improved through either effort or strategy use.
- **Quick learning**: Belief that learning occurs quickly or not at all.

When investigating their relationship to sociological variables and information-processing skills, Schommer (1990) found the following:

- The amount of higher education received by students is inversely related to their belief in certain knowledge. This study implies that better-educated people may be more willing to believe that knowledge is tentative and subject to personal interpretation.
- Females are more likely than males to believe that learning is gradual, rather than quick and thereby more willing to persevere with a difficult-to-learn subject.
- Quick learning predicted oversimplified conclusions.

According to Bruning, Schraw and Ronning (1999), beliefs about knowledge affect the way one reasons, how long one persists at a difficult task, and perhaps what academic discipline one enters. These beliefs are more significantly impacted by factors at home (e.g. parental beliefs) and school (e.g. performance demands) than one's measured ability.

2.5.5 Problem-solving

A problem exists when our current state differs from a desired state (Bransford & Stein, cited in Bruning, Schraw & Ronning, 1999). Research on problem solving has received a great deal of attention since Thorndike, Dewey and Gestalt, with most contemporary models tending to reflect a five-stage sequence (Bruning, Schraw & Ronning, 1999). This sequences is as follows:

- Identify the problem.
- Represent the problem.
- Select an appropriate strategy.
- Implement the strategy.
- Evaluate solutions.

Bruning, Schraw and Ronning (1999) note that the ability of a person to follow each step sequentially, and to complete each step thoroughly, influences their problem-solving capability.

2.5.6 Influence on instruction

According to Bruning, Schraw and Ronning (1999), the autonomy and control of a learning environment is affected by the following:

- **Nature of the materials**: Materials that are too difficult for students promote a controlling environment, reduce intrinsic motivation and promote resistance to the

task. Materials may be difficult for several reasons, including their grammatical complexity and their relative familiarity. Also the "interestingness" of the topic/content affects learning (Guthrie, Van Meter, McCann, Wigfield, Bennett, Poundstone, Rice, Faibisch, Hunt, & Mitchell, 1996). In general, materials are most apt to promote autonomy and to be remembered when they are student-selected or generated, of moderate difficulty, personally interesting and familiar.

- **Task constraints**: The nature of the task affects whether individuals perceive it to be autonomy producing or controlling. One constraint is if the task is clearly understood (Andersen, 1981). Other factors include the task's difficulty; the pace and variability of tasks (tasks that require active student participation tend to increase intrinsic motivation and learning, as well as question-asking). Varying the types of tasks also increases interest and learning. Sansone, Sachau and Weir (1989) found that expectations prior to the task impact learning, and that students responded more favorably to instruction when it matched perceived academic goals.
- **Teacher expectations**: Research shows that it is not so much what a teacher does, but rather how she or he does it that matters most to students e.g. use of lesson-framing statements (Grolnick & Ryan, 1987). Grolnick and Ryan found that students who were told to read a passage and then complete a test, and that they were expected to do well in the test, outperformed those who were told to read whatever aspect of the passage they found interesting. The type of feedback, whether it is performance oriented (emphasizes how well as student has performed in relation to others) or information-oriented (emphasizes how performance can be improved), also impacts learning. Bruning, Schraw and Ronning (1999) note that a number of studies have shown that informational feedback leads to greater intrinsic motivation, task engagement and persistence than performance feedback.
- **Student expectations**: Students create their own autonomous and controlling environments by the expectations they hold for themselves (Bandura, 1977). Beliefs promote autonomy through self-efficacy (as efficacy increases, individuals feel a greater sense of control, which leads to less anxiety, greater persistence, more task-

related effort and better use of feedback). Beliefs also influence how modifiable the environment appears. Bruning, Schraw and Ronning (1999) note that low self-efficacy has been associated with a greater sense of futility, lower aspirations and less ingenuity.

- **Evaluation**: One area of academic life that imposes a strong perception of control is testing and evaluation. Not all types of evaluation elicit the same reactions in students. Norm-referenced evaluation (students compete against other students) often reduce intrinsic motivation for average and low-achieving students. In contrast, criterion-referenced evaluation (students compete against a predetermined standard) may increase intrinsic motivation (Stipek, 1993).
- **Rewards**: Deci and Ryan (1985) identified two types of rewards; informational and controlling. Rewards that provide useful information or feedback to students generally increase intrinsic motivation and learning, whereas rewards that attempt to shape or control student behaviour and performance generally decrease it. Moreover, controlling rewards invariably lead to poorer performance, reduced task engagement and interest once they are terminated (Kohn, 1993).

With regards to beliefs and problem-solving, Bruning, Schraw and Ronning (1999) note the following instructional impacts:

- The beliefs students hold about intelligence and knowledge affect the choices they make, and the way they reason. Instruction should therefore focus on making students aware of their beliefs, and on being aware that teacher and student views may conflict and influence openness to learn.
- Students need to be encouraged to review their problem-solving process and to practice using the problem-solving stages to come to their own conclusions.

2.6 SUMMARY

When designing, delivering and evaluating any training course from a Cognitivist perspective, it is important to consider the cognitive factors that impact learning.

In this chapter, a brief overview of the Cognitivist approach to learning was provided, including the identification of key themes running through Cognitivist learning theories. The memory systems, encoding processes and retrieval processes of the Information Processing Models were discussed. This was then followed by a review of exactly what people learn, the personal factors influencing learning and the various impacts that these have on instructional design and delivery.

CHAPTER 3: INSTRUCTION OF COMPUTER SOFTWARE

3.1 INTRODUCTION

In this chapter, the two key approaches used for computer software training are described. This is followed by a review of the specific factors that studies have shown to impact on the overall effectiveness of a computer software training course. These include the measurement of the learning outcomes; the match of the target audience's learning needs with their current performance gaps; the match of the learning approach with the specific learner characteristics; the utilisation of appropriate instructional strategies, techniques and delivery media; and the transfer of the newly acquired skills and knowledge to improved performance.

3.2 LEARNING APPROACHES USED FOR COMPUTER SOFTWARE INSTRUCTION

Any type of solution that one undertakes for the purpose of computer software learning can be thought of as either group-based or individual-based (Marx, 1999). A group-based approach involves personal contact within a group of two or more people. This can range from a master-apprentice relationship to a larger group setting (such as a classroom) with an instructor leading. An individual approach relies on the independent review and use of information by individuals who review the material on their own (e.g. giving someone a printed guide to work through).

Within the computer training field, the group-based has become synonymous with the term "instructor-led training" while individual-based has been more commonly termed "self-managed or self-paced training" (Bassi & Van Buren, 1999). The key differences between the two forms of training, according to Bassi and Van Buren (1999), are

primarily the media used and the learning driver (i.e. the person/program that controls the delivery pace and information flow).

Over the years, more complex technologies have been used for both group and individual training aids. According to Marx (1999) and Rothwell and Kazanas (1998), one can group approaches into two main groupings, namely instructor-led (group-based) and self-managed (individual-based).

3.2.1 Instructor-led (group-based)

The primary medium used in instructor-led training tends to be the lecturer who imparts the majority of information using the spoken word (i.e. verbally). The delivery normally occurs in a classroom setting. The lecturer may use a number of other media to support his/her delivery e.g. white boards, flipcharts, overhead projectors, and computer-linked projectors. The learning driver of this delivery method tends to be the instructor. This is done through the instructor determining when and how the information is provided to the learner, as well as the pace and flow of information provided. The communication and behavioural skills of the lecturer therefore significantly influences the delivery quality of the learning information.

3.2.2 Self-managed (individual-based)

This delivery method is not classroom bound, and can be delivered at the learner's desk or in an any convenient location. Although the delivery medium used in this method differs, the learning driver is always the learner. Here the learner determines when and where s/he receives the information, as well as the pace of that instruction. The types of delivery media currently used in self-managed courses can be categorised as follows:

(a) Computer-based

An increasingly popular medium for instruction, computer-based training (CBT) is delivered via the computer itself. The course may be obtained from a CD-ROM or directly off the web, but the learner will receive the information from the computer monitor. The control over the flow of information is done either through the mouse or keyboard (i.e. the learner has control over when new information should appear and what that information should be dealing with), or is programmed to appear in defined time periods or in a defined order (i.e. the learner has no control over the timing or flow of the information). More and more CBT now contains video clips and sound bites, although older versions and web-delivered courses tend to be more text-intensive (i.e. the learner obtains the information through reading).

(b) Paper-based

Many empowered learners prefer to teach themselves how to use new computer software, using specifically designed learning and reference guides. These guides describe the concepts, and usually set up exercises for the learners to attempt on their own. The control over the pace and flow of the learning is held by the learner, who can read at the pace that suits him/her, and can select the chapter or module or page s/he views as most relevant.

(c) Video-based

A number of commercially available courses on various computer software packages are provided using video as the delivery medium. This usually takes the form of a lecturer verbally conveying the learning material, but often includes effective graphics and scenarios where appropriate. Although this is similar to instructor-led training, the key difference remains the control that the learner has over the pace (they can pause the video

when required) and flow (they can fast forward or rewind to relevant sections) of the information provided.

The choice of delivery method is affected by two factors: the cost of supporting the delivery medium and the learning effectiveness of that medium.

From a cost point of view, training providers need to consider the costs associated with offering a specific medium. This is because the delivery method impacts heavily on the nature of future investment. If the company opts for an instructor-led approach, investment will need to focus on building training facilities and skilling and managing training staff. If a self-managed delivery medium is chosen, more investment would need to be made in product development and testing, as the success of the product is not dependant on the ability of a trainer. Investment into the delivery channels for this method would also need to be made (e.g. web-servers and tracking systems would need to be provided if the self-managed course was delivered via the web).

Costs aside, training providers are also left with a difficult decision when judging the medium on its effectiveness in promoting learning. This is because there is very little research available on which to base their decisions. In a review done on studies focusing specifically on the delivery methods used for computer software-related courses, very few studies could be found. This is supported by Gist (1987), who notes that there is a need for significantly more research into the effectiveness of different training media on the learning of microcomputer software skills.

In addition to the limited studies performed in this area, those that could be found did not appear to make the distinction of delivery method along the lines of instructor-led and self-managed, and tended to differentiate more on instructional strategy than delivery medium. For example, Gist, Rosen and Schwoerer (1989), found that using a video of an instructor explaining how to perform certain computer-related tasks and then allowing the

students to try for themselves (i.e. a behaviour modeling approach) yielded consistently superior computer software mastery compared to when learners were given the content in work manuals and were provided with tutorial assistance (i.e. a non-modelling approach). The conclusions drawn related to the instructional strategy, and did not relate to the differences in the delivery mediums used.

A number of studies, however, appear to indicate that certain techniques commonly used in instructor-led training are more effective than certain techniques used more in self-managed instruction. In Simon and Werner's (1996) study, where three approaches to computer training (behaviour modelling, self-managed study and lecturing) were provided to a sample of 160 novice computer users, they found that measures for cognitive learning and skill demonstration were highest for behaviour modelling (instructor-led), followed by self-managed study, and finally lecturing (instructor-led). Results were similar for measures collected immediately after training and 1 month after training. Satisfaction with the computer system 1 month after training was also highest for behaviour modelling.

In Harp, Taylor and Satzinger's (1998) study of 263 licensed users' individual preferences for three software training methods (computer-based training, video tutorials and instructor-led classroom training), results indicated that computer-based training (self-managed) and instructor-led classroom training were both perceived to be as effective as the other, and more effective than video tutorials (self-managed).

No studies comparing an instructor-led computer software course and a self-managed paper-based computer software course could be found.

From these studies, it is difficult to draw any definite conclusions, although it appears that various forms of instructor-led training are more effective than self-managed learning in teaching people specific computer software-related skills.

This finding is, to some extent, contradicted by organisational demand throughout the world, where the demand for self-managed learning solutions is steadily rising, and instructor-led courses falling. Although organisational demand does not provide an accurate idea of learner preferences and learning success, is does tell us something about organisational perceptions. In a study of delivery methods used from 1997 to 1999 in over 1220 non-American organisations and 801 American organisations, Bassi and Van Buren (1999) predicted that by the year 2000, the use of instructor-led classroom methods would drop from 78% to 61%, while self-managed methods would increase from 16% to 33%.

Training providers are therefore left in somewhat of a quandary. Do they opt to focus on providing instructor-led training based on inconclusive research evidence and overall organisational demand (61% is still significantly more than 33%); or do they opt to provide self-managed learning based on current forecasts and trends (i.e. the increasing demand for self-managed learning, and the falling demand for instructor-led training)?

Understandably, many training providers are uncomfortable making such important strategic decisions based on inconclusive evidence. Some organisations have the resources to sponsor research on their own products, but many are too small to fund this kind of research. And if they did, many would not know where to start..

This study will hopefully assist these organisations by contributing to the pool of knowledge in this area, as well as highlighting areas for future research.

3.3 FACTORS THAT INFLUENCE COMPUTER SOFTWARE LEARNING

From a detailed review of literature, a number of factors appear to influence learning and performance results following attendance of a computer training course. It must be noted, however, that the list of factors described in this chapter are by no means exhaustive, although they do highlight the wide range of factors that need to be considered. These factors need to be viewed in conjunction with the various factors highlighted by general Cognitivist research (see Chapter 2).

3.3.1 Learning needs and performance gaps

Knowles (1978) notes that an important factor influencing the motivation of an adult to learn new skills and knowledge is the perceived link between the skills and knowledge and their ability to perform valued tasks effectively. If the learner does not perceive this link, s/he will tend not to apply him/herself to the task of learning.

Nadler (1994) and Rothwell and Kazanas (1998) support this view, highlighting that a key limitation in many training courses is the mismatch between knowledge and skills on offer, and those required to improve the target audience's performance at their jobs.

3.3.2 Learner characteristics

The match between the learning design and delivery, and the specific characteristics of the learners impacts heavily on the effectiveness of any learning intervention (Rothwell & Kazanas, 1998). What may work very well for one group of people may not work for another. The characteristics that need to be considered include:

(a) Preferred learning style

According to Keefe (1979), learning styles are the composite characteristic of cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment. These learning styles impact on learning achieved, depending on the training approach adopted (Curry, 1987; Dunn & Dunn, 1978; Griggs, 1991; Guild, 1994; Hodges, 1994; Honey & Mumford, 1982; Kolb, 1984; Myers, 1978; Perrin, 1981).

Honey and Mumford (1982) identified four different learning styles, and noted significant differences between the type of activities that people with these learning styles learn best from, and those they struggle to learn from. This indicates that the effectiveness of any learning initiative depends on the match achieved between the activities used and the person's learning style preferences.

Below is a summary of the type of activity, according to Honey and Mumford (1982), that each learning style prefers and dislikes:

TABLE 3.1: LEARNING STYLE PREFERENCES AND DISLIKES

Learning Style	Activities - Best Learning	Activities - Worst Learning
Activist	❑ New experiences/ problems/ opportunities ❑ "Here and now" activities – games, exercises ❑ Diverse activities ❑ Require one to take the limelight ❑ Allow one to generate ideas without constraints	❑ Involve passive learning ❑ Require one to stand back and not get involved ❑ Require one to assimilate, analyse and interpret messy data ❑ Require one to engage in solitary work

Learning Style	Activities Best Suited	Activities Worst Suited
Activist	❑ Thrown in at the deep end ❑ Involve one with other people	❑ Require one to assess learning objectives and learning achieved ❑ Require one to repeat activities ❑ Give one precise instructions
Reflector	❑ Allow one to watch/think/ chew over activities ❑ Allow one to stand back and observe ❑ Allow one to think before acting ❑ Allow one to carry out painstaking research ❑ Give one the opportunity to review and analyse activity ❑ Give one as much time as you need to make a decision	❑ Force one into the limelight ❑ Require one to act without prior planning ❑ Provide one with insufficient data on which to base decisions ❑ Give one precise instructions ❑ Force one to make rushed decisions
Theorist	❑ Offer one part of a model, system, concept or theory ❑ Give one time to explore inter-relationships of ideas, events and situations ❑ Stretch one intellectually ❑ Involve structured situations with a clear purpose ❑ Offer ideas and concepts that emphasize rationality or logic	❑ Don't provide one with a context or clear purpose ❑ Require one to participate in situations emphasising emotions and feelings ❑ Are unstructured and ambiguous ❑ Require one to act or decide without a basis in policy, principle or concept

Learning Style	Activities - Best Learning	Activities - Worst Learning
Theorist	❑ Allow one to rationalise and generalise reasons for success or failure ❑ Require one to understand and participate in complex situations	❑ Provide one with numerous methods and no time to analyse all of them in depth ❑ Shallow subject matter ❑ Involve other people who lack the same intellectual capabilities
Pragmatists	❑ Provide one with an obvious link between subject matter and a problem or opportunity on the job ❑ Show one techniques that have obvious practical advantages ❑ Provide one with a chance to try out techniques currently applicable to their job ❑ Give immediate opportunities to implement what one has learned	❑ No immediate need for the new skill or knowledge can be seen ❑ Too theoretical ❑ No practice or guidelines provided ❑ Where people appear to argue in circles ❑ There is no apparent reward from the learned activity

(b) Age

Age may affect an individual's attitude toward and use of computers if the individuals who have more experience with computers are assumed to be younger than those with less computer experience (Mc Connell, O'Shea & Kirchoff, 1989). Yet does age without experience not impact learning and computer use as well? According to Knowles (1978),

it does. Knowles proposed that older people may lack confidence in their abilities to master a new technology.

Massoud (1991) found no significant relationship between age and attitudes towards computers. This was confirmed by a study by Kuhn (1989). Raub, cited in Keeler and Anson (1995) also found no linear relationship between computer anxiety and age.

These findings, however, appear to be overshadowed by the number of studies that have found that age affects learning of computer software skills. Polakov and Korobeinikov (1996), in their research into age-related features of learning and relearning in computer operation, found that an individual's ability to be trained and then retrained decreases with age. They also found that successful performers exhibited increased arterial pressure and decreased tension of the cardiac rhythm regulation at the beginning of the test. Pope-Davies and Twing (1991) also found a link between age and attitudes towards computers, with older learners tending to exhibit more negative attitudes than younger learners. This finding is supported by Gist, Rosen and Schwoerer (1989), who found older people exhibited significantly lower performance than their younger counterparts. Bandalos and Benson's (1990) study showed that older people may be more computer anxious than younger people because of the relative unfamiliarity of the former group with computers.

(c) Computer efficacy

Self-efficacy, according to Martocchio and Webster (1992), deals with the self-assessment of personal effectiveness. This affects how people feel, think, motivate themselves and behave. Bandura (1977) defines the concept as the individual's belief in their ability to perform a particular task. Kinzie and Delcourt (1991) recognized fluctuating levels of self-efficacy with regard to specific technologies and derived the term "self-efficacy of computer technologies". They then defined the term "computer efficacy" as a person's belief in their ability to use a specific computer technology.

Computer efficacy has also been defined as a person's belief to perform certain computer-related tasks (Murphy, Coover, & Owen, 1989). Yet does this affect how we learn to use new computer software?

In Houle's (1996) research aimed at understanding student differences in a computer training course, perceived computer efficacy was found to influence the individual's overall performance. Szanja and Mackay (1995) also found that computer aptitude and achievement appeared to relate to performance of learners, while Torkzadeh and Koufteros (1994) found that training significantly improved computer efficacy. In Decker's (1998) study of 2597 university employees, job type, previous classroom computer training, computer use required on the job, frequency of computer use and training responsibilities had a predictive relationship to computer self-efficacy. Decker concluded that a person's job type coupled with job-like training is indicative of high levels of computer self-efficacy and, thus, high performance.

It therefore appears from the research that computer self-efficacy does influence a person's ability to learn new computer skills and knowledge, and that job type, previous classroom computer training, computer use required on the job, frequency of computer use and training responsibilities have an indirect effect on this learning.

(d) Performance expectation

Only one study could be found relating to the influence of one's own expectations of learning computer software. Lee, Pliskin and Kahn (1994), in their study of 104 undergraduate business students, found that expectation of excellent performance correlated significantly with the individual's actual performance in a specific computer training course. This supports the Cognitivist findings mentioned in Chapter 2.

