SOME PSYCHOLOGICAL AND BIOGRAPHICAL PREDICTORS OF COMPUTER PROFICIENCY:

AN ANALYSIS OF THE POTENTIAL OF A NOVICE TO BECOME A GOOD COMPUTER USER.

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I declare that the dissertation hereby submitted by me for the Master of Commerce (Computer Information Systems) degree at the University of the Free State is my own independent work and has not been submitted by me at another university/faculty. I furthermore cede copyright of this dissertation in favour of the University of the Free State.

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Introduction and Aim of Study

1.1 INTRODUCTION

It has become apparent that during the past two decades more and more people have started using computers in their everyday lives. Not only are they using computers in their work, but also for relaxation, shopping, study, information and communication purposes. Society and individuals are beginning to undergo a mindshift towards the use of computers. Today, individuals as well as the business world are dependent on computers and the Internet for communication, the dissemination of information within and between organisations and the execution of their day to day tasks. Computers and the Internet were first generally used in the western world, but in the nineties gained more and more ground in Africa and especially in South Africa.

Chivhanga (2000) states that there has been a phenomenal growth in the use of the Internet in Africa during the past few years. This has already led to a transformation in the lives of large numbers of people and is fast changing the way organisations communicate and do business. A full awareness of what the Internet is and what it can do becomes apparent when one considers what is actually happening in practice.

The number of Internet users continues to increase throughout Africa, though at a much slower rate than in the world at large (Chivhanga, 2000). According to Duvenhage (2003), of the world's 501.3 million Internet users, about 5.3 million are in Africa south of the Sahara. Of these 5.3 million users, approximately 58.5% (3.1 million) are in South Africa. This means that about 0.6% of the world's Internet users are in South Africa.

These statistics show that the number of computer users in Africa, and more specifically South Africa, form only a very small part of the global picture. Nevertheless, in the South African context this is quite substantial. This means that many people in South Africa, from different races and cultures, use and come into contact with computers, either at home or at the office. Therefore, the need for computer literacy has become a priority.

1.2 NECESSITY AND PURPOSE OF THE STUDY

South Africa, like most countries, is experiencing rapid changes in technology use in all the different sectors of our society, for instance industry, education, commerce and social structures (Clarke, 2000; Chivhanga, 2000; Dickinson, 1999). Because of the proliferation of computers throughout the business world, more and more demands are placed on workers to develop sufficient computer skills. There are various types of training in which workers can obtain these much needed computer skills. Although several people may use identical training methods, it is very likely that they would end up with different computer abilities (Hicks, Hicks & Senn, 1991).

Despite the growth in computer use in so many aspects of our daily lives, research shows that there is still resistance to and anxiety about computers. Ostrowski, Gardner and Motawi (1986) found that more than 50% of their subjects had computer attitude problems, with anxiety occurring most often. Orr, Allen and Poindexter (2001) suggest that the profile of students dropping out of computer courses due to high levels of anxiety should be investigated.

The previous paragraph suggests that computer anxiety is one of the factors influencing computer skills and proficiency. Although anxiety plays a significant role in end-user computing, there are also other cognitive, biographical and psychological factors that may influence the user's computer proficiency.

Harrington, McElroy and Morrow (1990) are of the opinion that the success of an information system can be influenced by the psychological make-up of individual people. According to Harrison and Rainer (1992), organisations should attempt to understand the relationship between individual differences among people and their computer skills.

Other research indicates that people are different in many ways and that we tend to notice the physical differences among people more readily than we notice their differences in thinking styles or in ways of representing information (Riding and Rayner, 1998).

It is thus important to identify biographical, psychological and cognitive attributes that have the potential to influence the computer proficiency of people. Knowledge of this nature can enable educators and trainers to understand the underlying factors that influence computer proficiency. This is especially true in a multicultural society such as that of South Africa.

The purpose of this study is therefore to identify biographical, psychological and cognitive factors that may help to predict computer proficiency among prospective computer users from different cultural groups.

1.3 RESEARCH QUESTION AND GOALS

The research will be an interdisciplinary study between the disciplines of information technology and psychology.