(e) Computer anxiety

Computer anxiety is defined as the fear and apprehension felt by an individual when considering the implications of utilising computer technology, or when actually using computer technology (Cambre & Cook, 1985). The individual is in this state because of fear of interaction with the computer even though the computer possesses no immediate or real threat.

Woodrow (1991) points out that computer anxiety influences people's ability to learn and use computers, and should therefore be taken seriously by organisations implementing new computer systems. In a study by Howard (1986), it was found that managers with higher levels of computer anxiety had less favorable attitudes towards computers. Raymond (1988) found that computer training and education have an important positive effect on the attitudes and computer usage behaviour of small business managers, while Houle (1996), in his research in trying to identify reasons for student performance differences in a computer skills course, found that prior experience of the course content, as well as ownership of the computer, appeared to decrease computer anxiety.

From the research it therefore appears that the level of anxiety an individual feels regarding the use and learning of new computer software impacts on their ability to learn.

(f) Motivation to learn

Knowles (1978) highlighted that the two factors that should be considered when deciding on an instructional approach include the learner's motivation, and their ability to learn the specific content. Motivation to learn different computer software depends heavily on the person's perceived need for those skills. This continues to be one of the big problems organisations face with skilling people in new software, especially if the person is comfortable with the 'outdated' software and does not see the need to change.

Self-managed courses, often those using the computer-based delivery medium, are particularly vulnerable to lack of use when learner motivation is low (Singh, 1987). Instructor-led courses, however, are not immune from the problem, as learners are able to switch off during the session and to blame the lack of learning on the poor instruction given (Rothwell & Kazanas, 1998).

(g) Gender

No studies could be found that show a person's gender is directly related to their ability to learn computer software skills and knowledge effectively. What studies could be found showed that gender may impact indirectly on software learning (i.e. by influencing factors that are themselves predictors of ability to learn software knowledge and skills).

The majority of research done on gender differences has been carried out with students at the primary and high school levels (Arch & Cummins, 1989). A study by Collis (1985) found that gender was a better predictor of attitude towards computers than age. Koohang (1989) notes that in most cases, male students tend to show higher positive attitudes toward computers than female students, while Wilder (1985) points out that gender differences in attitudes toward the computer are statistically significant, but quite small in the absolute sense.

Houle (1996), on the other hand, found that gender did not appear to be related to the student's ability to learn new computer software skills. One possible limitation to Houle's findings was that the study was based on an American sample where gender roles are not as rigidly enforced as in other cultures. As Howard (1986) points out, the gender effect can be suspected to be based on the negative socialisation of woman toward mathematics, science and technology, something that is more prevalent in developing countries.

(h) Educational level

Lee, Pliskin and Kahn (1994), in their study of 104 undergraduate business students, found that high school academic achievements and SAT scores correlated with performance in a computer training course. Houle (1996) also found that education levels appeared to influence computer self-efficacy (which in turn appeared to affect the performance levels obtained from any given learning intervention).

(i) Prior computer use/exposure

Linde and Bergstrom (1998) found that prior knowledge of computer software course content and key principles increased learning speed. Houle (1996) found that previous computer experience (not related to the course) did not appear to be related to performance after learning, while prior experience that related to the course content appeared to influence computer efficacy and therefore post-training performance.

(j) Learning potential

Knowles (1978), in his theory of Situational Androgogy, highlights the importance of analysing the learner's ability to learn before deciding on the appropriate instructional strategy. According to Shirley (1993), instruments for the measurement of ability must concentrate on the identification of potential rather than on measures which reflect crystallised competencies or skills, if they are to be fair to groups originating from impoverished education and development backgrounds.

De Beer (2000a) suggests that the learning potential of subjects is likely to affect their performance after training, with people who have low learning potential more likely to perform at lower levels after training than those with higher learning potential.

3.3.3 Instructional strategies and techniques

In addition to ensuring that the design and delivery is aligned with learner characteristics, research has also identified a number of instructional strategies and techniques that appear to affect learning outcomes. Although not exhaustive, the following instructional strategies and techniques appear to influence, to a greater or lesser extent, the learning achieved.

(a) Previews

Webster and Martocchio (1995), in their study on the effects of using optimistic and realistic course previews, found that optimistic previews appear to enhance outcomes during the training program, while realistic previews tend to enhance post-training reactions of learners.

(b) Animated demonstrations

Kerr and Payne (1994) examined the instructional efficacy of animated demonstrations within active and passive learning contexts of teaching basic spreadsheeting skills. The demonstrations used were a commercial scenario machine, an animated demonstration of the machine, and problem-solving supported by either the user manual or a set of task demonstrations. The results of this study showed a clear learning advantage of problem solving over the first two demonstrations (i.e. prompted interaction).

(c) Prompting

Karlsson and Chase (1996), in their comparison of three prompting methods for training software use (namely prompting correct responses throughout, progressively delaying prompts, and progressively adding keypress choices to a command menu), found that

people trained with continuous prompting made twice as many errors on a post-test than those trained with prompt delay or addition-of-choices.

(d) Analogies and metaphors

Russon, Josefowitz and Edmunds (1994) showed that the use of analogies and metaphors in explaining software concepts during training correlated with improved performance and self-efficacy.

(e) Co-operative learning

In Keeler and Anson's (1995) assessment of co-operative learning used for basic computer skills instruction, they compared the difference in learning performance and student retention between students learning in co-operative learning teams and students taught in the traditional individual learning format. The results showed that both the performance and retention were significantly improved with the use of the co-operative learning.

(f) Visual and verbal descriptions

Hagmann, Mayer and Nenniger (1998) found that using visual and verbal descriptions in learning manuals improved the learning transfer by more than 100%.

(g) Behaviour modelling

Bandura's (1977) Social Cognitive Theory provides the basis for behaviour modelling, a technique in which the learner observes the model of required behaviour (e.g. the steps on how to type in data into a spreadsheet cell), remembers what the model did, does what the model did, and finally uses what they have learned on the job. Studies by Burke and Day

(1986), Kraut (1976), Latham and Saari, (1979), and Meyer and Raich (1983) found that behaviour modelling is a successful technique. Learning designers are therefore challenged to provide the learner with an example of the required behaviour, and then an opportunity to try the behaviour themselves (hopefully with some form of feedback). Where this is done successfully, learning appears to be enhanced.

(h) Job related content

Knowles (1978) and Rothwell and Kazanas (1998) highlight the importance of ensuring that the course content clearly reflects the requirements of the job. Where learners perceive the course to veer from the skills and knowledge they require to perform effectively, their motivation to learn drops, as does their subsequent post-training performance. Hansen, Laursens and Aarkrog (1993), in a study of 73 organizers of computer training courses for adults, found that learning appeared to be heavily influenced by the perceived tie-in of the learning content with their job requirements.

Effective skill transfer is therefore not only an issue of effective learning (i.e. addressing all the factors impacting on a person's ability to learn). It is also an issue of ensuring that all the factors impacting an individual's ability to perform with their various skills and knowledge are addressed effectively (Robinson & Robinson, 1995).

(i) The opportunity to try the actions on the computer for oneself

Berryman and Baily (cited by Sorohan, 1993: p47) note that "at the heart of cognitive research is the observation that intelligence and expertise are built out of interaction with the environment; not in isolation from it.....Research shows that effective learning engages both head and hand and requires both knowing and doing". The importance of providing people with the opportunity to learn through doing is increasingly being recognised (Juechter, 1993), especially with the advent of learning organisations. Unless the person is able to try new concepts and skills in a work-related environment, learning and performance will be limited (Eager, 1996).

3.3.4 Instructional design procedure

To aid learning designers in designing interventions that address all the key learning variables, a number of design procedures have been detailed by leading instructional design thinkers. The ability of the designer to implement these steps, and to address each issue in the correct order, impacts on the quality of the learning experience provided (Nadler, 1994).

One of the more recent instructional design procedures to be published is that of Rothwell and Kazanas (1998). This procedure is as follows:

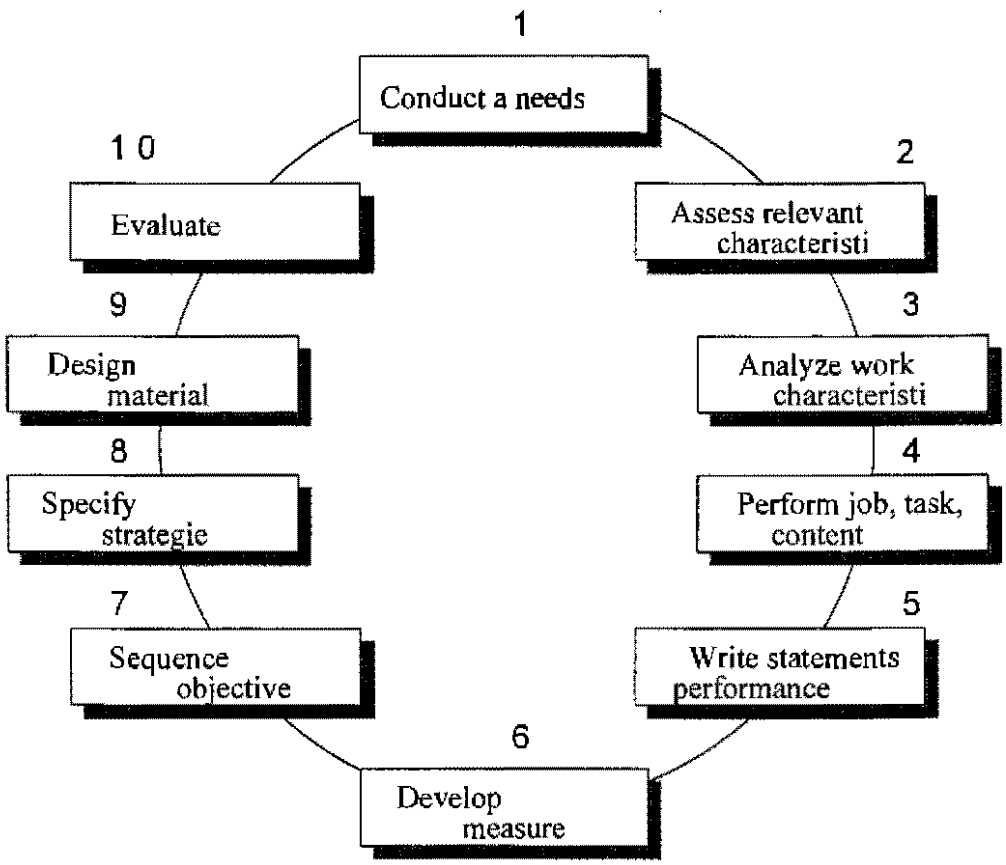

Figure 3.1: Instructional design procedure

Source: Rothwell and Kazanas (1998)

The logic of this procedure, according to Rothwell and Kazanas (1998), is as follows:

- **Conduct a needs analysis.** Unless the designer is able to clearly define the skills and knowledge required by learners to perform more effectively, s/he runs the risk of teaching them skills and knowledge that will have a minimal positive impact on their current performance.
- **Assess relevant learner characteristics.** This will impact on the selection of instructional strategies later on.
- **Analyse work setting characteristics.** A key step is to understand the environment where performance needs to take place. This will ensure that the training environment can be designed to mirror this environment as closely as possible. It will also allow the designer to identify factors in this environment that will impact on learning transfer.
- **Perform job, task and content analysis.** It is critical to gain an understanding of what exactly people's jobs involve, and the particular tasks they are required to perform effectively. This ensures that the learning initiative can align with these tasks, and the learning content can support what people need to know in order to perform more effectively.
- **Write performance objectives.** The next step is to clearly define what the designer wants people to have learned at the end of the training course (i.e. the learning and performance outcomes). This is a very important step, as it ensures that the designer can select instructional strategies to achieve these objectives.
- **Develop performance measures.** It is no use specifying objectives if the designer is not able to measure whether these objectives are met. These measures need to be clear, quantifiable and objective.
- **Sequence performance objectives.** Prioritising the objectives ensures that the design focuses on the most important aspects. This ensures that the critical learning outcomes are achieved.

- **Specify instructional strategies.** How to ensure that these outcomes are achieved is the designer's next focus. Rothwell and Kazanas (1998) highlight a number of strategies (e.g. expositive and discovery strategies) that one can select from, depending on the outcomes of the previous steps.
- **Design instructional materials.** The next step is to design the course material. This will be based on the information gathered from the previous steps in the process.
- **Evaluate instruction.** The final step is then to pilot the course with a sample of the targeted population. This step is critical, as it highlights whether the analysis performed during the design process was in fact accurate. It also confirms whether the instructional strategies and materials are effective.

This procedure reflects, to a large extent, the steps of the design procedure of Nadler (1994). Not only does the procedure assist people in the design of learning interventions; it also assists in the assessment of a specific training course's design and effectiveness.

3.4 FACTORS IMPACTING ON LEARNING TRANSFER

The ability of learners to transfer the new skills and knowledge to improved performance in their jobs/tasks is affected by a number of different factors, one of which is the support offered and opportunity to use the skills back at the work environment (Baldwin & Ford, 1988).

This is in line with Knowles' (1978) view that learning is a process, and learners need to be provided with the ability to continue their learning after the training program. Without the ability to translate the theory into practice (i.e. on the job), learning remains cognitive and seldom translates into sustained behavioural change.

According to Kolb (cited in Weinstein, 1995), learning takes place in a cycle (see next page).

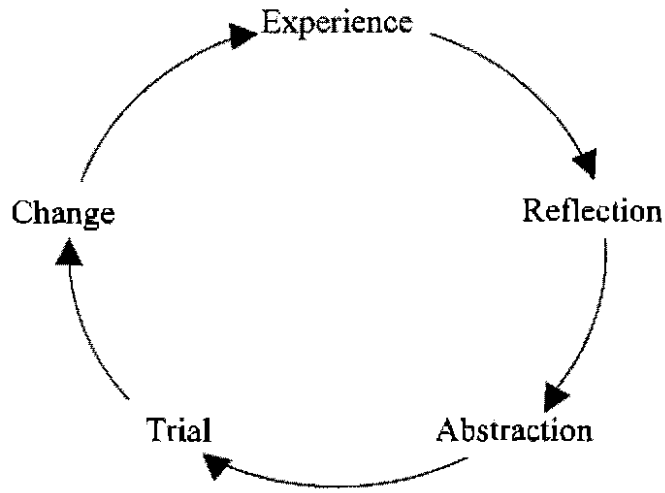

Figure 3.2: Learning cycle

Source: Kolb (cited in Weinstein, 1995)

A key element in this cycle, and one that is often neglected in learning interventions, is the ability to trial something on a continuous basis. Learning is a cycle, and the more often learners can move through the cycle, the more learning will take place. In order to do this, learners need to be provided with the following:

- Opportunities to apply the new skills and knowledge (i.e. experience learning).
- Ability to reflect on learnings.
- Ability to abstract key principles that can be generalized.

Post training support, in the form of providing relevant learning opportunities, the opportunity to reflect on learning, and access to effective knowledge support, is therefore a critical element in ensuring that learning translates to performance (Kemp, 1985).

Yet post-training support is only one important factor to consider. Baldwin and Ford (1988) note that learning transfer is significantly impacted by the array of factors influencing a person's ability to perform back at the work place.

"If you want to understand some phenomenon or appearance, you must consider that phenomenon within the context of all the completed circuits that are relevant to it" (Bateson, cited in Searight & Openlander, 1986, p. 75). Capra (1997) supports this notion, and highlights the systemic nature of performance. Capra notes that behaviour is not affected by a few isolated factors; rather by a whole system of inter-related variables impacting at different levels within the performance system.

Within this systemic framework, Rummler and Brache (1995) highlight a number of other key reasons why an individual may not be performing effectively after being trained.

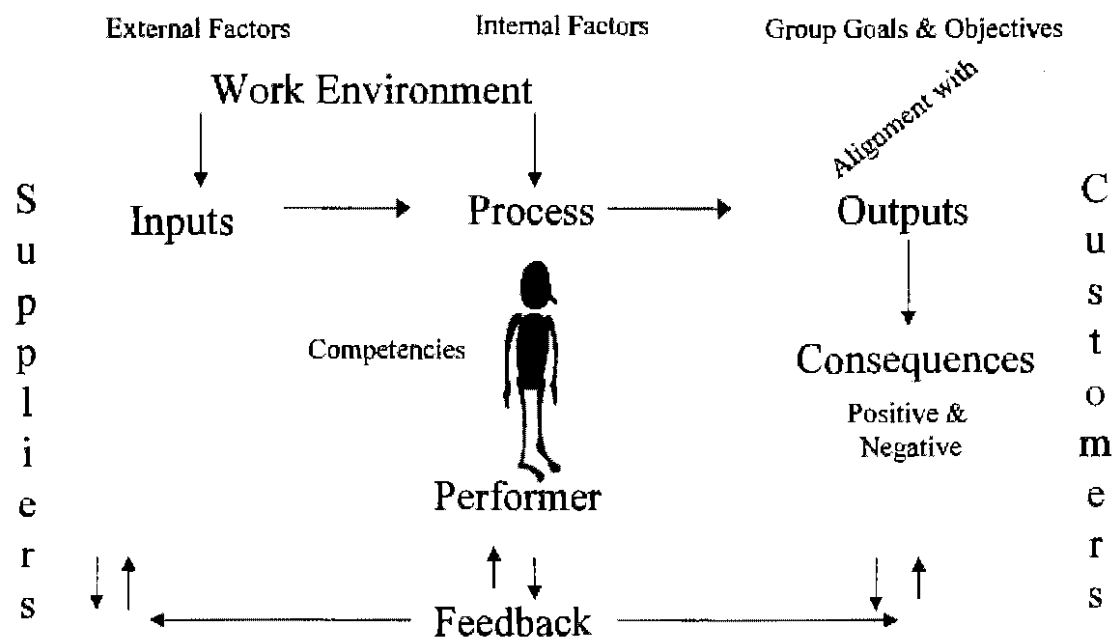

Figure 3.3: Performance system

Source: Rummler and Brache (1995)

Firstly, the individual's performance may be influenced by a whole host of macro-variables that are out of his/her control. These include external environmental issues (e.g. economic, political, social, environmental); the availability of resources; the changing customer demands; the competition; the organisation's leadership, culture and mission; and the alignment of the business processes of which that individual's job is but a part.

At a job level, Rummler and Brache (1995) also highlight the influence of clearly specified and benchmarked outputs; appropriate positive and negative consequences; ongoing and meaningful performance feedback; and appropriate and timeous inputs. All these factors impact an individual's ability to perform, and they therefore impact on the transfer of skills and knowledge into improved performance.

The challenge for learning designers and trainers is to broaden their focus to ensure that the systemic variables impacting on the transfer of the learning to on-the-job performance are also addressed.

3.5 SUMMARY

In addition of the various Cognitivist findings on factors that impact learning, there are a number of specific factors that have been identified with regards to the learning of computer software.

In this chapter, the different factors influencing the ability of adults to learn new software-related skills and knowledge were reviewed. These factors included the perceived match between the learning outcomes and performance gaps; the various learner characteristics; the different instructional strategies and techniques; and the different delivery media used in instructor-led and self-managed methods.

The factors impacting on learning transfer were then identified. These included post-training support, and the various system variables that influence performance back at the job/task.

CHAPTER 4: EMPIRICAL STUDY

4.1 INTRODUCTION

The primary focus of this study is to determine which of the two specifically designed training courses, the instructor-led or the self-managed, is more effective in teaching the sample of students the key skills and knowledge they required to complete key spreadsheet-related tasks using the software Microsoft Excel 97. To determine this, various **quantitative** data was collected for analysis.

The secondary focus is to determine, if there is a difference in course effectiveness, possible reasons for this difference. This includes identifying possible areas for improvement for both courses, and possible areas for further research. This investigation was performed based on the collection of various **qualitative** data.

4.2 COURSE DATA DESIGN

The needs analysis performed for both courses was initially based on the learning designer's personal experience in working with spreadsheets. The first step was to identify all the spreadsheeting outputs that had ever been personally required to be produced in a management consulting environment (the learning designer's previous work environment). The view was that if the designer had not yet been required to produce the output in that environment, the likelihood of the targeted learners requiring the output in their work environment would be very low. The designer also based the learner characteristics on himself, and those with whom he had worked. This included clients who had different computer software skill requirements. The work setting was based on the environments that the designer had been exposed to during his work as a consultant, and the tasks and job analysis was based on personal experience, as well as observed tasks and jobs performed by various client managers.

Once the outputs were detailed, all the system functions that would be used in producing these outputs were identified. Only functions that had a direct link to the identified outputs were included. The outputs and list of system steps were then presented to 15 Microsoft Excel 97 users from 5 different companies for face and content validation (i.e. did they feel that the outputs and system steps reflected what they would use on a day-to-day basis). Once validated, the outputs were then ordered in terms of conceptual difficulty, as well as the need for prior learning (i.e. whether the learner would require knowledge of other system functions and concepts in order to perform the specific system function required).

Key knowledge concepts that the learner would need to understand in order to be able to successfully apply the system steps in different examples and scenarios were then identified. Analogies and metaphors were documented for each concept, and graphics where required were drawn. Detailed explanations of each concept were then documented and provided to a small sample of people (n=3) for evaluation. Once these individuals were happy that the way in which concepts were explained was optimal, the different scenarios and examples were then designed and developed. These examples were designed to be as generic as possible, so that specific industry or job knowledge would not be required. These examples were then tested by the same small sample group (n=3), and were again confirmed as being appropriate and beneficial to learning.

The learning booklet (with exercise disk) to be used in the self-managed course was then completed, and was evaluated by a second sample group (n=5). Significant rework was done to ensure that the learning flow was optimal and that the explanations and examples were clear and easy to follow. Once complete, a facilitator's guide was then developed to assist the instructor in the delivery of the instructor-led course. The exact descriptions, explanations and examples contained in the self-managed learning booklet were used throughout. Where graphics were included, these were provided to the instructor on

PowerPoint slides. The instructor-led course was then piloted with a fresh sample (n=4), as well as two members of the sample who piloted the self-managed course (to confirm that the same information was provided by both courses).

4.3 RESEARCH DESIGN

This study, briefly described in Chapter 1, was designed as follows.

- First, the instructional design procedure and resulting learning materials of both the instructor-led and self-managed Excel 97 Fundamentals course was reviewed to identify any possible factors that may impact on the learning of the target audience.
- Second, a sample for the study was identified and two experimental groups were then randomly selected from the sample. The one experimental group was named the instructor-led group; the other the self-managed group.
- Third, each subject's demographic, learning style and learning potential data was collected.
- Fourth, the instructor-led group was given the instructor-led course on the one Saturday. The following Saturday, the self-managed group was given the self-managed course.
- Fifth, at the end of each course, the subjects were given an assessment of their ability to complete key spreadsheet-related tasks using Excel 97. Each subject was also asked to rate the course they attended.
- Sixth, a sample of the two experimental groups were contacted a month after attending the course and post-training support and performance system data was collected.
- Seventh, the quantitative and qualitative data was then processed and the results analysed.

4.3.1 Research variables

The variables that were used for the collection and processing of the quantitative data were as follows.

(a) Independent variable

The independent variable was the learning approach provided to the learner. In the first experimental group (labeled the "instructor-led group"), an instructor-led learning approach was administered; while in the second experimental group (labeled the "self-managed group"), a self-managed learning approach covering the identical content was administered.

(b) Dependent variable

The dependant variable was the performance score achieved on the learning outcome assessment.

4.3.2 Research validity

To maximize the validity of the study, the following steps were taken.

(a) Internal validity

To ensure that the experimental groups were not significantly different in any aspect that may influence their performance on the learning outcomes assessment (and thereby impact on the internal validity of the quantitative study), the two experimental groups were selected using a random sampling grid. Student numbers were allocated to each

surname (this list was arranged in alphabetical order), and then the sampling grid was used to allocate surnames to the different experimental groups.

(b) External validity

The sample group used in the study is not reflective of the general South African population. The external validity of the study is therefore limited to previously disadvantaged, literate South African adults who have an education level of matric (Grade 12) or higher, and who have limited experience using computer software.

4.4 RESEARCH METHOD

A number of different methods were used to operationalise the research design.

4.4.1 Sample

The selection of the sample groups was done as follows:

(a) Selection of general sample

The general sample was selected from a group of paying students (a token fee was charged for attendance). The students were at the time attending a special course offered by the Witwatersrand Business School. This course was aimed at the 'previously disadvantaged' sector, particularly non-government organisations (NGO's), school leavers and other interested parties. The course was advertised in various publications, and aimed to provide learners with both a practical and conceptual understanding of the world of information technology. The course ran over four consecutive Saturday mornings. The learning interventions used for this research were offered as an optional extra and were run on the two week-ends following the completion of their course. The researcher was

given an opportunity to explain the course content to the students, and to provide them with an understanding of the research topic. It was highlighted to the students that, should they decide to sign up for the course on spreadsheeting using Excel 97, they would be required to pay a token fee of R50.00. This fee would cover the cost of the take-away reference materials and the certificates. The fee was paid up-front to secure their place on the course. Of the total course attendance, 61% of the students signed up for the additional course covering Microsoft Excel 97 Fundamentals. This worked out to be 49 subjects in total.

The general population of this sample is limited to previously disadvantaged, literate South African adults who require computer-related skills and knowledge to perform effectively in their jobs.

(b) Selection of the experimental groups

The selection of the two experimental groups was done using random sampling. The entire student list was ordered alphabetically, and each student was then assigned a numerical number. Using a random sampling grid, student numbers were then allocated to each experimental group. Students in the first experimental group (labeled the "instructor-led group") were then scheduled to attend on the first Saturday morning, while those who were allocated to the second experimental group (labeled the "self-managed group") were told to attend on the second Saturday morning. One student requested to change from the first Saturday morning to the second Saturday morning due to transport difficulties.

The resulting group numbers was 23 in the instructor-led group and 26 in the self-managed group.

4.4.2 Delivery approach used for each training course

The following delivery approach was used for the instructor-led and self-managed course:

(a) Instructor-led group

The instruction was delivered by an instructor, following a clearly laid out instructor sheet (see Appendix 9). Exercises were explained using a laptop and on-screen projector. Where appropriate, Microsoft PowerPoint slides were shown to explain concepts further. The instructor first explained the concept and where it is applicable to the learners' jobs. A spreadsheet was then shown relating to the exercise scenario. The instructor then demonstrated the steps required to complete the specific exercise. Once everyone was satisfied, each subject was told to open a specific file on the exercise disk provided. This spreadsheet was identical to the one the instructor had just used. The subjects were then given an opportunity to repeat the steps, using their reference cards if they got stuck. Once the majority of the class had completed the exercise for themselves, and were comfortable with their understanding, the instructor would move on. Assistance to struggling learners was provided where possible.

(b) Self-managed group

Every subject was handed a self-managed learning booklet, an exercise disk and a pack of reference cards. The facilitator then explained how the learning process would work, and that the booklet would explain everything to them. The subjects were also told to raise their hand if anything was confusing. If not, they simply needed to follow the instructions provided. The three hour time limit was highlighted throughout the course.

The key differences between the instructor-led and self-managed course came in the different media used to deliver the information, as well as the key learning driver.

With the instructor-led course, the media used were the instructor (through oral and behavioural communication), and the projector linked to the computer (where the system steps required to successfully perform all examples were demonstrated). In addition, applicable diagrams and graphics were shown using the same projector, and all learners were provided with a pack of detailed, graphic reference cards that documented all the system steps that were covered during the course. Learners were also told not to try and remember all the steps, but to rather focus on understanding the concepts, and where to find the steps on the cards themselves.

The main driver of the instructor-led process was the instructor, who set the pace of information delivery and guided learners through the learning process by determining when and for how long learners should work on the examples provided on the exercise disk.

With the self-managed course, the medium used to deliver the information was a paper-based learning booklet. The booklet was written in a very talkative, chatty language style, similar to the language used by the instructor in the instructor-led course. For every concept covered, the learner was first provided with a descriptive explanation (using graphics where appropriate) of where and when they would use such a concept. The learner was then asked to open up a specific spreadsheet that was provided on the exercise disk. The scenario for the exercise was then explained (as well as other possible scenarios where they may find this particular concept useful), and the learner was provided with a step-by-step, graphically supported explanation of how they would resolve the exercise challenge.

Once the learner had completed the steps described, the booklet would then summarize the experience and highlight key principles that could be generalised. At the end of each chapter, a summary was also provided, and the learner was asked to repeat any exercise if they were not entirely comfortable with their understanding.

The driver of the self-managed learning process was the learner him/herself, with the facilitator simply providing learning support if and when the learner requested it. No pace was set, although the learners were reminded at various intervals how much time they had left to complete the course.

The key differences between the two learning approaches used in the study were therefore the media used in conveying the information, and the person who was required to set the learning pace (i.e. the instructor or the learner).

4.4.3 Design of the learning outcomes assessment

The performance assessment was based on clearly defined learning outcomes (see Appendix 2). This was in line with the recommended approach described by the South African Qualification Authority (2000). The view taken was that it is not valuable assessing the memory of system steps when this, in isolation of a specific task, does not necessarily indicate an ability to perform effectively. What, according to the South African Qualification Authority (SAQA), should rather be assessed is whether or not the subject was able to create the outcome requiring those steps.

For example, asking the subject to write down the system steps s/he would take to insert a formula does not necessarily mean that the subject can insert a formula in a job-related spreadsheet. It just means that they can remember these system steps, not necessarily that they can perform them in a real-life situation. What is more useful is to give the subject a spreadsheet that requires a formula inserted into a specific cell in order for it to be complete. If the subject is able to perform the task (irrelevant of the system steps they opt to use), then they can be viewed as competent in that task. If not, they are not competent.

To develop the outcomes-based assessment, the outcomes created during the course were used as guidelines. Exercises, very similar to those used in the courses (except for small naming and data changes), were then designed. Marks were then allocated according to the following criteria:

- The number of system steps required to perform the task (i.e. the mechanical complexity of the task).
- The conceptual difficulty of the task.

An assessment instruction sheet was then drawn up, as well as a detailed marking schedule. This schedule was then cross-checked against the desired learning outcomes to ensure that all were assessed correctly.

4.4.4 Post-training support

To support learning and performance after the training course was complete, a pack of learning support cards was designed for each learner. The pack of cards covered every action that the learner would be taught during the training course, and provided step-by-step explanations of how to perform each action using Excel 97. Each step was also graphically explained on the card (using the relevant screendumps).

The first card in the pack, the Index card, listed the actions and the card number where the steps for that action were described. The learner therefore simply needed to look up the action s/he wished to perform, and then flip to the referenced card.

The cards were wire-bound and colour printed on hard paper to enable the learner to stand the cards upright, as if it were a tent. This allowed the learner to look at the steps while working with both hands on the keyboard. The size of the cards was also designed to ensure that the learner could keep the cards near where they would need them.

The reference cards were available to the learner during the learning outcomes assessment. This was aimed to ensure that the learners were tested on conceptual understanding, and their ability to use available resources to resolve spreadsheeting problems. No other post-training support was provided to the learners.

4.4.5 Performance system variables

To some extent, the consequences to performance on the learning outcomes assessment were addressed by both courses. Subjects were offered a certificate if they completed the learning outcomes assessment at the end of the course. Other than that, no attempt was made to determine whether any macro or job-level variable may negatively impact on the learners performance after the training was complete. This was left up to the learner him/herself to manage.

4.5 DATA GATHERING

Both quantitative and qualitative data was collected in this study. The measuring instruments used and the procedure to gather the data are described below.

4.5.1 Measuring instruments

A number of standardised (n=2) and non-standardised (n=5) measuring instruments were used to collect and measure the data. The standardised and then the non-standardised instruments are described below:

(a) Learning Style Questionnaire (see Appendix 4)

(i) Development: The Learning Styles Questionnaire is designed by Honey and Mumford (1982).

(ii) Rationale: Learning styles appear to influence the ability of different people to learn from a specific training program. By identifying the preferred learning style, different instructional techniques can be applied.

(iii) Aim: To identify the learning styles of the learner.

(iv) Physical description:

- Scales: The Learning Styles Questionnaire is scored by awarding one point for each item. There are no points for crossed items. The questions are ordered under different learning styles. To calculate the total score per style, scores need to be added up by scoring column.
- Administration: The Learning Styles Questionnaire consists of 80 questions. There is no time limit to the questionnaire, and the individual simply needs to indicate if they agree with the statement or not.
- Interpretation: Score strength for each style reflects the strength of preference. The styles with the highest scores are therefore those styles that the individual prefers most.
- Validity: The questionnaire, according to Honey and Mumford (1982), has acceptable face validity, with the real validity continually being tested.
- Reliability: The Pearson's product-moment coefficient of correlation was 0.89. People with strong Theorist and Reflector preferences were most consistent, with correlations of 0.95 and 0.92 respectively. Pragmatists produced a test-retest consistency of 0.87, while Activists had a correlation of 0.81.

(v) Measurement and results reporting: The subject's answers are transferred to a mark sheet. The mark sheet consists of 4 columns, each representing a specific learning style. The frequency of answers selected in a particular column are then added up to give total scores. The higher the total score, the greater the preference for the particular learning style.

(b) Learning Potential Computerised Adaptive Test (LPCAT)

(i) Development: This is a computerized test developed by De Beer (2000b), and evaluates the learning potential of individuals. A preliminary research version of this test was used for the present study.

(ii) Rationale: Individuals with different learning potentials may benefit from different learning methods, and may also learn at different speeds. One's learning potential may also influence one's ability to learn complex system skills and knowledge.

(iii) Aim: The aim of the Learning Potential Computerised Adaptive Test is to identify the potential of an individual to learn new skills and knowledge.

(iv) Physical description:

- Scales: Learning potential initial z-scores are transformed to t-score stanines and percentage scores.
- Administration: The test is administered using a computer.
- Interpretation: The people with the highest scores are deemed to have the highest potential to learn from the training program.

- Validity: In terms of construct validity, LPCAT correlations with other cognitive tests range between 0.400 and 0.713. For predictive validity, LPCAT correlations with average grade 8 academic results range between 0.439 and 0.543.
- Reliability: Internal consistency reliability for the LPCAT ranges between 0.925 and 0.987 for the total group and various subgroups respectively.

(v) Measurement and results reporting: The computerised test records each response in a data file (see Appendix 5).

(c) Checklist about instructional materials and methods for expert reviewers (see Appendix 3)

(i) Development: The "Checklist about instructional materials and methods for expert reviewers" was created by Rothwell and Kazanas (1998).

(ii) Rationale: The learning of computer software is impacted by the design of the learning experience. It is therefore important to evaluate the courses to see whether there are any design factors that may influence learning.

(iii) Aim: To assess whether there are any design factors that could negatively influence the effectiveness of the training course.

(iv) Physical description:

- Scales: The scale is a simple yes/no/not applicable rating scale.
- Administration: The checklist is completed by the course reviewer using pen and paper.
- Interpretation: The data needs to be interpreted as a subjective perspective of the reviewer.

- Validity: The validity of this checklist has not been assessed as it pertains to qualitative data.
- Reliability: The reliability of this checklist has not been assessed as it pertains to qualitative data.

(d) Demographics Questionnaire (see Appendix 4)

(i) Development: The Demographics questionnaire was developed by the researcher.

(ii) Rationale: Age, gender, education level and previous experience using a computer were identified as possible factors that impact on a person's ability to learn new software skills and knowledge.

(iii) Aim: To identify learner demographics.

(iv) Physical description:

- Scales:
  - ⇒ Highest education level is categorized as either Std 5, Std 8, Std 10, Diploma, Degree, and Other.
  - ⇒ Previous computer experience is categorized as either; I have no previous computer experience; I have a limited exposure to and understanding of computers; I have a fairly good exposure to and understanding of computers; I have a good exposure to and understanding of computers; I have a very good exposure to and understanding of computers
- Administration: The paper-based questionnaire is handed out to each subject prior to attending the course. The subjects then need to complete the questionnaire using pen or pencil.

- Validity: The questionnaire has a high face validity. This was assessed by the research supervisor and the Witwatersrand Business School course convener.
- Reliability: The reliability of this questionnaire was not assessed.

(v) Measurement and results reporting: The demographic data is self-reported by each subject using pen and paper.

(e) Excel 97 Fundamentals Competence Assessment

(i) Development: The Excel 97 Fundamentals Competence Assessment was developed by the researcher, based on the outcomes-based assessment guidelines of the South African Qualifications Authority (2000).

(ii) Rationale: The primary factor used to assess the effectiveness of each training course in this study was the ability of the learners to demonstrate the application of newly acquired software skills and knowledge to a number of spreadsheeting tasks.

(iii) Aim: The aim of the Excel 97 Fundamentals Competence Assessment is to measure the ability of the learner to apply learned skills and knowledge to complete key spreadsheet-related tasks using the software Microsoft Excel 97.

(iv) Physical description:

- Scales: Learner competence is scored as a percentage. Full marks, or 100% would translate to a raw score of 53. These raw scores are based on correctly applied skills or knowledge. 1 mark would relate to the correct fulfillment of a single action or task.

- Administration: The test is provided as an Excel 97 file to each learner on disk. Instructions on how to complete the test are provided on paper handouts (see Appendix 6)
- Validity: The face validity of the test was assessed by two (2) Excel 97 software trainers as being high.
- Reliability: The reliability of the test has not been determined.

(v) Procedure:

- Measurement and results reporting: The results file of each learner is printed out onto hard copy, and scores are manually allocated on the hard copy, based on the guidelines provided by the detailed scoring sheet. Total scores are then calculated off the marked hard copies, and final raw scores are then recorded on an Excel spreadsheet. These scores are then converted to percentage scores.
- Interpretation: The higher the percentage score, the more competent the learner is to complete key spreadsheet-related tasks using Excel 97.

(f) Course Rating Questionnaire (see Appendix 7)

(i) Development: The Course Rating Questionnaire was developed by the researcher, based on the guidelines of Kirkpatrick (1996).

(ii) Rationale: Kirkpatrick's level 1 (Reaction) assessment of course effectiveness indicates how people perceived the course itself, and provides the first level of assessment data. Each question in the assessment relates to key course assessment criteria.

(iii) Aim: To identify the reaction of a learner to a number of aspects of the particular course attended.

(iv) Physical description:

- Scales: The questionnaire uses a 5-level Lickert scale (Excellent, Good, Average, Below Average, Poor).
- Administration: The paper-based questionnaire is handed out to each subject after the course has been completed. Subjects then complete the questionnaire using pen or pencil.
- Validity: The questionnaire has a high face validity. This was assessed by the research supervisor and the Witwatersrand Business School course convener.
- Reliability: The reliability of this questionnaire has not been assessed.

(v) Procedure:

- Measurement and results reporting: The reaction data is self-reported by each subject using pen and paper. Each subject's answers is then recorded onto a spreadsheet by the assessor.
- Interpretation: The higher the score for a question, the more favorable the learner perceives the particular aspect questioned.

(g) Structured Telephonic Interview (see Appendix 8)

(i) Development: The Structured Telephone Interview was designed by the researcher.

(ii) Rationale: There are a number of post-training support and performance system factors that may influence learning. By giving a sample of the learners the opportunity to provide qualitative feedback, these factors may be highlighted.

(iii) Aim: To obtain post-training support and performance system feedback on possible factors that may have influenced the learning of the assessed skills and knowledge in Excel 97.

(iv) Physical description:

- Administration: The interview is held individually over the phone.
- Validity: The interview questions have a high face validity. This was assessed by the research supervisor and the Witwatersrand Business School course convener.
- Reliability: The reliability of this questionnaire was not assessed.

(v) Measurement and results reporting: Subject responses are recorded using a tape recorder held to the phone mouthpiece. Thereafter, shortened transcripts are created from the recordings.