The researcher will focus on identifying specific biographical, psychological and cognitive factors that may explain why, with the same amount of computer training and experience, some people will have a higher degree of computer proficiency than others. It is therefore imperative that the researcher identify the pool of factors that may contribute to computer proficiency. These factors, with the reasons for including them in the current study, are presented in Section 1.4. Another goal of the study is to determine whether computer attitude and its three components, as presented by Loyd and Gressard (1984a), are influenced by computer experience.

From the preceding paragraph, the following primary and secondary objectives, as stated in Section 1.3.1 and 1.3.2, can be stipulated.

1.3.1 PRIMARY OBJECTIVE

To investigate the following hypothesis:

Hypothesis: A user's computer proficiency is influenced by the following individual and cognitive factors: personality type, learning style, general anxiety, spatial 3D, numerical ability, computer attitude, grade 12 final examination mark and mathematical ability.

This will be done by:

- explaining these individual and cognitive factors by means of the existing literature, and
- determining the degree of the empirical relation between the above-mentioned factors and computer proficiency.

1.3.2 SECONDARY OBJECTIVES

To investigate the following hypotheses:

- Hypothesis 1: The computer attitude of users from different cultural groups changes as more computer experience is gained.
- Hypothesis 2: The computer anxiety of users from different cultural groups changes as more computer experience is gained.
- Hypothesis 3: The computer confidence of users from different cultural groups changes as more computer experience is gained.
- Hypothesis 4: The computer liking of users from different cultural groups changes as more computer experience is gained.

1.4 INDIVIDUAL AND COGNITIVE FACTORS

In this section the individual and cognitive factors that might influence computer proficiency are listed. The reasons why these factors were included in the current study are also presented. It is, however, important to remember that the selected factors are not the entire list that could be used as possible predictors. Despite the fact that other possible predictors could also have been included in the current study, it is important to remember that the administration time of the tests was limited (students completed the questionnaires in their practical periods). Therefore, only the factors mentioned below were included.

1.4.1 COMPUTER ATTITUDE

Much controversy exists about the role that computer attitude plays in computer proficiency. This is evident if one looks at the research already conducted (see Section 2.2.2). Some researchers state

that there is a positive relationship, while others maintain that there is no relationship between the concepts of computer attitude and computer proficiency. Because of these differences, the components of computer attitude were included as possible predictors of computer proficiency. Loyd and Gressard (1984a) identified these components of computer attitude as computer anxiety, computer liking and computer confidence. The researcher will try to determine the effect of attitude on the computer proficiency of students attending an introductory computer literacy course. Apart from being included as a predictor in the primary study, computer attitude and its components also form the basis of the secondary study (see Section 1.3.2).

1.4.2 PERSONALITY TYPE

In Section 3.2 the definition of personality states that personality influences people's actions and reactions in certain circumstances. Therefore, personality may influence the manner in which a person acts and reacts towards computers. In turn, this may influence the individual's ability to acquire computer skills and thus inhibit or promote his/her ability to become computer proficient.

Holland's theory on personality types (see Section 3.8.1) also states that personality may influence the working environment that a person chooses. This theory makes provision for the fact that certain personality types favour certain occupations.

It is thus possible that personality type may have an influence on the computer proficiency of people.

1.4.3 LEARNING STYLE

Orr et al. (2001) recommend that research be conducted to examine the relationship between learning style and student performance in a course. Students' performance in an introductory computer literacy course was taken to represent their computer proficiency (see Section 6.3.1).

1.4.4 GENERAL ANXIETY

In Section 1.4.1 the reasons for including computer attitude were presented. One of the components of computer attitude is computer anxiety. From the literature it can be inferred that computer

anxiety is a specific type of anxiety (see Section 2.4.2). Therefore, the researcher deemed it necessary to determine whether general anxiety also has an influence on computer proficiency.

1.4.5 SPATIAL 3D AND CALCULATIONS

Spatial 3D and Calculations are two sub-tests of the Senior Aptitude Test (SAT). This test was developed to measure whether a person has the potential to attain a specific level of ability with a given amount of training and/or practice (Fouché & Verwey, 1978). Given the fact that the primary purpose of the current research is to establish a battery of predictors for computer proficiency, it makes the SAT an obvious choice to include in the study. However, the time it takes to administer the test will not allow for the whole test to be included. Thus, only the sub-tests that measure spatial 3D and calculations were chosen. These two tests present the general reasoning ability of a person as well as the ability to work quickly and accurately with figures (Fouché & Verwey, 1978). Because these abilities may also be important when working with computers, as is evident from previous research (see Section 2.6), they were included as possible predictors.