4.5.2 Data gathering procedure

The procedure used for gathering the various data (using the measurement instruments described above) was as follows:

(a) Collection of course design data

The design process of both the instructor-led and self-managed Excel 97 Fundamentals courses was assessed based on the "Checklist about instructional materials and methods for expert reviewers" (see Appendix 3). This checklist was completed by the researcher, based on a review of the entire design process and the course content. The data was recorded using pen and paper, and the results were entered into a spreadsheet for storage.

(b) Collection of subjects' personal details

After the general sample had been randomly allocated to two experimental groups (one called the instructor-led group, the other the self-managed group), each subject was allocated a student number for the purposes of the training course. This number was verbally given to each subject, and was also available to them on a list in the training venue. Each subject was then handed a Demographic Questionnaire together with a Learning Styles Questionnaire (see Appendix 4). The researcher highlighted to the subjects that all information would be viewed as strictly confidential, and any personal information would be available to the student should they wish to view it. They were then asked to complete the questionnaires at home and to bring the completed questionnaires with them on the day of their training course. The importance of the information was stressed, and the presentation of completed questionnaires was specified as a requirement to attend the course.

The subjects were also told that the first hour of the course would entail a Learning Potential Computerised Adaptive Test. Again the confidentiality of the data was highlighted, and the purpose of the test explained. The course was to run from 8.30am to 2.30pm, with short breaks in-between. Subjects were warned that a lunch break would only be provided at the end of the course (with breaks restricted to three biological and refreshment breaks of 10 minutes).

On arrival at the training venue (on the prescribed day), subjects were informed that the course convenor had instructed the researcher, with no prior warning, to shorten the Excel 97 training course due to complaints by business school students. The end time was therefore altered to 1.30pm (1 hour shorter than scheduled). The students were then asked to hand in their completed questionnaires, after which they were allocated their own computer.

Once everyone was seated, the instructions for the Learning Potential Computerised Adaptive Test were read out. The test had been loaded onto each computer prior to the subjects arriving. The subjects were reminded to use their student number where required, and were given personal assistance if they were unable to start the test. Once the student had begun the test, no further assistance (unless technical) was provided.

On completion of the Learning Potential Computerised Adaptive Test, subjects were shown how to close the test and how to return to the desktop view. Once everyone was ready, the delivery of the instruction commenced. For the instructor-led group, this delivery was provided by the instructor. Subjects needed to listen to the various explanations, as well as view how the various actions needed to be carried out (from the projection of the instructor's computer screen). They then needed to repeat the actions at their own computer terminal (when told to do so). For the self-managed group, delivery was provided using the learning guides. Subjects needed to read the descriptions provided, and then complete the various exercises described.

(c) Collection of competence assessment data

Once the learning intervention was completed, each group was allowed a 15-minute break before they were asked to complete the Excel 97 Fundamentals Competence Assessment. Each subject was handed the assessment instructions (see Appendix 6), as well as a disk containing the file used in the assessment.

The researcher then explained to the subjects that this was simply a final exercise to test how much they understood from the training course that they had just completed. The subjects were also told not to concern themselves if they did not know how to complete a task, and to simply move on to the next task. The researcher highlighted the reference cards that were handed to each subject at the beginning of the course, and told the

subjects to feel free to use the cards if they could not recall the system steps required to perform a given task.

The subjects were told that they had one hour to complete the final assessment. The researcher refused to assist any subject, unless it involved a technical problem with the computer.

When the hour was complete, the subjects were asked to save their assessments using their student name as the file name. The researcher verbally described every step that the subjects needed to follow to save their files correctly. The researcher also highlighted that subjects would only receive a certificate of attendance once they had handed in their assessment disks with their files correctly saved.

Once all subjects had saved their assessment files, the researcher thanked them for their attendance. A certificate of attendance was then handed to the student once they had handed in their assessment disks. Each student was then permitted to take their reference cards with them to practice at home. Certain students also asked to take their exercise disks with them to continue their learning.

Once all subjects had left the training room, the researcher downloaded all the learning potential result files onto disk. These files were automatically saved with the student number as the file name (for later reference). At this point, the researcher discovered that a number of students had not completed the Learning Potential Computerised Adaptive Test (although they said they had), as the results file was not present on their computers. The researcher also later discovered that a large number of students had failed to save their learning outcomes assessment files correctly. The files that were handed in were the original assessment files, with no changes made to them.

(d) Collection of course rating data

Upon completion of the course, each student was then handed a Course Rating Questionnaire (see Appendix 7) and a pencil, and asked to complete the questionnaire before leaving. These were then collected at the door.

(e) Collection of post-training support and performance system variables data

The impact of the post-training support and performance system variables was assessed using a structured telephonic interview (see Appendix 8 for the questions asked). The contact details of only 8 students could be found at the business school's office. 3 subjects from the instructor-led group and 5 subjects from the self-managed group were phoned either at their home or at work and questioned regarding the effectiveness of the reference support cards, and the impact of a number of performance system variables on their ability to perform effectively. The subject's responses were recorded using pen and paper.

4.6 DATA PROCESSING

The data was processed in the following manner:

4.6.1 Course design data

The completed "Checklist about instructional materials and methods for expert reviewers" was analysed based on the subjective perspective of the researcher.

4.6.2 Demographic data

Of the 23 subjects who attended the instructor-led course, only 19 were found to have completed the demographic questions listed in the questionnaire. In the self-managed

group, only 14 out of the 26 subjects were found to have completed the demographic questions correctly.

In order to determine whether any of the demographic variables of the two experimental groups were significantly different (and therefore a confounding variable on the final assessment scores), the chi-square of each variable was calculated. This was done due to the fact that each variable (e.g. education level) was categorical. The categories within each of the demographic variables were as follows:

- Gender: Female; Male
- Education level: Degree; Diploma; Std 10; Std 8; Std 5
- Previous experience with computers:
  - Level 1 (I have no previous computer experience)
  - Level 2 (I have a limited exposure to and understanding of computers)
  - Level 3 (I have a fairly good exposure to and understanding of computers)
  - Level 4 (I have a good exposure to and understanding of computers)
  - Level 5 (I have a very good exposure to and understanding of computers)

In order to increase the expected frequencies in cells (where data in certain categories was minimal), categories were collapsed and the chi-squared value re-calculated (Siegel, 1988).

A t-test was performed on the variable Age (given that it was an interval-scaled variable). A non-parametric Wilcoxon 2-sample test was also performed, due the small subject data available on the Age variable.

In addition to analysing whether the various demographic variables of the two groups were significantly different, correlations with the learning potential, learning styles and assessment scores were also performed. This was done to determine whether a demographic variable correlated in any way with the aforementioned variables.

4.6.3 Learning styles

Of the 23 subjects who attended the instructor-led course, only 19 were found to have completed the learning styles questionnaire. In the self-managed group, only 14 out of the 26 subjects were found to have completed the questionnaire correctly.

In order to determine whether the learning styles of the two experimental groups were significantly different (and therefore a confounding variable on the final assessment scores), t-tests were performed on the following learning styles:

- Reflector
- Theorist
- Pragmatist
- Activist

Given the low number of subjects who completed the questionnaire correctly, it was also decided to perform a non-parametric Wilcoxon 2-sample test on all of the above measures.

In addition to analysing whether the learning styles of the two groups were significantly different, correlations with all the demographic variables, learning potential scores and assessment scores were also performed. This was done to determine whether any of the learning styles correlated in any way with the aforementioned variables. Correlations were also performed with each learning style, to determine whether a learning style correlated with another learning style.

4.6.4 Learning potential

On completion of the Learning Potential Computerised Adaptive Test, a results file was automatically generated by the computer program. This results file (see example provided in Appendix 5) recorded the following important information:

- The student name and number.
- The pre-test item scores.
- The post-test item scores.
- The final pretest score (z-score) and variance score indicating accuracy of measurement.
- The final posttest score (z-score) and variance score indicating accuracy of measurement.

Of the 23 subjects who attended the instructor-led course, only 12 were found to have completed the learning potential test correctly (i.e. there was a results file available). In the self-managed group, only 9 out of the 26 subjects were found to have completed the test correctly.

In order to determine whether the learning potential of the two experimental groups were significantly different (and therefore a confounding variable on the final assessment scores), t-tests were performed on the following:

- Difference between the post-test and pre-test mean and the difference between the post-test and pre-test variance.
- Pre-test mean and the pre-test variance.
- Post-test mean and the post-test variance.

Given the low number of subjects who completed the learning potential test correctly, it was also decided to perform a non-parametric Wilcoxon 2-sample test on all of the above measures.

In addition to analysing whether the learning potential of the two groups was significantly different, correlations with all the demographic variables, learning styles and assessment scores were also performed. This was done to determine whether learning potential correlated in any way with the aforementioned variables.

4.6.5 Competence assessment

Of the 23 subjects who attended the instructor-led course, only 19 were found to have saved their assessment on the assessment disk. In the self-managed group, only 14 out of the 26 subjects were found to have saved their assessment on the assessment disk. The rest of the subjects either did not save their assessments (and simply closed the file), or saved the assessment in an incorrect location.

To determine whether the learning outcome assessment results were different in the two groups, a t-test was performed on the assessments scores across the two groups. Given the low number of subjects who saved the completed assessments correctly, it was also decided to perform a non-parametric Wilcoxon 2-sample test.

In addition to analysing whether the learning outcomes assessment results of the two groups were significantly different, correlations with all the demographic variables, learning potential scores and learning styles were also performed.

4.6.6 Course reaction ratings

Of the 23 subjects who attended the instructor-led course, only 4 returned completed Course Rating Questionnaires. In the self-managed group, only 2 out of the 26 subjects returned completed Course Rating Questionnaires.

These ratings were then combined into a frequency table to provide an idea of the overall reaction to each aspect of the course.

4.6.7 Post-training support and performance system variables data

Of the 23 subjects who attended the instructor-led course, only 3 could be contacted for their post-training support and performance system feedback. In the self-managed group, only 5 out of the 26 subjects could be contacted. Points raised by each contacted subject were then summarised under the following headings:

- Frequency of Excel 97 use.
- Usefulness of the reference cards.
- Frequency of reference card use.
- Other impacting factors and suggestions for improvement.
- Motivational impact of the certificate.

4.6.8 Determinants of competence assessment performance

In addition to the data processing described above, it was also decided to correlate the various data with each other, to determine any possible relationships that could be investigated further. The correlations calculated were as follows:

- Age and assessment score.
- Gender and assessment score.
- Educational level and assessment score.
- Previous computer experience and assessment score.
- Learning potential and assessment score.
- Learning style and assessment score.

In addition, correlations between the various personal factors were also calculated.

4.7 HYPOTHESIS FORMULATION

The hypothesis of this investigation is that the specifically designed self-managed training course is more effective that the specifically designed instructor-led training course in teaching the sample of students the key skills and knowledge they required to complete key spreadsheet-related tasks using the software Microsoft Excel 97.

4.8 SUMMARY

In this chapter, the research design, and the methods used to operationalise the design were described. This was followed by a description of the measurement instruments and procedure used to gather the required data, as well as the manner in which the data was processed. Finally, the hypothesis for the quantitative aspect of the research was formulated.

CHAPTER 5: RESEARCH RESULTS

5.1 INTRODUCTION

The results of this study will be presented according to the specific data gathered and processed. Firstly, the results from the course design assessment will be detailed, followed by the results from the processed demographic, learning styles and learning potential data. Thereafter, the results from the processed competence assessment, course rating and post-training support and performance system variables data will be presented.

5.2 COURSE DESIGN DATA

The results of these reviews are provided below.

5.2.1 Instructional design procedure

The design procedure appeared to follow the procedure described by Rothwell and Kazanas (1998), although the following discrepancies were noted:

- The needs assessment was based on personal experience and the perceptions of a couple of training managers. No assessment was done using the target audience. This resulted in the course content being too demanding on the learners involved.
- The assessment of learner characteristics was very subjective, and led to a number of unfounded assumptions. The characteristics were generally of white professionals in retail and financial sector jobs. These characteristics were therefore not similar to the "previously disadvantaged" group used in the study. This would have impacted on the instructional strategies and materials developed.
- The assessment of learner characteristics did not take into account the cognitive strategies and repertoire used by the learners; their belief in autonomy and control;

their belief in intelligence and knowledge; and their problem-solving techniques and process.

- The assessment of the jobs and tasks was done on professional jobs in the retail and financial sector. None of the target audience had those types of job or task requirements, and hence the content may not have been appropriate for their specific requirements.
- The pilot was conducted using a non-representative sample. This may have resulted in problems not being picked up before the study session was conducted.

5.2.2 Clearly stated outcomes

The desired outcomes were clearly identified and noted, although this was more evident in the self-managed guide. With the instructor-led courseware, the outcomes were only discussed at the beginning of the course and may have been forgotten by the learners (although they did match up with learning content).

5.2.3 Learning materials match to learner characteristics

The learner characteristics (although not accurately enough defined) and the learner materials were noted as having a fairly close match. The concern was, however, raised regarding the level of language used. Although it was written for novice Excel users, the style appeared to assume a certain computer literacy that may not have been evident. The content also assumed certain background experiences that may not have been valid for the sample group.

5.2.4 Learning materials match to instructional objectives

The learning materials and the stated instructional objectives were noted as having a fairly close match. A concern was noted that the stated objectives may not have matched

the objectives of the subjects, where they may have wanted a less demanding and comprehensive course content.

5.2.5 Use of instructional strategies and techniques

The effectiveness of the various instructional strategies was noted as follows:

(a) Previews

A single positive or optimistic preview of the course was provided to both groups prior to either course commencing. This was partly aimed at increasing motivation to attend and learn the software skills covered in the course. This appeared to raise expectations, and may have lowered the learners' self-efficacy as the course progressed and they became increasingly lost.

(b) Animated demonstrations

Both the instructor-led and self-managed courses utilised the same animated demonstrations (one shown off PowerPoint slides; the other contained in the learning guide itself). All problem-solving opportunities were also introduced in the same way, and at the same time during the course itself. Learners in the instructor-led group appeared to find these demonstrations beneficial to their understanding (positive body language was given e.g. nodding heads). The effect of the written demonstrations in the self-managed group can only be deduced from the lack of questions that were asked relating to the demonstrations (i.e. they found them beneficial).

(c) Prompting

Where it was viewed appropriate for the instructor to prompt the subjects, the identical written prompt was provided in the self-managed learning guides. This was possible due to the chatty writing style that was used for the learning guide. The prompting provided to the instructor-led group appeared to facilitate learning, as students willingly engaged in interaction with the instructor at every opportunity. The impact of the written prompts on the self-managed group can not be accurately gauged as students who were questioned on this may have been overly compliant to avoid getting into a long discussion that may have eaten into their learning time (they claimed they did benefit).

(d) Analogies and metaphors

Identical analogies and metaphors were used for the conceptual explanations given in both courses (the one was verbally conveyed, whereas the other was conveyed in writing). The instructor-led group appeared to benefit from the analogies and metaphors, as many students appeared to understand once the concept was explained using an analogy or metaphor. The impact of the written metaphors and analogies on the self-managed group can also not be accurately gauged as students who were questioned on this may have been overly compliant to avoid getting into a long discussion with the researcher (they claimed they did benefit). No mnemonics were incorporated, and there was limited use of imagery.

(e) Co-operative learning

The learning design of the instructor-led and self-managed courses allowed for learners to work together on practice exercises provided at the end of the course (if there was time left over). This aimed to provide learners with the opportunity to share experiences and insights, and to jointly problem-solve. During the study however, time proved a limiting

factor (neither course had the time to offer the additional exercises). Learners were assigned their own computer terminal with sideboards separating them from their neighbouring students, and little or no interaction between the students took place. The effect of this appeared to be different, depending on the learning difficulty experienced. Those who appeared to be struggling often approached neighbours for advice, and would probably have benefited from co-operative learning. Those who appeared to have no learning difficulty, however, appeared to enjoy being left alone undisturbed.

(f) Visual and verbal descriptions

All visual or verbal descriptions provided by the instructor in the instructor-led course were reflected in the self-managed learning manual. Again, the chatty writing style adopted in the learning guide made this possible. The instructor-led group appeared to benefit from the visual and verbal descriptions provided, based on their positive body language. The self-managed group was only provided with verbal descriptions, and this may have limited their ability to encode and recall the information later on. This, however, could not be accurately gauged as students who were questioned on this may have been overly compliant to avoid getting into a long discussion with the researcher (they claimed they did benefit).

(g) Behaviour modelling

The process of behaviour modelling (i.e. show the behaviour; let the student try the behaviour for themselves; give them feedback and practice opportunities before providing them with a chance to try the new behaviour in their job environment) was to some extent used in the instructor-led course. The elements that were missing were detailed performance feedback, an opportunity to practice and an opportunity to try in their job environment. What did occur was the instructor showing the group how to perform each task, and then giving them an opportunity to try it for themselves (giving

support where required). No behaviour modelling was used in the self-managed course. The behaviour modelling used in the instructor-led course appeared to have assisted learning, especially given the time pressures. Rather than have to work it out themselves, the learners were quickly able to see how it was supposed to be done, and then to imitate it.

(h) Learning content closely reflective of job requirements

All four (n=4) training managers interviewed confirmed that the course content of both the self-managed and instructor-led courses were reflective of the job requirements of employees working with spreadsheets in their organisations. No additional content was suggested, although two (n=2) managers did query the time duration of 5 hours, given the extensive content that was to be covered. This proved correct, especially given the 3 hour limit. Learners appeared to feel overly pressurized to learn an extensive course content that they had very little hope of completing. This appeared to have a significant impact on their learning.

(i) Exercise opportunity

The number of exercises provided in both courses appeared to be well received. Learners questioned about the exercises noted that they wish they could have had even more opportunity to further exercises, as this they believed was the only way to learn. Although this maintenance rehearsal was built into each course, a lack of time limited its application.

(j) Metacognition

No focus was given to providing subjects with an insight into their use of cognitive strategies, or ways to improve memory and recall.

5.2.6 Content completeness

The instructional package was noted as being complete and up to date.

5.2.7 Learner opportunity

The learners, in the learning design, did receive information about the learning content, and would be given opportunities to practice and apply what they learned. It was, however, noted that time would be a key factor in this, although sufficient time was planned for. The assessment at the end was noted as being an effective way of providing learners with feedback on how well they applied what they learned. It was recommended, however, that a detailed feedback report should be provided to each learner.

5.2.8 Additional issues

No other issues were noted.

5.3 DEMOGRAPHICS

To determine whether any of the interval-scaled data collected from the subjects in the self-managed group were significantly different from the interval-scaled data collected from the subjects in the instructor-led group, t-tests and Wilcoxon tests were conducted.

5.3.1 Age

The mean age of the total sample was calculated as being 29.6. The mean age of the different group's subjects was calculated as being 29.4 years in the instructor-led group, and 29.9 years in the self-managed group.

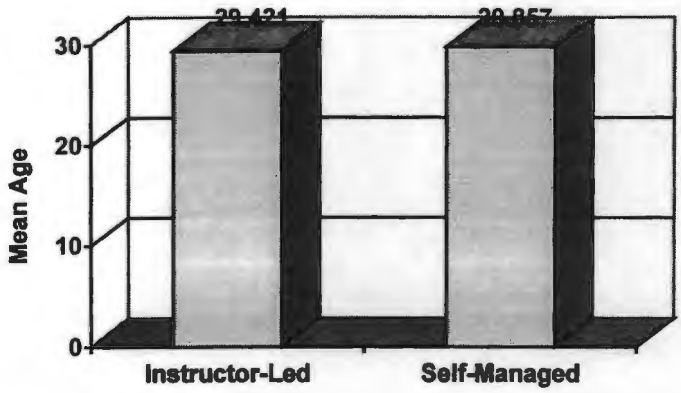

Figure 5.1: Mean age of the two groups

When a t-test and Wilcoxon test was done using these means, the following results were obtained:

TABLE 5.1: T-TEST AND WILCOXON TEST RESULTS FOR AGE

Instructor-led group (n=19)		Self-managed group (n=14)		T-Test		Wilcoxon	
Mean	Std. dev	Mean	Std. dev	T score	Prob	S score	Prob
29.421	5.757	29.857	3.920	-0.244	0.809	252.00	0.620

The results of the t-test show that, at a probability level of 0.05, there does not appear to be a significant difference between the mean age of the two groups. This finding is supported by the Wilcoxon s-score of 252 and probability score of 0.62.