1.4.6 GRADE 12 FINAL EXAMINATION MARK

The grade 12 final examination mark of a student represents his/her performance in the grade 12 final examination. The researcher included this score as a possible predictor, because there may be a correlation between a student's prior performance in school and his/her performance in a computer course.

1.4.7 MATHEMATICAL ABILITY

Mathematics is a pre-requisite for many courses and especially the B.Sc. computer courses at the University of the Free State (www.uovs.ac.za). Therefore, it can be inferred that school performance in mathematics is important in these courses. Together with this, mathematics is a subject that requires the ability to think logically. This skill is also needed when working with computers, e.g. the menus of computer programmes have logical layouts and groupings. Thus, the researcher will try to determine whether a person's mathematical ability influences computer proficiency.

1.5 RESEARCH DESIGN

1.5.1 RESEARCH PARTICIPANTS

To ensure that all the research participants were on the same level of computer literacy, only students enrolled for the basic computer literacy course at the University of the Free State were used in the study. The necessary permission to use these participants was obtained from the relevant lecturer and head of department.

1.5.2 MEASURING INSTRUMENTS

Because the research will be used as a prediction study for computer proficiency, the research participants were tested early in February 2003, before the introductory computer literacy course commenced. This was to ensure that the participants' attitudes, abilities or feelings toward computers were assessed prior to their exposure to computers.

The only test that was repeated (on the same students) towards the end of the semester course was the Computer Attitude Scale (CAS) (see Appendix A). Apart from measuring a person's attitude towards computers, the test also contains sub-tests that measure computer anxiety, computer liking and computer confidence (see Section 2.2.6). The researcher needed these retest scores to determine whether users' computer attitude, as well as the three mentioned components changed as more computer experience was gained (see Section 1.3.2).

The actual tests were conducted during the practical periods of the participants. The participants were asked to answer the questionnaires honestly and confidentiality of the results was assured.

Each participant completed a booklet which consisted of the following:

- A biographical section in which gender, home language and culture were indicated.
- A section with questionnaires that tested the following psychological and cognitive factors: personality type, learning style, numerical ability, spatial 3D, general anxiety and computer attitude.

Each student also indicated his/her grade 12 mathematics mark (a space was provided in the above-mentioned booklet), while the grade 12 final examination mark was obtained from the administration department at the University of the Free State.

1.5.3 STATISTICAL ANALYSIS

The statistical analysis of the data is presented in Chapter 7. The statistical methods used consist of the following:

- A multiple regression was used to investigate the possibility of predicting computer proficiency on the basis of the factors stated in Section 1.4.
- The t-test for dependent groups was used to determine whether computer attitude and its components change as users gain more computer experience.

1.6 VALUE OF THE RESEARCH

The findings of this study may be used to develop a battery of predictors of computer proficiency. Such a battery may be used by training or education institutions to predict whether a student has the ability and personality make-up to complete a computer course successfully. For example, university departments of computer science and informatics may use such a battery of predictors to identify individuals that have a high likelihood of dropping out of introductory computer courses. This would save the student, as well as the university, a great deal of time and money that would otherwise have been wasted.

Secondly, the findings of this research can be used to identify the reasons why a student of a computer-related subject may have problems in performing according to his/her ability. An example would be where a computer training institution may subject a student to tests that could identify which biographical, psychological and cognitive factors are responsible for poor performance in computer use. Some of these factors are difficult or impossible to change, e.g. a person's personality (see the literature review in Chapter 3). In these cases students may be provided with exercises that improve their skills on a computer. Other factors, like learning style (see Section 4.3) and computer attitude (see Section 2.2.5), can be changed. The student may be provided with exercises to alter or improve these factors.