5.3.2 Gender

The percentage of females to males in the total sample was 65.41% females and 34.59% males. The percentage of females to males in the instructor-led group was 73.68%

females to 26.32% males. In the self-managed group, 57.14% of subjects were female, while 42.86% were male.

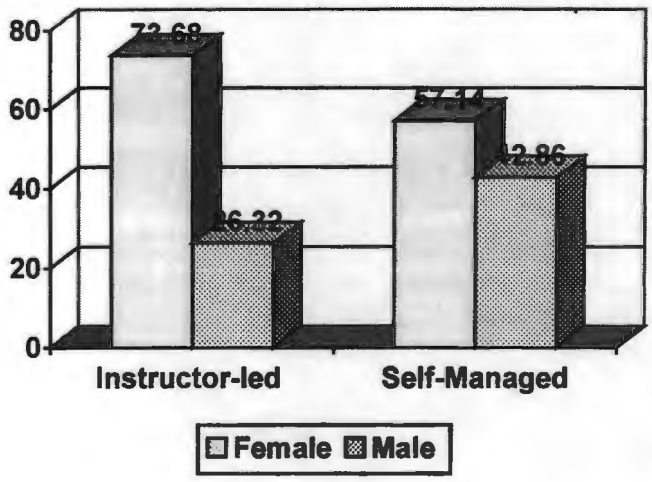

Figure 5.2: Gender percentage frequencies

When a Chi-Square test was performed on the two groups to determine whether there was a significant difference between the number of females and males in the two groups, the Chi-Square value was 0.992 and the probability score was 0.319.

TABLE 5.2: PERCENTAGE FREQUENCY OF MALES AND FEMALES IN GROUPS

Group	Measure	Female	Male
Instructor-led	Frequency	14	5
	Percentage	73.68	26.32
Self-managed	Frequency	8	6
	Percentage	57.14	42.86

This indicated that there was not a significant difference between the number of females and males in the instructor-led and self-managed groups.

5.3.3 Educational level

In the total sample, 6.2% (n=2) had a tertiary degree; 38.91% (n=13) had a diploma and 54.89% (n=18) had a matric (Std 10).

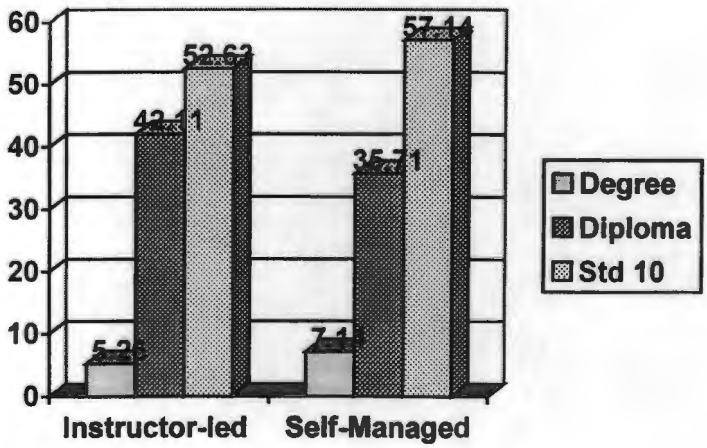

Figure 5.3: Percentage frequency of education levels

In the instructor-led group, 5.26% (n=1) of students had a tertiary degree, 42.11% (n=8) had a diploma and 52.63% (n=10) had a matric (Std 10). In the self-managed group, 7.14% (n=1) of the students had a degree; 35.71% (n=5) had a diploma and 57.14% (n=8) had their matric (Std 10). No subjects in either group had a qualification level lower than Standard 10.

TABLE 5.3: FREQUENCY PERCENTAGE OF EDUCATION LEVELS

Group	Measure	Degree	Diploma	Std 10	Std 8	Std 5
Instructor-led	Frequency	1	8	10	0	0
	Percentage	5.26	42.11	52.63	0	0
Self-managed	Frequency	1	5	8	0	0
	Percentage	7.14	35.71	57.14	0	0

When a Chi-Square test was performed to determine whether there was a significant difference between the education levels of the two groups, the Chi-Square value was 0.161 and the probability score was 0.923. To increase the expected frequencies in the cells, the data under Standard 5 and Standard 8 was collapsed into the data of Standard 10. The Chi-Square value, using this data, was 0.066 and the probability score was 0.797. This indicated that there was not a significant difference between education levels of subjects in the instructor-led and self-managed groups.

5.3.4 Previous experience with computers

In the total sample, 46% (n=15) of the subjects had a limited exposure to and understanding of computers (Level 2); 37.22% (n=12) had a fairly good exposure to and understanding of computers (Level 3); 14.01% (n=5) had a good exposure to and understanding of computers (Level 4) and 2.63% (n=1) had a very good exposure to and understanding of computers (Level 5).

In the instructor-led group, 42.11% (n=8) of the subjects had a limited exposure to and understanding of computers (Level 2); 31.58% (n=6) had a fairly good exposure to and understanding of computers (Level 3); 21.05% (n=4) had a good exposure to and understanding of computers (Level 4) and 5.26% (n=1) had a very good exposure to and understanding of computers (Level 5).

In the self-managed group, 50% (n=7) of the subjects had a limited exposure to and understanding of computers (Level 2); 42.86% (n=6) had a fairly good exposure to and understanding of computers (Level 3); 7.14% (n=1) had a good exposure to and understanding of computers (Level 4) and 0% (n=0) had a very good exposure to and understanding of computers (Level 5).

No subjects in either group had no previous exposure to computers (Level 1).

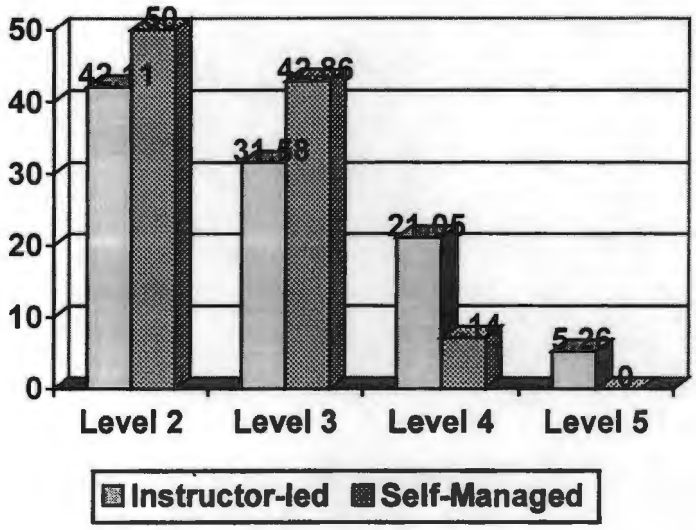

Figure 5.4: Percentage frequency of previous computer experience

When a Chi-Square test was performed to determine whether there was a significant difference between the previous experience of computers of the two groups, the Chi-Square value was 2.159 and the probability score 0.540. To increase the expected frequencies in the cells, the data in Level 1 was collapsed into the data of Level 2. The Chi-Square value, using this data, was 2.022 and the probability score was 0.364.

TABLE 5.4: FREQUENCY AND PERCENTAGE OF PREVIOUS COMPUTER EXPERIENCE

Group	Measure	Level 1	Level 2	Level 3	Level 4	Level 5
Instructor-led	Frequency	0	8	6	4	1
	Percentage	0	42.11	31.58	21.05	5.26
Self-managed	Frequency	0	7	6	1	0
	Percentage	0	50.00	42.86	7.14	0.00

This indicated that there was not a significant difference between the level of previous computer experience of subjects in the instructor-led and self-managed groups.

5.4 LEARNING STYLES

In the total sample, the mean learning style scores were 15.2 (Reflector), 13.7 (Theorist), 12.6 (Pragmatist) and 10.5 (Activist).

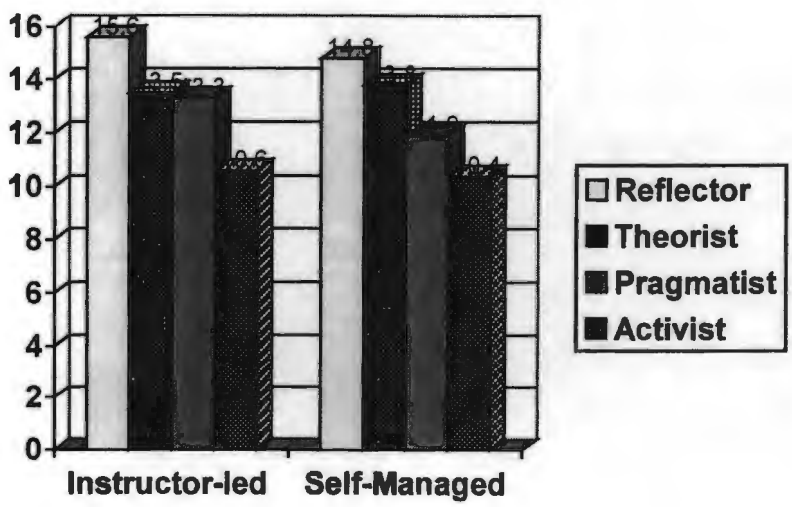

Figure 5.5: Learning style mean scores

In the instructor-led group, the mean learning style scores were 15.6 (Reflector), 13.5 (Theorist), 13.3 (Pragmatist) and 10.6 (Activist). In the self-managed group, the mean learning style score was 14.8 (Reflector), 13.8 (Theorist), 11.9 (Pragmatist) and 10.4 (Activist).

When a t-test and Wilcoxon test was performed using these means, the following results were obtained:

TABLE 5.5: T-TEST AND WILCOXON SCORES FOR LEARNING STYLES

Variable	Instructor-led group (n=19)		Self-managed group (n=14)		T-Test		Wilcoxon	
	Mean	Std. dev	Mean	Std. dev	T score	Prob	S score	Prob
Reflector	15.579	3.115	14.786	2.833	0.751	0.459	210.00	0.311
Theorist	13.526	2.455	13.786	2.455	-0.251	0.804	233.00	0.863
Pragmatist	13.316	2.496	11.929	2.495	1.578	0.125	194.00	0.109
Activist	10.632	2.833	10.429	3.081	0.196	0.846	233.00	0.865

The results of the t-test show that, at a probability level of 0.05, there does not appear to be a significant difference between the mean of any of the two groups' learning styles. This finding is supported by the Wilcoxon s-score and probability score of each of the learning styles.

5.5 LEARNING POTENTIAL

To determine whether the learning potential of the subjects in the two groups was significantly different, a variety of t-tests and Wilcoxon tests were performed using different variables obtained from the results files. The results of these tests were as follows:

TABLE 5.6: T-TEST AND WILCOXON TEST RESULTS FOR LEARNING POTENTIAL VARIABLES

Variable	Instructor-led group (n=12)		Self-managed group (n=9)		T-Test		Wilcoxon	
	Mean (z-score)	Std. dev	Mean (z-score)	Std. dev	T score	Prob	S score	Prob
Pre-test mean	-0.0004 (50.00)	0.441	0.410 (54.1)	0.622	-1.775	0.092	120.00	0.148
Pre-test variance	0.094	0.016	0.103	0.017	-1.302	0.208	119.00	0.164
Post-test mean	0.139 (51.39)	0.455	0.290 (52.90)	0.560	-0.687	0.501	109.00	0.508
Post-test variance	0.034	0.004	0.032	0.005	0.881	0.389	90.00	0.540
Post-Pre test mean	0.139 (1.39)	0.219	-0.120 (-1.2)	0.342	2.116	0.048	70.00	0.041
Post-Pre test var.	-0.060	0.014	-0.072	0.015	1.757	0.095	75.00	0.092

The results of the t-tests (see Table 5.6) show that, at a probability level of 0.05, there does not appear to be a significant difference between the pre-test mean, the pre-test variance, the post-test mean and the post-test variance. This finding is supported by the Wilcoxon s-score and probability of each of variable.

However, there does appear to be a significant difference in the post-test minus the pre-test score mean and variance (a finding supported by the probability score of both the t-test and Wilcoxon test). To investigate this finding further, a t-test for dependant measures was performed on the different group's post-test minus the pre-test score mean and variance. The results of the test was as follows:

TABLE 5.7: LEARNING POTENTIAL POST-TEST MINUS PRE-TEST SCORE MEAN AND VARIANCE

Variable	Instructor-led group (n=12)				Self-managed group (n=9)			
	Mean (z-score)	Std. dev	T score	Prob	Mean (z-score)	Std. dev	T score	Prob
Posttest – Pretest mean	0.139	0.219	2.195	0.051	-0.120	0.342	-1.053	0.3231
Posttest – Pretest var	-0.060	0.014	-14.579	0.0001	-0.072	0.015	-14.317	0.0001

For assessment of comparable (academic) level of reasoning ability, De Beer (2000a) transformed the mean level of performance from z-score to t-score. The levels were as follows:

- Average: 50 (Grade 10 level); $^{+}/.52$ (Grade 12 level)
- Above average: $^{+}/.55$ (Tertiary; Technicon level); =60 (Tertiary; University level)
- Below average: -40 (Primary school level); 45 (Grade 8 level)

Translating these comparisons to the results described on Table 5.6, the education level indicated by the pre and post test scores is as follows:

TABLE 5.8: LPCAT Z-SCORES TRANSLATED TO EDUCATION LEVEL

Test	Instructor-led	Self-managed
Pretest	50.00 (Grade 10 level)	54.1 (Tertiary level)
Posttest	51.39 (Grade 11-Grade 12)	52.90 (Grade 12 level)

Whereas the post-test minus the pre-test score means in the instructor-led group were positive (as would generally be expected), the means were negative in the self-managed

group. This indicates that on average the subjects in the self-managed group tended to do worse on the post-test that the pre-test. When looking at the overall levels of performance, the self-managed group performed at a slightly higher level compared to the instructor-led group. This could to some extent be explained by a regression to the mean effect, considering that the two groups did not differ statistically in terms of their educational level. Statistically, however, the difference is not significant, as is indicated in the discussion that follows.

In an attempt to overcome this problem, the researcher decided to opt for testing the average of each group's pre-test and post-test mean and variance. The results of these t-tests and Wilcoxon tests were as follows:

TABLE 5.9: AVERAGE OF LEARNING POTENTIAL PRE-TEST AND POST-TEST MEAN AND VARIANCE

Variable	Instructor-led group		Self-managed group		T-Test		Wilcoxon	
	Mean (z-score)	Std. dev	Mean (z-score)	Std. dev	T score	Prob	S score	Prob
Ave. Pre + Post mean	0.069	0.434	0.350	0.566	-1.291	0.212	116.00	0.247
Ave. Pre + Post var.	0.064	0.009	0.068	0.010	-0.899	0.380	113.50	0.319

Using the average pre-test minus post-test score mean and variance, it appears that there is not a significant difference, at a probability level of 0.05, between the learning potential of the subjects who belong to the instructor-led group and those who belong to the self-managed group.

5.6 COMPETENCE ASSESSMENT

In this section, the competence assessment scores of the instructor-led group and the self-managed group will be provided. In addition, the results from the comparison of the two group's scores will be given.

5.6.1 Competence assessment scores of the two experimental groups

The raw score (out of a maximum of 53) and overall percentage score of the various subjects in the instructor-led group and the self-managed group (ordered in descending order) was as follows:

TABLE 5.10: COMPETENCE ASSESSMENT RAW SCORES AND OVERALL PERCENTAGES

Subject	Instructor-led group (n=12)		Self-managed group (n=12)	
	Raw Score	Percentage	Raw Score	Percentage
1	53	100.00	38	71.70
2	42	79.25	23	43.40
3	41.5	78.30	20	37.74
4	39	73.58	19	35.85
5	29	54.72	19	35.85
6	29	54.72	18	33.96
7	28	52.83	18	33.96
8	24	45.28	17	32.08
9	22	41.51	13	24.53
10	20	37.74	13	24.53
11	14	26.42	11	20.75
12	13	24.53	9	16.98

Subject	Instructor-led group (n=19)		Self-managed group (n=14)	
	Raw Score	Percentage	Raw Score	Percentage
13	11	20.75	6	11.32
14	11	20.75	4	7.55
15	10	18.87		
16	8	15.09		
17	6	11.32		
18	6	11.32		
19	2	3.77		

Given these assessment results, both t-test and Wilcoxon tests were applied to determine whether the mean assessment score obtained by the subjects in the self-managed group were significantly higher than the assessment scores obtained by the subjects in the instructor-led group.

5.6.2 T-test and Wilcoxon analysis of the mean assessment scores

The results of the t-test and Wilcoxon test on the mean assessment score obtained by the subjects in the instructor-led group and the self-managed group were as follows:

TABLE 5.11: T-TEST AND WILCOXON TEST RESULTS FOR PERFORMANCE ASSESSMENT

Instructor-led group (n=19)		Self-managed group (n=14)		T-Test		Wilcoxon	
Mean	Std. dev	Mean	Std. dev	T score	Prob	S score	Prob
21.500	14.542	16.286	8.371	1.200	0.239	213.50	0.382

Judging by the mean scores, it appears that the subjects in the instructor-led group performed better on the learning outcomes assessment than those in the self-managed group.

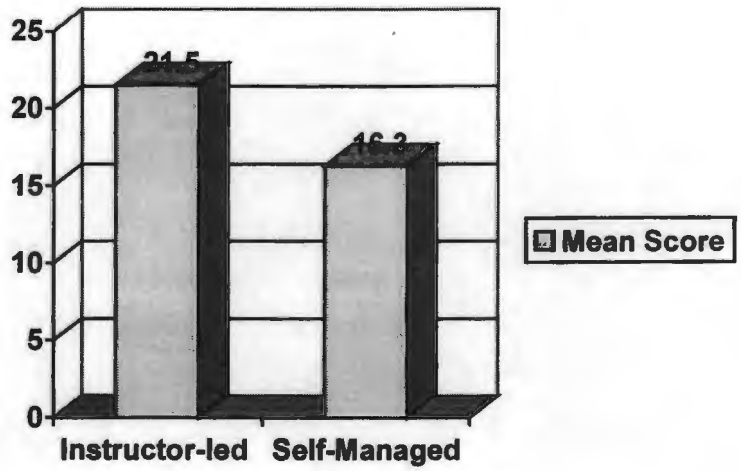

Figure 5.6: Mean performance assessment per group

However, when analysing the t-test and Wilcoxon test probability scores, based on a probability of 0.05, it was found that the mean assessment score obtained by the subjects in the instructor-led group was not significantly higher than the mean assessment score obtained by the subjects in the instructor-led group.

5.7 COURSE REACTION RATINGS

Although the sample size used to gather these perceptions was too small to represent the overall perceptions of each group, they do provide additional information that proves helpful in the overall assessment of the training courses.

5.7.1 The instructor-led course

The feedback obtained from the four (n=4) subjects who attended the instructor-led course was as follows:

TABLE 5.12: COURSE RATINGS OF THE INSTRUCTOR-LED GROUP SAMPLE

The course content (i.e. did it contain all the information you wanted covered)	2	2			
The concept explanations (i.e. were the different concepts explained clearly and simply)	1	2	1		
Exercises and scenarios (i.e. were the exercises and scenarios clear and helpful)	2	1	1		
Timing (i.e. did you feel you had enough time to complete the course)			3	1	
Assessment (i.e. were the assessment exercises instructions clear and understandable)		2	2		

Comments made regarding other factors that may have limited their ability to learn and perform on the learning outcomes assessment included the following:

- There were too many people in the training group, and sometimes the noise of the other people distracted the learner.
- They did not feel comfortable asking questions. This was because the group size intimidated them, as well as the pace of the instructor (whose body language indicated that there was a problem with time).
- They couldn't see the projector clearly, and so had to contend themselves with listening and trying to understand what the instructor was saying.
- They felt under pressure to learn. The time was too short to cover the content.

The sample of subjects in the instructor-led course appear to have felt the course content, concept explanations, exercises and scenarios were satisfactory, and did not impact negatively on their learning. Timing, however, appeared to be a limiting factor (i.e. they felt that the course should be a little longer). The assessment instructions, although not viewed as exceptionally clear and understandable, appear not to have limited performance. Clarity may also have been affected by the understanding of the subjects of the content matter. The size of the group appears to be a limiting factor, where noise and proximity to the projector screen impacted on the quality of learning delivery.

5.7.2 The self-managed course

The feedback obtained from the three (n=3) subjects who attended the self-managed course was as follows:

TABLE 5.13: COURSE RATINGS OF THE SELF-MANAGED GROUP SAMPLE

Aspect of the Course	Rating Level				
	Excellent	Good	Average	Below average	Poor
The course content (i.e. did it contain all the information you wanted covered)	2	1			
The concept explanations (i.e. were the different concepts explained clearly and simply)	3				
Exercises and scenarios (i.e. were the exercises and scenarios clear and helpful)	2	1			
Timing (i.e. did you feel you had enough time to complete the course)				1	2
Assessment (i.e. were the assessment exercises instructions clear and understandable)		2	1		

Additional comments regarding other factors that may have limited their ability to learn and perform on the learning outcomes assessment included the following:

- Time was a real issue. They did not manage to finish half of the guide in the time provided.
- They felt rushed throughout, and so did not spend time trying to understand what they had read; instead they moved on in an attempt to cover everything in the time provided.
- The assessment covered lots of things they had not covered (due to time pressures).
- They liked the ability to learn on their own. They found the guide very easy to follow, but were limited by time pressures.

The subjects in the self-managed course that were interviewed appear to have felt the course content, concept explanations, exercises and scenarios were more than satisfactory, and did not impact negatively on their learning. The assessment instructions, although not viewed as exceptionally clear and understandable, also appear not to have limited performance. Timing however appeared to be a significantly limiting factor. Subjects appear to highlight this as the key factor that impacted on their ability to learn from the self-managed course.

5.8 POST-TRAINING SUPPORT AND PERFORMANCE SYSTEM VARIABLES

The effect of the post-training support and management of the performance system variables, based on the responses of the interviewed subjects (3 from the instructor-led course and 5 from the self-managed course), were as follows:

5.8.1 Frequency of Excel 97 use

Of the 3 subjects from the instructor-led group, 1 subject was using Excel 97 infrequently, while the other 2 subjects had not used Excel 97 since attending the course. Of the 5 subjects from the self-managed course, 3 subjects had used Excel 97 infrequently, while the other 2 had not used Excel 97 since attending the course.

5.8.2 Usefulness of the reference cards

All subjects interviewed believed that the reference cards did or would provide very effective post-training support. The 5 subjects who attended the self-managed course, however, all mentioned that the learning guide would have also proved invaluable (learning guides were not given to the students to take home with them). This, they believed, would have allowed them to continue their learning at home, without the time pressures placed on them during the course.

5.8.3 Frequency of reference card use

All the 4 subjects who had used Excel 97 since completing the course said that they made extensive use of the reference cards.

5.8.4 Other impacting factors and suggestions for improvement

Subjects from both groups who had not yet used Excel 97 since attending training, mentioned the lack of immediate performance requirement (i.e. they did not need to create or use spreadsheets back at their work) as a limiting factor. They said that they had attended the course to develop skills that they felt they may one day require, but that they did not require immediately. Three of these subjects also mentioned the lack of access to a computer with Excel 97 loaded on it as a performance problem. All 3 subjects pointed

out the need for a second training session to answer all questions and refresh their memory.

The subject from the instructor-led group (n=1) who had used Excel 97 after attending the training, mentioned that memory retention was a problem. The subject noted that if they had been provided with a reference book containing exercises and conceptual explanations, they could then have gone back and practice what was covered during the course. Although the reference cards provided the system steps, conceptual understanding needed to be refreshed.

This point was supported by the 3 subjects in the self-managed group who had used Excel 97 after attending training. They highlighted that if they had been given the learning guide in addition to the reference cards, they would have been able to redo all the exercises, and to complete their learning on their own (i.e. they did not feel they needed a formal refresher training course).

5.8.5 Motivational impact of the certificate

One subject felt that the certificate had motivated them to perform effectively. Seven of the subjects, however, felt that the certificate had limited performance impact, as they knew that they would get a certificate whether they passed the assessment or not. They noted that the certification should be based on whether you passed the course, not whether you attended. This would also make the certificate more meaningful in the market place.

5.9 CORRELATIONS OF COMPETENCE ASSESSMENT PERFORMANCE WITH OTHER RESULTS OBTAINED

In this section, the results from the correlations between the various personal factors of the subjects in the instructor-led group and the self-managed group, and their competence assessment scores will be provided. In addition, the results from the correlations between the various personal factors themselves will be given.

5.9.1 Correlations between personal factors and competence assessment performance

The results of the correlation between the various personal factors and the subject's learning outcomes assessment performance provided the following measures:

- Pearson Correlation Coefficient (r)
- The probability (p)
- The number of observations (n)

These measures for the combined group (both the instructor-led and self-managed), the instructor-led group and the self-managed group were as follows:

TABLE 5.14: CORRELATION SCORES OF PERSONAL FACTORS WITH LEARNING OUTCOME SCORES

Personal Factors	Measure	Combined Group	Instructor-led group	Self-managed group
Age	r	-0.269	-0.372	0.107
	p	0.129	0.116	0.716
	n	33	19	14

[illegible]				[illegible]
Gender	r	-0.203	-0.152	-0.245
	p	0.257	0.535	0.398
	n	33	19	14
Education Level	r	0.668	0.782	0.488
	p	0.0001	0.0001	0.077
	n	33	19	14
Previous computer experience	r	0.355	0.212	0.735
	p	0.042	0.383	0.003
	n	33	19	14
Learning Potential (Ave. Post + Pre mean)	r	0.274	0.149	0.674
	p	0.230	0.644	0.046
	n	21	12	9
Learning Style (Reflector)	r	0.126	0.109	0.090
	p	0.483	0.658	0.759
	n	33	19	14
Learning Style (Theorist)	r	0.287	0.427	-0.079
	p	0.105	0.068	0.788
	n	33	19	14
Learning Style (Pragmatist)	r	0.171	0.144	0.078
	p	0.341	0.557	0.789
	n	33	19	14
Learning Style (Activist)	r	0.156	0.078	0.338
	p	0.385	0.750	0.237
	n	33	19	14

Based on the results from the correlation calculations, performance on the learning outcomes assessment appears to correlate with the following personal factors:

- **Education level**: The education levels of both the combined group and instructor-led group significantly correlate with performance on the learning outcomes assessment at a 0.001 probability level. The mean education level of the self-managed group, however, correlated significantly with performance on the learning outcomes assessment only at a probability level of 0.1.

- **Previous computer experience**: The level of previous computer experience of both the combined group and self-managed group significantly correlate with performance on the learning outcomes assessment at a 0.05 probability level. The mean level of previous computer experience of the instructor-led group, however, does not correlate significantly with performance on the learning outcomes assessment at the 0.05 or 0.1 probability level.

- **Learning potential**: The average posttest plus pretest mean of the self-managed group correlates significantly with performance on the learning outcomes assessment at a 0.05 probability level. The average posttest plus pretest mean of the combined group and instructor-led group, however, does not correlate significantly with performance on the learning outcomes assessment at the 0.05 or 0.1 probability level.

- **Learning Style (Theorist)**: The score for the Theorist learning style of the Instructor-led group significantly correlated with performance on the learning outcomes assessment at a 0.10 probability level. The score for the Theorist learning style of both the combined group and self-managed group, however, does not correlate significantly with performance on the learning outcomes assessment at the 0.05 or 0.1 probability level.

5.9.2 Correlations between personal factors

From the many correlations calculated, there were only a few personal factors that correlated with each other at the 0.05 probability level. These factors were as follows:

TABLE 5.15: INTERCORRELATION OF PERSONAL FACTORS (P<=0.05)

Group	Personal factors	Personal factors	[illegible]	[illegible]	[illegible]
Combined	Learning style (Reflector)	Learning style (Theorist)	0.348	0.05	33
Combined	Gender	Age	0.397	0.02	33
Combined	Education Level	Previous Computer Experience	0.345	0.05	33
Instructor-led group	Learning style (Pragmatist)	Learning style (Theorist)	0.604	0.01	19
Self-managed group	Education Level	Previous Computer Experience	0.828	0.0003	14

5.10 SUMMARY

In this chapter, the quantitative results from the various data calculations was provided. The results indicated the following:

- There was no significant difference found between the distribution of age, gender, education level, level of previous computer experience, learning potential, and learning styles across the instructor-led and self-managed groups.
- The following factors correlate significantly with the subjects' performance on the learning outcomes assessment:

- Education levels: The education levels of the combined groups and the instructor-led group correlated at the 0.05 probability level, while the education levels of the self-managed group only correlated at the 0.1 probability level.
- Previous computer experience: The level of previous computer experience of the combined groups and the self-managed group correlated at the 0.05 probability level, while the level of previous computer experience of the instructor-led group did not correlate at either the 0.05 nor 0.1 level.
- Learning potential: The average posttest plus pretest mean score for the self-managed group correlated at the 0.05 probability level, while average posttest plus pretest mean score for both the combined groups and instructor-led group did not correlate at either the 0.05 nor 0.1 level.
- Learning style (Theorist): The Theorist learning style of the instructor-led group correlated at the 0.05 probability level, while the Theorist learning style for both the combined groups and self-managed group did not correlate at either the 0.05 nor 0.1 level.

- The Reflector and Theorist learning styles correlated in the combined groups but not in the separate groups.
- The Pragmatist and Theorist learning styles correlated in the instructor-led group, but not in the combined groups or the self-managed group.
- Education level and previous computer experience correlated in the combined groups and self-managed group, but not in the instructor-led group.

In addition, the qualitative data was analysed. The data indicates the following:

- The design process used for both the self-managed and instructor-led courses was fairly effective, although too much was based on subjective views. The learner characteristics also did not match those of the study group. This may have affected the instructional strategies used and the feedback obtained from the pilot phase.

- Most of the instructional strategies were addressed effectively, although the co-operative learning designed to take place at the end of the course was not carried out (due to time pressures).
- Subjects who attended both courses felt that time was a significant limiting factor, although this was perceived as more of an issue by the self-managed group. Issues of group size resulting in noise disturbance and lack of visual clarity regarding the projector screen appeared to be experienced by the instructor-led group only.
- The reference cards provided as post-training support were perceived as useful by both groups. Those who had used Excel 97 after the training also reported that they used their cards frequently
- Factors that were perceived to limit performance after training included limited access to computers with Excel 97 loaded; lack of immediate spreadsheeting requirements; and a need for a reference book that covers conceptual explanations and exercises to practice on.
- The subjects in the instructor-led group appear to perceive the need for an additional training course, while those who completed the self-managed learning course appear to perceive themselves empowered enough to learn on their own, given the learning guide used in the course. This is a key finding given the cost of post-training support experienced by organisations who have employees trained on new software.
- The certification needs to be linked to performance on the assessment for it to have any motivational value.

CHAPTER 6: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

This chapter will discuss the implications of the results described in chapter 5, as well as limitations of the study. Thereafter, conclusions will be drawn and recommendations offered. Finally, suggestions for further research will be given.

6.2 DISCUSSION OF RESEARCH RESULTS

The discussion of the qualitative and quantitative results will be done together. This is because certain qualitative insights support the quantitative findings and vice versa. The initial discussion will, however, focus on the primary research problem. Thereafter, attention will be given to the factors considered in the secondary research problem.

6.2.1 Internal and external validity

The two experimental groups did not appear to have shown significant differences in any of the personal factors assessed in the study. These include age, gender, education level, previous computer experience, learning style preference and learning potential. This finding supports the random selection of the groups, and indicates that the study was internally valid (i.e. there were no confounding variables).

In addition to ensuring that the study was internally valid, the different personal factors assessed also provided some insight into the two groups. This also contributes to the determination of the study's external validity.

Key features of the experimental groups that impact, to a greater or lesser degree, on the external validity of the study include:

- The average age of the two groups was 29.6 years. This age appears to reflect a large number of new job entrants who need to develop basic desktop software skills. Although there are significant numbers of older people who still need to develop their skills, it can be argued that this average age reflects the majority of learners who will do this course in the future.
- The general sample consisted of 67% females. This percentage does not reflect the target population's make-up, with still a majority of males having jobs in the formal sector. Although unlikely, this may have influenced the mean scores obtained in the learning outcomes assessment, assuming that females from the previously disadvantaged sector may not have had mathematics (a key skill for Excel) promoted as strongly as males in their formal education. This can, however, not be tested in this study.
- Fifty four point six percent of the total sample had a matric education, while 39.4% had a diploma. Only 6% had a degree. These figures indicate that the sample was literate and well educated. The generalisability of these results is therefore limited to people who have at least a matric level education.
- Eighty one percent of the sample either had a limited or fairly good exposure to computers. Placed in context, most of the sample had just completed a course covering information technology basics. The course briefly covered Windows basics, and an hour session on Word, Excel and PowerPoint. Most of the sample were therefore very new to technology, and may have found their lack of basic software knowledge a limiting factor (the course assumption was that students were Windows proficient). This may have, therefore, impacted on the mean scores of the learning outcomes assessment.

- The general sample appeared to have an overall preference for the Reflector learning style. This may also have influenced mean scores of the learning outcomes assessment, especially since the students were placed under huge time pressure (a worst-case scenario for a reflector learning style).

Overall, the findings do appear to be generalisable to previously disadvantaged literate South African adults who have an education level of matric (Grade 12) or higher, and who have limited experience using computer software. However, had more cognitive factors such as cognitive strategies used by the subjects, computer self-efficacy, belief in autonomy and control, belief in intelligence and knowledge, and problem-solving procedures been assessed, a more comprehensive picture of the sample group's characteristics could have been obtained.

6.2.2 Test score means and differences

The overall poor assessment scores obtained by both the instructor-led and self-managed groups can be partly explained as a result of the fact that:

- The limited time prevented subjects from rehearsing effectively.
- Subjects did not have the background knowledge and cognitive strategies to cope with the large volume of new information required to be learned in such a short time.
- The focus of the researcher, although not stated, was more on getting the results than ensuring people learned effectively. This may have been perceived by the subjects and may have caused them to resist the entire process.
- There was a lack of clear performance consequences to not learning and performing.

The fact that there was no significant difference between the learning outcomes assessment scores of the sample of students who attended the instructor-led course, and the learning outcomes assessment scores of the sample of students who attended the self-

managed course proves, to some extent, that the hypothesis of the study could not be supported by these results.

There are, however, a number of considerations that need to be made when drawing this conclusion. These include:

- Only 33 out of 49 students completed the learning outcomes assessment (19 in the instructor-led and 14 in the self-managed). These numbers make it difficult to draw conclusions even though the statistical processes could not find any significant differences. Possible reasons for this include:
  - People felt very self-conscious about their ability. This may have been exacerbated by the instructor who, in the preview to the course, highlighted how easy it will be and that they must not worry.
  - People did not want their lack of learning highlighted to other people. Although they were reassured by the researcher that all marks and information was strictly confidential, they may still have felt uncomfortable having information available that may affect their job prospects or social standing.
  - The researcher failed to give effective instructions on how to save. Although the instructions did appear to be clear, the fact that they were given verbally increases the chance of people getting lost. If the steps had been provided on paper, more people may have saved their files correctly.
- The mean learning outcomes assessment score of students who attended the instructor-led course was 40.57%, as opposed to 30.73% for those who attended the self-managed course. Although not significant, it does indicate that to some degree, the instructor-led course was more effective than the self-managed course in teaching the students the skills and knowledge required to complete key spreadsheet-related tasks using Excel 97. Possible reasons for this are:
  - The fact that the instructor controlled the pace of the instructor-led course so that all the key content was covered by the time 3 hours was up. Those students who

were doing the self-managed course did not benefit from this increased pace, and few managed to finish the course in the prescribed time.

- A main requirement for self-managed courses is that the learner can set their own learning pace. Given the time restrictions, slow readers and people who required additional time to work through concepts did not benefit from this approach. Instead, they were forced to keep moving on, even though they did not understand a certain concept. This may also have impacted on their confidence. If people find themselves not understanding concepts, their belief in their ability to learn on their own diminishes and they begin to feel less empowered and capable. This may have also been one of the key reasons why fewer people from the self-managed group handed in their assessment files.
- The fact that behaviour modelling was used in the instructor-led course and not the self-managed course. This, however, may have been more of a factor due to the time pressure, than if there was no time issue. By seeing how an Excel task should be performed, it may have allowed students to recall it long enough to complete the assessment (which took place immediately after the course was finished). Had the assessment been done a few hours after the completion of the course, this may not have been the case.
- The fact that the instructor-led course used both visual and verbal senses, while the self-managed course concentrated only on visual. The combination may have proved more effective, especially given the time pressures.

It is therefore difficult to draw any conclusions as to the difference between the Excel 97 instructor-led and self-managed computer software courses. Further research needs to be done, taking the following into account:

- Larger sample groups. The size of the samples limited the significance of the quantitative data
- More time. The course duration needs to be extended to reflect the original duration time. Limited time was a key confounding variable in the current study.

6.2.3 Course design process and instructional strategies

The course design process appeared to be relatively effective, although the designer tended to rely too heavily on personal perceptions rather than on researched fact. This, however, would not have been a problem had the target audience remained the same. The researcher's personal exposure to this audience allowed for these assumptions to be made, and would probably not have impacted negatively on their learning.

A key problem of the design process was, however, the focus on a different target audience. The significant differences between the target audience that was originally used to design the course, and the target audience of the study were as follows:

- The original target audience was mainly white, adult, professional, with a tertiary education. These learners tended to have good Windows and computer basics skills and knowledge, and most had an understanding of the use of software, and particular spreadsheets, in a business environment.
- The study group was all from previously disadvantaged groups, and none had professional jobs. All students were either working for NGO's, were teachers, were currently studying or were looking for a job. Few had previous experience of computers, hence their attendance to the Witwatersrand Business School's Information Technology course. These students' therefore had different background exposure to technology and mathematics; had limited exposure to computers prior to the Information Technology course (and although perceived by some to be sufficient, this exposure was mainly theoretical); came from different cultural and educational backgrounds, had different experiences of the use of computers, and particularly spreadsheets in business; and had limited knowledge and skills in Windows and computer basics.

If these target audience differences had been taken into account in the course design, the following would probably have changed:

- The course content would have been thinned out to focus on key spreadsheeting basics.
- Conceptual explanations may have been done in more depth. For example, not enough time was spent explaining the concept of spreadsheeting, which may have limited the students ability to understand the various spreadsheeting software concepts. Few appeared to have ever seen or worked with spreadsheets before, and so may have struggled with the basic understanding of what they were trying to do with this new software.
- The length of the course may have been extended. This would have allowed learners more time to rehearse their actions more thoroughly. However, given the fact that the original course was designed for 5 hours, and that due to unforeseeable circumstances the researcher had to shorten it to 3 hours, time may not have been such an issue.
- Exercises may have been less business orientated. As most students did not come from a business background, some of the business-related examples may have been confusing. More home-orientated examples may have been more effective in experientially reinforcing conceptual understanding.
- More co-operative learning may have been built in. Cultural groups in South Africa have different views on group work. It is the researcher's perception that many of the study sample may have preferred to learn in pairs, or even in small groups. This may have made them less intimidated to learn, and may have allowed them to explore confusions in a less threatening environment.
- Analogies and metaphors used in the course may have been different. Although the analogies and metaphors appeared not to be culturally bias, a pilot review from the study group may have highlighted these as a limiting factor to learning.