Thirdly, the research (secondary study) attempted to determine whether users' computer attitude, computer anxiety, computer liking and computer confidence change as more computer experience is gained (see Section 1.3.2). If the research indicates that these four components improve as users gain more computer experience, lecturers can spend less time on improving these attitudes, because computer experience will automatically rectify the problem. However, if these attitudes worsen or stay consistent over time, irrespective of experience, training personnel may have to use appropriate techniques to alleviate this problem.

1.7 LAYOUT OF STUDY

The layout of the study as presented in this dissertation is described below.

1.7.1 CHAPTER 1

In this chapter an introduction and overview of the dissertation are given. The problem is stated briefly and the objectives of the study are discussed. All the individual and cognitive factors that are included in the current research and that might predict computer proficiency are presented. This chapter also outlines the methodology that is used in this study. Furthermore, the value and the benefits of the research are discussed.

1.7.2 CHAPTER 2

In this chapter a number of concepts are explained. Firstly, the concept of computer attitude receives focus. Definitions of computer attitude and aspects such as findings of previous studies, reasons for inconsistencies in prior research, the effects of attitude on computer use and strategies to enhance computer attitude are explained. Next, the concept of general anxiety receives attention. Aspects like the definition and symptoms of anxiety are discussed. The next three parts of the chapter explain the three components of computer attitude, as presented by the Computer Attitude Scale (CAS) developed by Loyd and Gressard (1984a) (see Appendix A). Lastly, spatial 3D receives focus with a discussion of what it is and previous research on the subject.

In this literature review it will be explained how the above-mentioned concepts might influence computer proficiency.

1.7.3 CHAPTER 3

This chapter focuses on personality as a possible predictor of computer proficiency. The different personality types are mentioned with a thorough discussion of each one. The chapter ends with the relation between personality types and preferences towards certain professions and jobs.

1.7.4 CHAPTER 4

This chapter is dedicated to a discussion of learning styles and how they may relate to computer proficiency. The concept of learning is explained first, followed by a definition and explanation of learning styles. Kolb's learning theory is presented, followed by a discussion of the basic learning modes and styles. Finally, the significance of learning styles for lecturers and students receives attention.

1.7.5 CHAPTER 5

In this chapter cultural and multicultural issues are discussed. Issues such as the definition of culture, the differences between cultures and how cultures relate to the current research are presented.

1.7.6 CHAPTER 6

In this chapter the focus is on the methodology of the study with specific reference to the composition of the research group, measuring instruments that were used in the study, the data collection process and the statistical procedures that were followed.

1.7.7 CHAPTER 7

In this chapter the results of the primary and secondary study are presented and discussed.

1.7.8 CHAPTER 8

In this chapter the findings, as presented in Chapter 7, are interpreted and compared with previous research. Conclusions and recommendations are made and limitations of the current study are discussed.

Chapter 2

Computer Attitude, Anxiety and Some Cognitive Factors

2.1 INTRODUCTION

In the previous chapter a broad overview of this dissertation was presented. The goals of the study as well as a broad methodology were discussed. In this chapter the focus is on computer attitude, general anxiety and Spatial 3D as possible determinants of computer proficiency.

Currently there is a variety of training mechanisms that will introduce a person to new computer skills, as well as develop and increase already existing skills. This does not mean, however, that the effect of this training will be the same on everyone. People that undergo identical training methods will nonetheless be likely to end up with different computer abilities (Hicks et al., 1991). Because end-user computing plays an important and strategic role in the well-being and existence of organisations, it is extremely important to find out which factors influence the success of end-user computing. What are the reasons that some people excel on a computer while others have problems and even build up resistance toward computers and the use of computers? The contents of this chapter is basically a literature review of the variables explained above and how they may affect the prediction formulas of computer proficiency in Chapter 7.

Section 2.2.1 starts by explaining the concept of computer attitude, while the three components of computer attitude are discussed in Sections 2.4 and 2.5. However, before the three components are discussed, general anxiety will be explained in Section 2.3. There are two reasons for this layout. Firstly, in Section 2.4.1 it is made clear that computer anxiety is simply anxiety towards a specific object, namely computers. It is thus important to understand the meaning of anxiety in general and the effect it has on people. Secondly, as indicated in Section 1.4.4, anxiety in general (apart from computer anxiety) is also a variable which is included in the current study as a possible predictor of computer proficiency. Therefore, it is necessary to explain anxiety in general, because without an explanation the reader will not understand the effect it may have on computer proficiency. Finally, in Section 2.6 spatial 3D is discussed.

2.2 COMPUTER ATTITUDE

In Section 1.4.1 computer attitude was identified as a factor that may predict computer proficiency. The definitions of computer attitude will be discussed in Section 2.2.1, followed by a discussion on inconsistencies as found in prior research (see Section 2.2.2). As a result, in Section 2.2.3, the reasons why these inconsistencies may appear are discussed. Furthermore, the effect that computer attitude has on computer use will be explained in Section 2.2.4. It will become evident that a negative attitude towards computers may impede computer use. For this reason the strategies to enhance computer attitude are explained in Section 2.2.5. Finally Section 2.2.6 presents the components of computer attitude.

2.2.1 DEFINITIONS

Before computer attitude can be discussed, it is important to look at the concept of attitude in general. Taylor, Peplau and Sears (2000) argue that although many people have a good idea of what an attitude is, they find it difficult to define it in objective terms.

Gordon Allport (1935, p.810) formulated the following definition:

> "An attitude is a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related."

Another, more recent, definition for attitudes is the following:

> "Attitudes are complex internal states of human beings that affect their choice of action or behaviour toward people, objects and events." (Scarpa, Smeltzer & Jasion, 1992, p.72)

These two definitions suggest that attitude is a mental state of mind which influences the way a person will react towards other people, objects and events. Allport's definition also states that a person's attitude is influenced by experience. It is therefore safe to infer that if a person has a positive or negative experience with an object, it will influence the manner in which they will react

and behave towards that object in the future. By keeping this in mind, it may be possible that a person's previous experience with a computer will influence his/her attitude towards computers or similar technology in the future. Therefore, computer attitude and its components were included in the secondary study (see Section 1.3.2). This study will determine whether experience on computers has a positive effect on computer attitude and its components. The results for the secondary study are presented in Section 7.4.

However, Taylor et al. (2000) caution that although the definition of Allport is useful, it is not that accurate, because it incorporates a number of assumptions about attitudes. The first is that attitudes are enduring. This assumption is inaccurate, because people can often come up with a new attitude on the spur of the moment toward people or objects that they never encountered before. Secondly, attitudes do not always exert a direct or dynamic influence on behaviour, because in some instances the relationship between attitudes and behaviour can be weak.

With relation to computers, this means that although a person has never had any encounter with a computer or related technology before, he/she might have a positive or negative attitude towards computers. Also, the fact that a person might have a positive or negative attitude towards a computer does not necessarily predict how they will behave and perform when physically working on a computer. This view of attitude is in line with the inconsistent results of previous studies (see Section 2.2.2) about the influence of computer attitude on end-user performance.

Thus, with this background, the researcher will determine if there is a relationship between computer attitude and end-user performance for students, from different cultural groups, enrolled in a basic computer literacy course. The results for this study are presented in Chapter 7. In Section 2.2.2 the findings of previous research with regard to this topic will be presented.

It is important to keep in mind that uniformity regarding the definition of computer attitude and its components does not always exist (see Section 2.2.3). An example of this can be found in the research of Orr et al. (2001) where they sometimes refer to computer anxiety as being synonymous with computer attitude. In most cases computer anxiety is seen as a component of computer attitude (see Section 2.2.6), but the line between the two is not always clear. Computer anxiety as a component of computer attitude will be discussed in Section 2.4.

2.2.2 PREVIOUS RESEARCH

Several studies involving the relationship between attitudes and end-user performance have been conducted in the past. However, the results of these studies have been inconsistent. Some reported positive relationships while others failed to find any relationship between attitudes and end-user performance.

Nickell and Pinto (1986), developers of the Computer Attitude Scale (CAS), found a positive correlation between scores on the CAS and the final course grades of students enrolled in an introductory computer class. Also, in studies conducted by Jawahar and Elango (1998, 2001) on a large sample of undergraduate business students enrolled in a Management Information Systems course, a positive relationship between computer related attitudes and performance in the course was reported.