6.2.4 Course delivery

The delivery of the instructor-led course was, on the whole, effectively done. The use of the projector aided presentation greatly, as the instructor was able to work through exercises using Excel 97, with the entire class being able to observe. A key limitation to the instructor-led delivery was the size of the audience in the classroom. The sample size of 26 in one classroom prevented the instructor from being able to interact with any of the students. Students at the back of the classroom also had to contend with having the screen far away from them, and the general classroom noise drowning out the instructor's voice. Support provided was limited, and students would tend to switch off if they did not understand, rather than try and ask a question. This was also influenced by the time pressure, which forced the instructor to skip questions and to forge ahead.
The effectiveness of this approach would have been clearer had classes been limited to 8 people, and the time pressures placed on the instructor removed. This would have allowed the instructor to interact more with the class, and make students feel less intimidated in asking questions.

One factor that may have influenced the usage of Excel 97 after the course (fewer people interviewed from the instructor-led class had worked on Excel 97 after completing the course) was the fact that learners were reliant on the instructor for their learning. The instructor became their information source and Excel 97 guru. Their learning was therefore strongly influenced by the instructor, and when they returned home, this source of comfort and information disappeared. Although they may have felt the need to continue their learning using the support cards, many may not have done so because of the instructor was not there to hold their hand. The instructor may have become a critical requirement for further learning (i.e. a source of comfort and knowledge); limiting further learning to formal classroom environments.

The self-managed course, on the other hand, appeared not to have this disempowering effect. More students that were interviewed said they had used Excel 97 after the course. A key reason for this may be the fact that they had experienced learning the software on their own in the classroom, and therefore felt empowered to continue this process at their homes. This may have been more evident had each learner been allowed to take their learning guide with them.

Regarding the delivery during the course, it appeared that learners enjoyed working in the paper-based medium. They seemed to enjoy the sense of control they had over the information (they could turn back a page, or forward a chapter). It was also a familiar medium to them. The main problem that arose with this medium was, with time pressures applied, the slow reading speed of many learners. This limited their ability to get through the course content, and to benefit from the self-paced nature of the medium. Given more time, this medium may have proved to be significantly more effective.

6.2.5 Course assessment

The course assessment design was effective in testing the learner's ability to perform certain spreasdsheet-related tasks. Given the course content that was covered, all key actions were assessed. However, the length of the assessment, due mainly to the course contents, made it difficult for people to finish. This is more a criticism of the course than the assessment. Allowing people to make use of their reference cards during the assessment was an effective outcomes-focused approach. It ensured that people were not tested on their ability to regurgitate system steps and facts, but rather their ability to perform key spreadsheeting actions effectively using Excel 97.

6.2.6 Post-training support

The quick reference cards provided to students during the course (as a post-training support tool) proved highly effective. This appears to be due to the following:

- The concise, distilled nature of the information. Everything people needed to know was provided on 18 cards. This ensured that learners did not feel overwhelmed and intimidated by the length of the material (as they do with thick manuals).
- The quick referencing capability. All students needed to do was look up the action they wanted to perform on the index card, and then flip to the relevant card. This made referencing quick and easy.
- The user-friendly design. Having summarised steps with colourful screendumps, tips and hints makes the cards more user-friendly.
- The small size. Being able to carry the cards in a briefcase or jacket pocket allows people to take them to where they will need them.

6.2.7 Other factors impacting learning

Some important systemic factors appear to have impacted on the learners' ability to transfer their learning into performance at their workplace. These include:

- The lack of immediate performance requirement. Many people in the group appear not to have required spreadsheeting skills in order to improve their current performance. They appear to have volunteered to attend the course, in the hope that these skills will hold them in good stead in the future. The lack of immediate use is a performance problem that will need to be addressed. Skills and knowledge recall will decline, and people will not be able to reinforce the classroom learning into workplace learning. Possible ways around it is to provide a needs assessment up front. This would assess the individual's skill requirements, and match them with the job requirements.

- The lack of performance consequences. The fact that whether learners were competent or not, they would receive a certificate (i.e. the same consequences) impacted on the motivation of the learner to learn and perform.
- The lack of ongoing performance feedback, provided after the training course, limited the ability of the learner to continue correcting their performance at their workplace.

6.3 LIMITATIONS OF THE STUDY

There appear to have been a number of limitations to this study. These include:

- Size of sample. The small number of students who completed the pre-course tests and questionnaire, and who handed in a saved learning outcomes assessment, made statistical analysis difficult. Had there been a larger sample group, significant differences between the two learning methods may have been found.
- Time. The fact that the course length was shortened from 5 hours to 3 hours had a significant impact on the results. People were not given the opportunity to benefit from either instructional method, and were forced to rush through the experience in the hope of finishing.
- Poor planning. The fact that subjects failed to hand in completed questionnaires and saved results files could have been prevented had the researcher been more thorough in the planning of the data collection.
- Inability to assess learning after 1 month. The learning outcomes assessment provided immediately after the course tested, in effect, short term understanding and memory. Had the study included an assessment of learning 1 month later, a more insightful picture may have emerged. This may have highlighted the empowering nature of self-study as opposed to instructor-led, where people on the self-managed course may have felt more empowered to continue their learning at the workplace.
- Inability to assess performance on the job. In addition to testing learning after 1 month, it would also have been useful to assess whether people's performance on the

job had improved as a result of the training. One problem, however, was the limited number of people who appeared to be using spreadsheets in their jobs.

- The size of the classes. Due to resource limitations and demands placed on the researcher by Witwatersrand Business School, classes were large. This did not reflect the typical class size of between 8 and 15 people. The noise and distractions created by this large sample size may well have influenced the learning.
- The learning potential tests performed just before training. Due to time pressures, the researcher was forced to test learning potential immediately before the course commenced. This may have impacted on the learning during the course, as learners had to endure a pressurised assessment before they could relax and focus on the course content at hand. People may also have felt intimidated by the learning potential test, and this may have impacted on their concentration during the course itself.
- Lack of training in metacognition. Had the research focused initially in providing the learners the opportunity to identify and understand their cognitive strategies, understand their belief in intelligence and knowledge, evaluate their problem-solving techniques, and assess their belief in their autonomy and control, competence assessment scores may have been higher.

6.4 CONCLUSIONS

From the results obtained in this study, it appears that the specifically designed self-managed learning course and the specifically designed instructor-led learning course were not significantly different in their ability to teach the sample of students the key skills and knowledge they required to complete key spreadsheet-related tasks using the software Microsoft Excel 97. This indicates that the previously disadvantaged, literate adults with limited previous computer experience learn computer software skills and knowledge as effectively when given instructor-led training, as they do when given self-managed training.

Areas that appear to enhance learning (and should therefore be retained) include:

- The extensive use of exercises. Students appeared to benefit from being able to experience the actions and concepts described.
- The use of scenarios. Contextualising exercises appeared to assist students in understanding where and when the actions should be applied.
- The provision of reference cards. This appeared to give students the security that they did not need to memorise steps, and allowed them to focus on the concepts described. It also appears to assist learning after the course is completed.

Additional findings that may have impacted learning, and therefore need to be addressed by the organisation, include:

- The lack of knowledge of the target audience in the design of the instruction limited the effectiveness of the instructional experience. Assumptions were made about the learner requirements that may not have been valid.
- The course length did not align with the course content. People were expected to learn too much in too short a time. This impacted on the learning delivery, and on the students' ability to learn.
- The class size may have impacted negatively on learning. Having over twenty subjects in one class, as opposed to the widely acknowledge "ideal" class size of 8 to 10 students, limited the instructor's ability to address personal learning requirements in the instructor-led group. It also impacted on the learning support person's ability to answer questions in the self-managed group.
- Most of the students from both groups did not require spreadsheeting skills in their current jobs. This may limit the learning transfer to performance.

6.5 RECOMMENDATIONS

Based on the primary research findings, it appears that the organisation can choose the delivery method based on financial and strategic factors, and not learning effectiveness. This is because, from the findings of this study, it appears that the self-managed method is as effective as the instructor-led method. However, caution is advised. These findings are not conclusive, and further studies are recommended (taking into account the limitations of this study).

In addition to being able to select the instructional method based on costs and strategic direction, the organisation is advised to do the following:

- A review of the course design and content is required, given further study into the learning characteristics and requirements of the specific target audience. This includes a review of all scenarios, analogies and metaphors used. Exercises and scenarios should be included.
- The course length needs to be reviewed. Learners must not be forced to rush the experience, as this limits their ability to learn.
- Classes should be kept between 8 to 10 students. This will enable the instructor to interact more effectively with the student's, and for the self-managed learners to feel comfortable asking for learning support. It will also limit the noise distractions caused by a large class.
- Reference cards should be provided to the learners (as was done in the study), as these appear to enhance learning after the training course has been completed. In addition, it is recommended that all students be given a learning guide to take with them. This will empower learners to continue their learning back at the workplace.
- A detailed needs analysis should be performed to ensure that people attending the course perceive the need for the skills and knowledge, and that they will in fact require those skills back at the workplace. If this is not done, students who attempt to

use their spreadsheeting skills after some time will find that they are not able to perform effectively. They will then perceive that they did not benefit from the course.

6.6 DIRECTIONS FOR FUTURE RESEARCH

Based on the findings and limitations of this study, as well as the limited studies done in this area, the following recommendations regarding future areas for study are given:

- The influence of learning potential on computer software-related learning.
- The influence of learning styles on computer software-related learning.
- The influence of computer self-efficacy on computer software-related learning.
- The influence of the learning driver role on computer software-related learning.
- The influence of different media on computer software-related learning.
- The influence of post-training support on computer software-related learning and performance.
- The influence of analogies and metaphors on computer software-related learning.
- The influence of metacognition training prior to computer software-related learning.

6.7 SUMMARY

This study failed to provide conclusive evidence on whether the specific self-managed computer training course was more effective that the specific instructor-led computer training course in teaching the sample of students the key skills and knowledge they required to complete key spreadsheet-related tasks using the software Microsoft Excel 97. The results show that neither instructional method is more effective, although important limitations to the study were noted.

The course design, delivery, assessment and post-training support was discussed, and recommendations were given. Future areas of research were also identified, and conclusions from the study drawn.

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APPENDIX 1

LEARNING STATISTICS GRAPHS

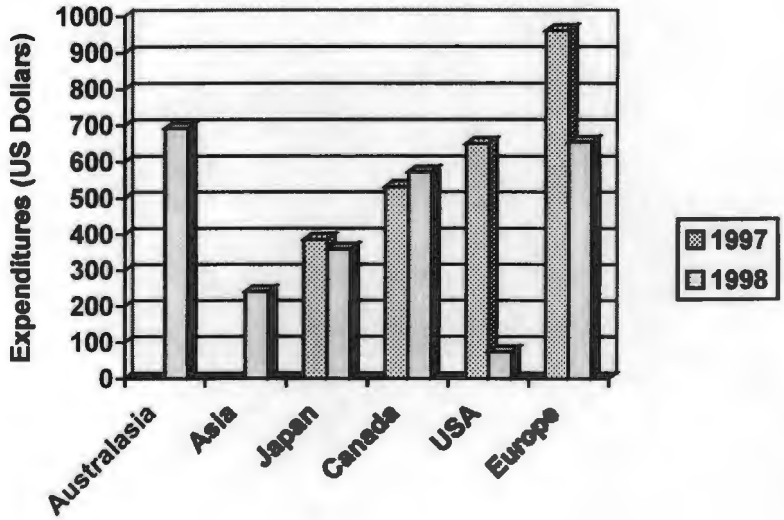


Figure 1: Training Expenditures Per Employee

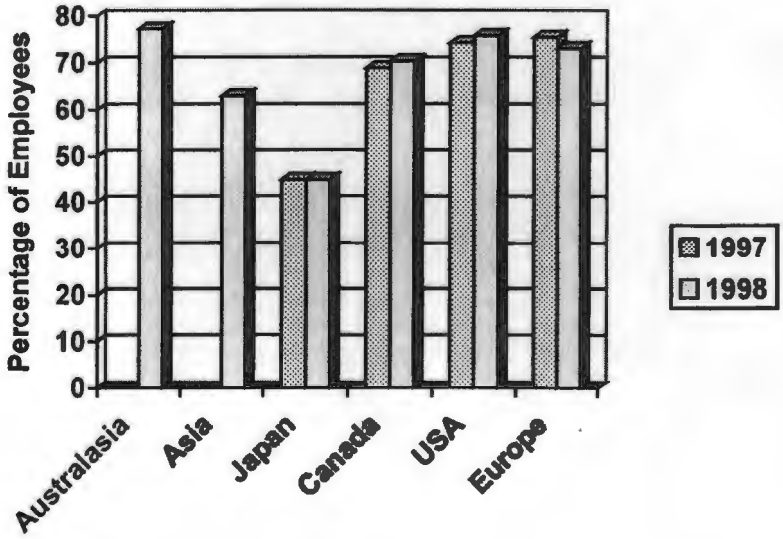


Figure 2: Percentage of Employees Receiving Training

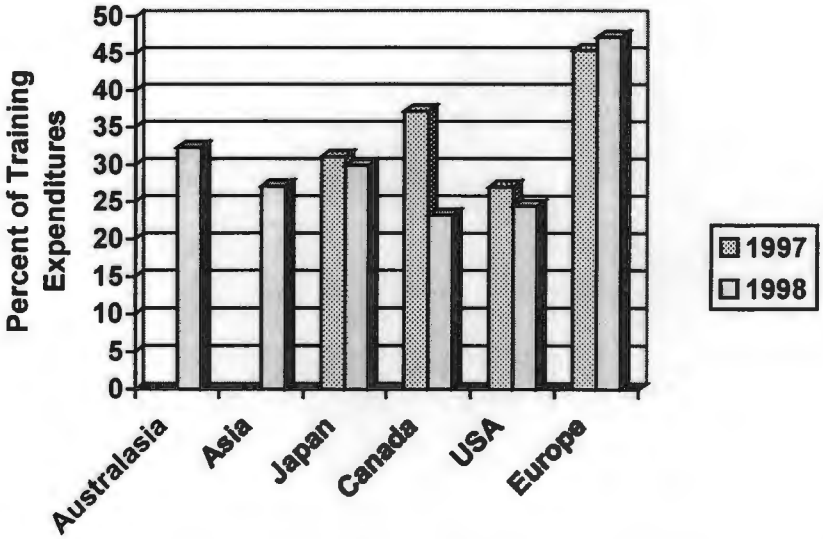


Figure 3: Percentage of Total Training Expenditure Going to Outside Companies

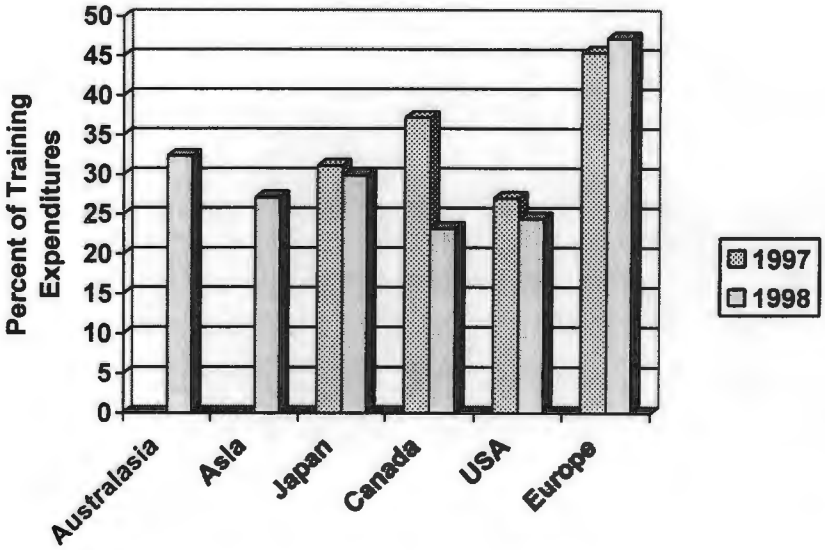


Figure 4: Use of Delivery Methods

APPENDIX 2

LIST OF LEARNING OUTCOMES

1. Excel 97 opened using one of the Microsoft Windows generic methods for accessing applications.
2. Workbook opened from existing, previously saved workbooks.
3. Worksheets viewed within a workbook.
4. Worksheet tabs named within a workbook.
5. Worksheets added and re-ordered within a workbook.
6. Text inserted in a cell.
7. Numbers or values inserted into cells.
8. Mathematical formulae entered in a worksheet.
9. Rows and columns calculated using the sum and average functions.
10. Formulae calculated across worksheets.
11. Errors interpreted and corrected using Excel 97 functions.
12. Cell contents copied from one cell to another using the copy and paste functions.
13. Cell contents moved from one cell to another using the cut and paste functions.
14. A cell manipulated to change its height and width.
15. Cells inserted and deleted within Excel 97.
16. Single and multiple cells highlighted within Excel 97.
17. Cell numbering formatted and aligned.
18. Text font changed within cells to change the look of the cells.
19. Border and background colours changed within cells.
20. Data sorted using different column variables.
21. A chart created within Excel 97.
22. A chart modified in order to change its type, appearance, position or size.

APPENDIX 3

A CHECKLIST FOR INSTRUCTIONAL MATERIALS AND METHODS FOR EXPERT REVIEWERS

Question	Yes	No	Not Applicable
1. Were all the key instructional design procedural steps addressed? Comments:			
2. Do the instructional materials clearly state the desired outcomes for instruction? Comments:			
3. Do the instructional materials match learner/trainee characteristics? Comments:			
4. Are the instructional materials clearly based on the instructional objectives? Comments:			

Question	Yes	No	Not Applicable
5. Are the instructional strategies used within the material appropriate for the target audience? Comments:			
6. Is the content of the instructional package: a) Complete? b) Up to date? Comments:			
7. Are learners given adequate opportunities to: a) Receive information about the content? b) Practice and apply what they learn? c) Receive feedback on how well they practised or applied what they learn? Comments:			
8. Are there other issues you noticed that should be considered? Comments:			

APPENDIX 4

DEMOGRAPHIC AND LEARNING STYLE QUESTIONNAIRE

Dear colleague,

Thank you so much for joining me in learning how to create effective spreadsheets using Microsoft Excel 97. I know that you will find the program very exciting and stimulating, and I look forward to the opportunity of assisting you in your learning.

In return for the opportunity to learn such a valuable skill, I need to ask for your help. My master's research thesis is focusing on the effect different training approaches have on people's learning. To ensure that I know as many factors about each learner as possible (so that I can pick up if any specific factor affects how one learns), I need to ask you for some general information. This includes:

- Your age
- Your gender
- Your formal educational level
- Previous experience that you have had with computers

I am also interested to find out if your learning style and your feelings towards computers in general affect the way that you learn. So what follows is a series of questions that I need you to answer honestly and carefully. The data is purely for scientific research, and no personal details will be given to anyone outside the research team (i.e. I guarantee complete confidentiality). If you have any questions about the use of the data, please don't hesitate to ask me.

Many thanks,
Ryan Falkenberg

DEMOGRAPHIC DETAILS

Please provide the following details (mark with an X where applicable):

Learner Number: _____

Age: _____

Gender: Male: ☐ Female: ☐

Formal Education Level:
(indicate highest level)

Std 5 ☐ Std 8 ☐

Std 10 ☐ Diploma ☐

Degree ☐ Other ☐

Previous Computer Experience: (tick one of the following):

I have no previous computer experience ☐

I have a limited exposure to and understanding of computers ☐

I have a fairly good exposure to and understanding of computers ☐

I have a good exposure to and understanding of computers ☐

I have a very good exposure to and understanding of computers ☐

LEARNING STYLE

The following questions are designed to find out your preferred learning style(s). There is no time limit to this questionnaire. It will probably take you 10 to 15 minutes. Please be as honest with yourself as possible (**there are no right or wrong answers!**).

If you **agree more than you disagree** with a statement, put a **tick** (√) in the box next to it. If you **disagree more than you agree**, put a cross (X) in the box next to it. Be sure to mark each item with either a tick or a cross (i.e. please don't leave any question blank).

Note: If the meaning of any statement is not perfectly clear to you, please don't hesitate to ask me for an explanation!