On the other hand, some researchers reported no relationship between computer attitude and end-user computing performance. O'Quin, Kinsey and Beery (1987) conducted their study on a sample of college faculty and administrative personnel. They found that computer attitude was not related to end-user computing performance. In another study Kernan and Howard (1990) found that course grade could not be predicted by computer attitude. Szajna and Mackay (1995) reported similar results in a study of undergraduate business students enrolled in a required computer skills course.

The findings of the foregoing studies indicate that the relationship between computer attitudes and end-user performance cannot necessarily be assumed. Also, similar studies have not been conducted in a South African context. For this reason, one of the objectives of this dissertation will be to determine whether there is a correlation between computer attitude and computer proficiency of students enrolled in an introductory computer literacy course.

2.2.3 REASONS FOR INCONSISTENCIES IN PREVIOUS RESEARCH

The research, as discussed in the previous section, indicates that there is no consensus about the relationship between computer attitudes and end-user performance. It is therefore important to identify reasons for these inconsistencies.

Blignaut (1999) researched computer attitude and anxiety among African nurses serving in a primary health care clinic. He also found that previous research involving nurses' attitudes toward computers had rendered inconsistent results. According to him, one possibility for these inconsistencies was that attitude might not be a single phenomenon: it could consist of more than one aspect.

This means that some researchers view computer attitude as being made up of certain components while others use different components. An example would be where the Computer Attitude Scale (CAS) (see Appendix A) of Loyd and Gressard (1984a) were based on three sub-scales, namely computer liking, computer confidence and computer anxiety. Bandalos and Benson (1990), on the other hand, revised the CAS and proposed that the three sub-scales of computer attitude should be computer liking, computer confidence and computer achievement. It is thus clear that these two computer attitude scales are made up of different components and as a result different conclusions about computer attitude may be rendered upon administration to the same group of people. Therefore, Blignaut (1999) argues that the contradictions in previous research could have been the result of a shift in focus with regard to the components of attitude.

Jawahar and Elango (2001) offer a similar reason for the inconsistent results reported in previous research. They found that such studies have used the concepts of computer anxiety and negative attitudes towards computers interchangeably. According to them these concepts are not interchangeable. This argument is in line with factor analytic investigations conducted by Kernan and Howard (1990).

Apart from this, Jawahar and Elango (2001) also offer another two reasons for contradictory findings. Firstly, favourable attitudes toward computers do not necessarily imply a willingness to work with computers. While some tests measure attitudes toward working with computers, others have components measuring general attitudes toward computers. They believe that attitudes toward working with computers will indicate a more consistent relationship with end-user performance than attitudes toward computers. Secondly, apart from attitudes, there is also a great deal of individual difference factors which have the potential to influence end-user performance. This means that research would be more fruitful if the focus were turned to specific and theoretically relevant individual difference factors which have the potential to influence end-user performance

rather than general dispositional factors, e.g. locus of control, self-esteem, conscientiousness, and so on.

2.2.4 EFFECTS OF ATTITUDE ON COMPUTER USE

Jawahar and Elango (2001) conclude that attitudes toward working with computers were one of the factors influencing the motivation of end-users. In turn, the motivation of end-users is an important factor influencing their performance. From these two statements we can infer that attitudes toward working with computers will influence how well a user will perform on a computer. Although this statement may be true, the conflicting results of earlier research, as presented in Section 2.2.2, with regard to this subject clearly indicate that more research needs to be done. In the light of this, one of the goals of this study will be to determine if there is a relationship between computer attitude and end-user performance among first year students enrolled in an introductory computer literacy course (see Chapter 7). This may help to resolve the inconsistencies of previous research and enlighten this intricate relationship in a South African context with our diverse peoples and cultures.

Shneiderman (1980) states that positive attitudes enhance the learning process. This means that whereas a positive attitude in a specific situation usually enhances the motivation to learn and to retain information, a negative attitude may impede learning and retention of new information. Learning and retention of new information are important constructs in the process of acquiring new skills. Therefore, a negative attitude towards working with computers may have a negative impact on the learning process associated with computers and as a result decrease end-user performance.

Blignaut (1999) states that a negative attitude may lead to computer resistance. According to Negron (1995), the computer resistance phenomenon can be found among experienced as well as inexperienced users and can be divided into the following categories:

- Resistance to learning, because users have a fear of losing control and they do not think that they will succeed.
- Resistance to using, because computer equipment may awaken a feeling of intimidation or fear in users.
- Resistance because of lack of information, because users feel that they are reduced to machine attendants as a result of not being informed about the implementation of computers.

- Resistance to change, because users are disinclined to learn new things and fear that they will not get the credit for success on the job.

In the previous paragraph it was shown that resistance to computers might have a subsequent negative effect on end-user performance. Thus, it is imperative to identify actions and behaviours that might indicate the presence of computer resistance among end-users. Gibson and Rose (1986) identified five symptoms of computer resistance among nurses working on a computerised patient care system. These symptoms can also be applicable to computer resistance in any working environment. The five symptoms are:

- passive resistance, e.g. workers call in sick on the day of computer training;
- defamation of the computer technology, e.g. workers spread rumours that computer terminals are frequently down and therefore they cannot do their work properly;
- users continue using the old method, because of their inability to learn to use the new technology;
- sabotage of the system by tampering with the data; and
- refusal to use the computer.

2.2.5 STRATEGIES TO ENHANCE COMPUTER ATTITUDE

In the previous section it was indicated that a negative computer attitude might lead to computer resistance. It is therefore important to identify strategies to enhance or sway users' attitudes toward computer use. Houle (1996) states that attitude is one of the factors that should receive attention to facilitate effective instruction in a computer skills course.

Yaghmaie, Jayasuriya and Rawstorne (1998) found that in order to bring about a positive computer attitude among users, they should be exposed to successful and positive computer experience. Conversely, a negative computer experience will result negatively on computer attitude.

This probably implies that computer students at training institutions should be exposed to as many pleasant and positive computer experiences as possible. Lecturers and training personnel should develop strategies to provide opportunities for their students to obtain positive computer experience from a large variety of programmes. By doing this, students may undergo a positive attitude change

towards working with computers that might result in less computer resistance and ultimately it may improve end-user performance. Boser, Daugherty and Palmer (1996) found that the methods of instruction have an influence on students' attitude towards technology. The attitude of women towards technology is focused on the social function of the machine, while a man's view is more focused on the machine itself (Brunner & Bennett, 1997). Houtz and Gupta (2001) argue, therefore, that a young woman would find a curriculum that presents technology as an end in itself less appealing than young men would. They recommend that technology should be introduced as a means to an end, for example a tool for communication and multimedia presentation. This would make technology more appealing to young women. Houtz and Gupta (2001) also recommend that curricula should infuse technology as a tool for communication, presentation, record keeping and research with numerous and varied opportunities for practice. Boser et al. (1996) recommend an interdisciplinary approach. From this we can infer that students should not just acquire computer skills in a theoretical manner, but should also integrate these skills in their everyday lives, e.g. completing assignments, using e-mail, acquiring information from the Internet, and so on.

Apart from the strategies mentioned above, the following practices may also help computer users to have a more pleasant computer experience (Emmet, 1988):

- Staff members should be taught how to get the most out of computers, because they are problem-solving devices.
- Employees should be allowed and encouraged to develop a "personal" sense of belonging regarding the computer, e.g. by using family pictures to personalise their workstation.
- Computers can make people and communication more efficient by providing a convenient way to store information that can be retrieved easily.
- Computers save time and money by allowing users to accomplish complicated tasks in an easy manner.
- Computers are fun. Thus, staff members should be allowed to "play" with the computer.
- Computers are tools that extend people's imagination, knowledge and skill base by allowing them to be more creative.
- Computer skills are marketable.

The above-mentioned strategies can be related to computer courses by allowing students to use computers as a means of communication, for instance for sending and receiving e-mail. They

should be allowed to use computers for presentations and assignments, and the gathering of information should be made possible by using the computers to access the Internet. Students should also be allowed to play games. Apart from this, an awareness of the importance of computer literacy in any future work environment should be established.