1. I have strong beliefs about what is right and wrong, good and bad ☐
2. I often "throw caution to the winds" (i.e. take a chance) ☐
3. I tend to solve problems using a step-by-step approach, avoiding any "flights of fancy" (i.e. I prefer making sure of things first) ☐
4. I believe that formal procedures and policies cramp people's style ☐
5. I have a reputation for having a no-nonsense, "call a spade a spade" style (i.e. I say it as I see it) ☐
6. I often find that actions based on "gut feel" are as sound as those based on careful thought and analysis ☐

7. I like to do the sort of work where I have I have time to "leave no stone unturned" (i.e. I prefer to be thorough) ☐

8. I regularly question people about their basic assumptions (i.e. what assumptions they are basing their views on) ☐

9. What matters most is whether something works in practice ☐

10. I go out and look for new experiences ☐

11. When I hear about a new idea or approach I immediately start to work out how to apply it in practice ☐

12. I am keen on self-discipline, such as watching what I eat, taking regular exercise, sticking to a fixed routine etc ☐

13. I take pride in doing a thorough job ☐

14. I get on best with logical, analytical people and less well with spontaneous (I think of them as "irrational") people ☐

15. I take care over the interpretation of information provided to me and avoid jumping to conclusions ☐

16. I like to reach a decision carefully after weighing up many alternatives ☐

17. I'm attracted more to original, unusual ideas than to practical ones ☐

18. I don't like "loose-ends" and prefer to it when things are presented in a logical pattern

19. I accept and stick to laid down procedures and policies so long as I regard them as an efficient way of getting the job done

20. I like to base my actions on general principles

21. In discussions I like to get straight to the point

22. I tend to have distant, rather formal relationships with people at work

23. I thrive on the challenge of tackling something new and different

24. I enjoy fun-loving, spontaneous people

25. I pay careful attention to detail before coming to a conclusion

26. I find it difficult to come up with wild, "off the top of my head" ideas (i.e. spontaneous "crazy" ideas)

27. I don't believe in wasting time by "beating around the bush" (i.e. avoiding discussing the real issues)

28. I am careful not to jump to conclusions too quickly

29. I prefer to have as many sources of information as possible – the more data to think over the better

30. People who don't take things seriously usually irritate me

31. I listen to other people's point of view before putting my own forward

32. I tend to be open about how I'm feeling

33. In discussions I enjoy watching how the other participants maneuver

34. I prefer to respond to events on a spontaneous, flexible basis rather than plan things out in advance

35. I like to plan things carefully to make sure that everything I do is done correctly

36. It worries me if I have to finish some work quickly in order to meet a tight deadline (i.e. if I don't have time to do a thorough job)

37. I tend to judge people's ideas on whether they can be practically implemented or not

38. Quiet, thoughtful people tend to make me feel uneasy

39. I often get irritated by people who want to rush headlong into things without taking the time to check all the details

40. It is more important to enjoy the present moment than to think about the past or future

41. I think that decisions based on a thorough analysis of all the information are better than those based on intuition (i.e. gut feel)

42. I tend to be a perfectionist (i.e. I want everything just right)

43. In discussions, I usually come up with lots of "off the top of my head" ideas (i.e. I can easily think up different ways of doing things)

44. In meetings, I put forward practical realistic ideas

45. I think, more often than not, rules are there to be broken

46. I prefer to stand back from a situation and consider all the different options and perspectives

47. I can often see inconsistencies and weaknesses in other people's arguments

48. On balance I talk more often than I listen

49. I can often see better, more practical ways to get things done

50. I think written reports should be short, punchy and to the point

51. I believe that rational, logical thinking should win the day

52. I tend to discuss things with people rather than engaging in small talk (i.e. I prefer it when people talk about real issues)

53. I like people who have both feet firmly on the ground (i.e. they are very down to earth and consistent)

54. In discussions I get impatient when people start talking about little things and trying to be clever with words

55. If I have a report to write I tend to produce lots of drafts before settling on the final version

56. I am keen to try things out to see if they work in practice

57. I am keen to reach answers via a logical approach

58. I enjoy being the one that talks a lot

59. In discussions, I often find I am the realist, preventing people from speculating and keeping them to the point

60. I tend to consider many alternatives before making up my mind

61. In discussions with people I often find that I am most objective and fair (i.e. I don't take emotional stances)

62. In discussions I am more likely to adopt a "low profile" than to take the lead and do most of the talking

63. I like to be able to relate current actions to a longer term bigger picture (i.e. I tend to look at the big picture)

64. When things go wrong I am happy to shrug it off and put it down to experience

65. I tend to reject wild, "off the top of my head" ideas as being impractical

66. It's best to "look before you leap" (i.e. to investigate something before coming to a decision)

67. On the balance I do the listening rather than the talking

68. I tend to be tough on people who find it difficult to adopt a logical approach

69. Most times I believe the end justifies the means (i.e. you do whatever it takes as long as the final outcome is what you want)

70. I don't mind hurting people's feelings so long as the job gets done

71. I find the formality of having specific objectives and plans stifling (i.e. they limit my ability to perform effectively)

72. I'm usually the life and soul of the party (i.e. the centre of attention and the one who makes a party happen)

73. I do whatever is appropriate to get the job done

74. I quickly get bored with methodical, detailed work

75. I am keen on exploring the basic assumptions, principles and theories underpinning things and events

76. I'm always interested to find out what other people think

77. I like meetings to be run on methodical lines, sticking to laid down agendas etc

78. I steer clear of subjective or ambiguous topics

79. I enjoy the drama and excitement of a crisis situation

80. People often find me insensitive to their feelings

Thank you very much for all your help. I really do appreciate it!

APPENDIX 5

LEARNING POTENTIAL TEST RAW SCORE RESULTS FILE EXAMPLE

Test data for 16 on DEFAULT 7 Mar 99

ID: 16 Name:

0.430	0.828	1.000FR050	2.000	2.000	27.742
-0.254	0.417	2.000FA148	3.000	1.000	73.992
-0.030	0.337	3.000FR086	3.000	3.000	108.039
0.177	0.295	4.000FR022	4.000	4.000	127.711
0.359	0.251	5.000FA113	3.000	3.000	148.031
0.485	0.216	6.000PV026	3.000	3.000	166.980
0.681	0.198	7.000FA153	4.000	4.000	202.680
0.534	0.150	8.000FR078	2.000	1.000	238.980
0.331	0.121	9.000FR071	4.000	2.000	298.031
0.133	0.098	10.000PV017	5.000	1.000	449.512

0.133 - PRETEST mean

0.098 - PRETEST variance

0.192	0.087	1.000FR017	1.000	1.000	37.520
0.270	0.083	2.000FR054	2.000	2.000	146.102
0.172	0.069	3.000FR027	2.000	4.000	172.520
-0.005	0.054	4.000FR077	1.000	4.000	206.031
0.038	0.051	5.000FR034	4.000	4.000	241.621
0.079	0.049	6.000PV075	2.000	2.000	269.852
0.124	0.047	7.000FR051	4.000	4.000	295.941
0.159	0.045	8.000FR068	2.000	2.000	309.293
0.203	0.043	9.000FR007	4.000	4.000	324.609

0.240	0.042	10.000PV030	4.000	4.000	386.133
0.270	0.040	11.000PV090	3.000	3.000	416.449
0.295	0.039	12.000FA142	3.000	3.000	437.871
0.316	0.038	13.000FA161	2.000	2.000	457.813
0.281	0.035	14.000PV027	4.000	3.000	482.910
0.297	0.034	15.000FA114	4.000	4.000	505.813
0.264	0.033	16.000FR041	4.000	2.000	524.051

0.264 - POST-TEST mean

2. - POST-TEST variance

APPENDIX 6

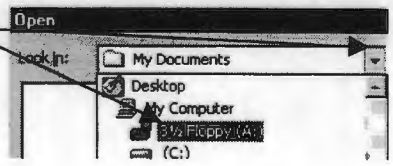
LEARNING OUTCOMES ASSESSMENT QUESTIONS

You have one hour for this exercise. Try complete as many questions as possible during this time. Feel free to use your learning cards to help you with the system steps. When you are finished (or when the hour is up), please hand the exercise disk back to me.

HOW TO COMPLETE THIS EXERCISE

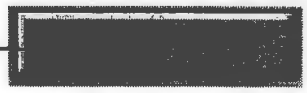
1. Insert the exercise disk into your (A:) drive
2. Make sure Excel 97 is open. If not, click on the "Start" button at the bottom left hand corner of the screen; then select "Programs" and "Microsoft Excel" (see card 1)
3. Select "File", then "Open" from the menu bar

4. Click on the black downward pointing arrow to the right of "Look in", and then select "3 ½ Floppy (A:)" from the list provided



5. Click on the file "Final Exercise"

6. Click "Open"



STEPS TO COMPLETE

Now read through the following instructions and complete each step as described. If you don't know how to do something, leave it and move on. Don't waste time trying to do something you can't do quickly and easily (rather come back to it later on).

Insert a sheet and type in data and simple formulae:

1. Click on the sheet tab "Half-Year".
2. Insert a new sheet and name the sheet tab "**Practice**".
3. Move the sheet between "End-Year" and "Shopping".
4. Type in the positive number "999" in cell A1.
5. Type in the negative number "-88" in cell A3.
6. Type in the fraction "3 $^{2}/_{5}$" in cell A5.
7. Type in "50%" in cell A7.
8. Type in the date 25th April 1999 in cell A9 (in any correct date format).
9. Type in the time 12h30 in cell A11 (in any correct time format).
10. In cell C1, type in the formula that would calculate what 300 multiplied by 50 gives you.
11. In cell C3, type in the formula that would calculate what the contents of cell C1 divided by the contents of cell A5 will give you.

Using Functions

12. Click on the tab "**Half-Year**", and then enter the formulae that would calculate the total marks scored by all students in Sociology (in cell H6).
13. In cell I6, enter the formula that would calculate the average score of all students in Sociology.

14. Use AutoFill to copy the total and average formulae in cells H6 and I6 down to H10 and I10.
15. Click on cell B11 and then insert the formula that will calculate the total scored by John for all subjects.
16. Use AutoFill to copy the formula in cell B11 across to G11
17. Click on the sheet tab "**End-Year**".
18. In cell J6, insert the formula that will calculate the overall total of all the half-year and end-year results for sociology (i.e. the results on sheet "Half-Year" and "End-Year").
19. In cell K6, insert the formula that will calculate the overall average of all the half-year and end-year results for sociology (i.e. the results on sheet "Half-Year" and "End-Year").
20. Use AutoFill to insert the overall total and average for the rest of the subjects.
21. Click on the tab "**Shopping**".
22. In cell D5, type in the formula that will calculate the total cost (including VAT) for each of the shopping items. To do this, you need to multiply the cost (excluding VAT) by the quantity and then by the VAT rate. Ensure that the formula will allow you to AutoFill down to cell C11.
23. AutoFill the formula down to C11.

Manipulating columns and rows

24. Click on sheet tab "**Products**".
25. Make column A wider (i.e. so that you can see all the product names clearly).
26. Make row 10 wider (so that you can see the cell contents clearly).
27. Move the column B (containing the costs) between column C (containing the selling prices) and column D (containing the margins).
28. Insert a new row between row 12 and 13, and a new column between column E and F
29. Move the words "Product List" from cell B1 to cell D1.

Sort

30. Sort the table of products from the highest to lowest selling price (i.e. descending order).
31. Click on the sheet tab "**Validate**".
32. Using AutoFilter, filter out the products that will give you more than R2000.00 profit.

Charts

33. Click on the "**Charts**" tab.
34. Insert a chart below the table, using the student marks as your source of data. Select the following:
    - 34.1. *Chart type*: Column.
    - 34.2. *Data range*: The entire student table (including headings).
    - 34.3. *Chart title*: Student Marks.
    - 34.4. *Category (X) axis*: Subject.
    - 34.5. *Value (Y) axis*: Percentage.
    - 34.6. *Chart location*: As object in.
35. Move and resize the chart (i.e. make sure that you can clearly read all the data labels).
36. Change the chart type from a column to a bar type.

Save

37. Save the file "Final Exercise" under the new name "*Surname – Number*" (where the word "Surname" appears, type in your own surname; and where the word "Number" appears, type in your assigned number e.g. "Falkenberg – 24").

    Note: If you have any trouble saving your file under this name, please give me a call.

APPENDIX 7

COURSE RATING QUESTIONNAIRE

Please place a cross (i.e. x) next to the rating level that you feel most accurately describes the particular aspect of the course. This is completely confidential, so please feel free to provide honest feedback.

Aspect of the Course	Rating Level				
	Excellent	Good	Average	Below average	Poor
1. The course content (i.e. did it contain all the information you wanted covered)					
2. The concept explanations (i.e. were the different concepts explained clearly and simply)					
3. Exercises and scenarios (i.e. were the exercises and scenarios clear and helpful)					
4. Timing (i.e. did you feel you had enough time to complete the course)					
5. Assessment (i.e. were the assessment exercises instructions clear and understandable)					

Please hand this sheet back to the instructor when you have completed it. Thank you.

APPENDIX 8

STRUCTURED TELEPHONIC INTERVIEW

1. How often have you used Excel 97 since you attended the course?

2. How useful have you found the reference cards that you were given?

3. Have you used the reference cards at all? If so, how many times have you made use of them?

4. What factors do you think may have caused you not to use Excel 97 as much as you would like? These factors can range from experiences you had during the course, factors at work or at home and your own personal factors?

5. How could these factors be overcome?

6. Did you find the fact that you could get a certificate at the end of the course motivated you to attend and to learn?

APPENDIX 9

INSTRUCTOR SHEET

	Welcome everyone, explain the cards and approach and then explain the agenda
Card 1	❑ Click on icon – close again ❑ Click Start, Programs then Microsoft Excel ❑ Explain could also use "Windows Explorer" – show how this works later ❑ Explain the concept of a worksheet (on flipchart) Note: has 256 columns and 16384 rows
Screen	Explain the key parts of the screen, namely: ❑ Title bar: "Book 1" with number of worksheets (tabs) ❑ Menu bar: ❑ Edit: Actions to edit worksheet ❑ View: Different ways of viewing the worksheet ❑ Insert: e.g. cells, columns, rows, chart, pictures ❑ Format: Format cells ❑ Tools ❑ Data: Ways to manipulate data ❑ Window ❑ Toolbars: Under view, ensure they know how to customise. End with Standard, Formatting and Drawing

Refer	Step
	◻ Columns and row reference cells (flipchart) ◻ Formula bar ◻ Scroll bars
Card 2	◻ Viewing different sheets (default 3) ◻ Naming: Costs, Revenue, Profit ◻ Adding: Insert a new worksheet (sheet 4) ◻ Re-ordering: Place it at the end ◻ Delete worksheet: Right click
Card 3	◻ Tab ◻ Shift+Tab ◻ Arrow keys ◻ Find "R25" and "BA56" using scroll bar and menu bar
Card 4	Refer to **Example 1 (handout)** Explain different types of data ◻ A1: Cost ◻ B1: Total Cost (incl. VAT) – see how moves over C1 ◻ C1: VAT – see how text in B1 disappears Different value formats: ◻ A4: 222 ◻ A5: -222 ◻ A6: 222.34 (explain why don't use comma) ◻ A8: 2 1/6 (click on again to see in formula bar) ◻ A9: 1/6 (see how converts to a date)

Refer	[illegible]
	❑ A10: 0 1/6 (see how recognised as a fraction) ❑ A11: 14% (see formula bar for alternative) ❑ A12: 24-Nov-97 ❑ A13: 3:21 PM
	Formulae: Simple ❑ C4: =40+60 ❑ C6: =110-10 ❑ C8: =25*4 ❑ C10: =200/2 ❑ C12: =10^2 Formulae: Using cells ❑ E4: 40 ❑ E5: 60 ❑ E6: =E4+E5 Change the amount in E4 and see the answer change

Card 6	Open "Practice Examples" from disk (show them)
	
	Mid-year: explain (see **Answer Sheet** if required)
	❑ H6: Click Paste Function icon and view alternatives (highlight Average (Statistical) and Sum (Maths and Trig))
	  ❑ Select Sum
	  ❑ Highlight B6 to G6, then click OK
	❑ Refer to Hint 1 (AutoSum)
	❑ B11: Do AutoSum

Refer	Step
	❑ Explain difference between Sum and AutoSum ❑ I6: Calculate average of John (don't highlight totals) ❑ Hint 2 (include formula from other sheets) ❑ Click on sheet "Finals" ❑ H6 and I6: Calculate sum and average of both – highlight sheet indicator ❑ Ask them to complete B11 and B12 for themselves
	5 min break
Card 7	Explain concept of AutoFill ❑ H6 (Mid-Year): AutoFill to H10 ❑ Click on H10 and see formula changed from "=SUM(B6,G6)" to "SUM(B10,H10)" – click on others to see the same Ask them to AutoFill and complete the totals and averages of both worksheets (using their cards) Explain other uses for AutoFill: ❑ Click on sheet "Practice" ❑ A2: January - AutoFill to A15 ❑ C2: Monday - AutoFill to C15 ❑ E2: 3:22 PM – AutoFill to E15 ❑ G2: "1" ❑ G3: "2" – AutoFill to G15 (first highlight both) ❑ I1: 1 – AutoFill to I15 (highlight that it copied)

Refer	Step
	Explain that there is something else they need to be aware of when using AutoFill (see Hint on "$"): ❑ Click on Shopping (see **Answer Sheet** if required) ❑ Ask what formula is needed in D5 (=B5*C5*B2) ❑ D5: Type in formula and use AutoFill to D11 ❑ Click on D11 and see that B2 has been updated ❑ Explain need for $ sign ❑ D5: = B5*C5*B$2, then AutoFill – see benefits ❑ Scroll down to A16 ❑ Ask what formula needed to AutoFill from B23 (=B21*B22*$B18) – AutoFill to H23 and click on H23 Refer to Cut/Copy/Paste ❑ Click on "**Copy**" sheet ❑ Cut A4 to A8 and paste in G4 to G8 ❑ Copy G4 to G8 and paste it back in A4 to A8 ❑ Hint 1: Use "Esc" to get out of copy ❑ Copy E4 down to E5, E6, E7 and E8 ❑ Move: E1 to A1 ❑ Move Column: Move C between D and E (click OK to dialogue box) – explain why it copied ❑ Undo ❑ Refer to hint: Use "Shift" this time ❑ Move Column: Move C between D and E
Card 8	❑ Click on "Address List" tab ❑ Decrease size of column A ❑ AutoFit column A

Refer	
	❑ Insert: Insert column after "Surname" and name it "Birthday" ❑ Insert row between "Richard" and "Julia" – call it "Philip" ❑ Insert cell between D3 and D4 (Shift cells down) – undo ❑ Delete contents: Delete column G contents ❑ Delete column and row: Delete "Birthday" and "Philip" RECAP

Card 11	**Sort**:
	❑ Click on "Sort" tab
	❑ Sort: B6 to B12 (using icons)
	❑ Undo
	❑ Sort A6 to B12 and sort by Column B "No Header row"
	❑ Sort B6 to C12 (Sales ascending; Costs descending)
	
	Filter:
	❑ Click on the "Products" tab
	❑ Highlight the headings and select "Data", "Filter", "AutoFilter"
	❑ Explain each option:
	  ❑ All
	  ❑ Top 10
	  ❑ Custom
	❑ Filter Cost using Top 10 – "4"
	❑ Custom: Units Sold "greater than or equal to" "456"
	❑ Deselect Filter

Card 13	❑ Click on tab "Chart" – need to create a chart showing these results graphically

Refer	Step

	❑ Click on Chart
	❑ Select Chart Wizard, then:
	  ❑ Chart Type: Column; then click Next
	  ❑ Data Range: A4 to G9; then click Next
	  ❑ Chart title: Type in "100m Times"
	  ❑ Category (x) axis: Heat Number
	  ❑ Value (Y) axis: Seconds
	  ❑ Click on the other tabs and select
	  ❑ Chart Location: Select "As object in", then click "Finish"
	❑ Move and resize
	❑ Format: Change the chart style to a "Bar" chart
	❑ Remove the legend from view

Card 17	Save the changes as "Practice Example 2"
Hand out	Final Exercise Highlight that they must just give it their best bet and not get too worried if they can't do something
	Ensure everyone saves correctly and hands their disks in