2.2.6 COMPONENTS OF COMPUTER ATTITUDE

Loyd and Gressard (1984a) identify the components of computer attitude to be computer anxiety, computer liking and computer confidence. In Section 6.3.2 it is shown that the three components of computer attitude were included as possible predictors of computer proficiency, while the pre- and post-scores of computer attitude and its three components were used in the secondary study (see Section 1.5.2). Taking into account the fact that the time available to measure these four constructs was limited (see Section 1.4), the researcher used the Computer Attitude Scale (CAS) (Loyd & Gressard, 1984a) as a measuring instrument, because this test provides the scores of all four these constructs. Gressard and Loyd (1986) proved that the CAS could be used to represent a general attitude toward working with computers.

Now that computer attitude has been discussed in detail, the three components of computer attitude will receive attention in Sections 2.4 and 2.5. However, as already mentioned in Section 2.1, general anxiety will be explained first.

2.3 GENERAL ANXIETY

In this section a broad overview of anxiety in general is supplied. The definition, together with a short discussion, is presented, followed by a description of the symptoms of anxiety.

Anxiety usually has a negative connotation associated with it (see Section 2.3.1). However, Higgins (1989) states that there appear to be optimal levels of anxiety which help people to function effectively. These optimal levels depend on the level of demand and the context under consideration. Lugo and Hershey (1981) and Beck and Emery (1985) argue that low levels of anxiety may help to make us more alert and aware of what is going on. Low and moderate levels of anxiety generally produce higher scores on complex learning tasks and problem-solving than do high anxiety levels or no anxiety at all.

Johnsgård (1989) explains that anxiety can be compared to fire, in the sense that fire can destroy (burn down a house) or it can create (it can be used to forge steel). In the same way, anxiety has the power to destroy or to fuel positive changes within people, e.g. new ways of feeling, thinking and being. Johnsgård (1989) goes further, saying that most therapists would concur that anxiety is the driving force behind personality change and that it is a necessary and powerful force in psychotherapy.

Although there is a positive side to anxiety, Higgins (1989) warns that people usually find it difficult to determine and then maintain the optimal level of anxiety for a specific setting. It is also important to remember that this optimal level of anxiety varies significantly from one person to another.

Thus, it is imperative to determine the role that anxiety plays on the performance and proficiency of computer users. The researcher will therefore try to determine whether anxiety has a positive or negative influence on the proficiency of computer students. These findings may help lecturers to understand the effect that anxiety has on end-user performance and to act appropriately. If this research finds that anxiety has a negative impact on students' computer proficiency, lecturers could identify students with high levels of anxiety and enlist the assistance of professionals in alleviating their anxiety.

2.3.1 DEFINING ANXIETY

Section 2.3 deals with anxiety in general and does not refer to any anxiety disorder or phobia in particular. Thus, the following definition refers to the concept of anxiety in a general sense:

> "…a diffuse, unpleasant, vague sense of apprehension, often accompanied by autonomic symptoms…" (Kaplan & Sadock, 1998, p.581).

Henderson, Deane and Ward (1995, p.24) give the following definition:

> "…anxiety is viewed as a drive that motivates the organism to avoid the stimulus for anxiety."

Therefore, it is evident from the definitions that anxiety is a feeling that people would prefer to avoid. According to Wolman (1994b, p.xi) anxiety is "…an endogenous feeling of helplessness and inadequacy". Rowan and Eayrs (1987) state that anxiety is an unpleasant feeling. This aspect is also emphasised by the fact that the word anxiety has its roots in the Latin word "angere", which means "to choke" or "to strangle", both of which are unpleasant experiences (Bakal, Hesson & Demjen, 1995). The definition also stipulates that anxiety is usually accompanied by specific symptoms which will be discussed in Section 2.3.2. Another important component of the definition is that the feeling is vague and diffused. In relation to this, Higgins (1989) and Plug, Louw, Gouws and Meyer (1997) state that it is usually difficult or impossible to pinpoint the exact cause of anxiety and why people have feelings of apprehension in certain circumstances or surroundings.

Another aspect that is obvious from the literature and relevant to this topic is the fact that it is important to distinguish between fear and anxiety. Kaplan and Sadock (1998) and Rowan and Eayrs (1987) state that people experience fear as a response to a known, external, definite or nonconflictual threat. On the other hand, anxiety can be explained as a response to a threat that is unknown, internal, vague or conflictual (American Psychiatric Association, 1994; Kaplan & Sadock, 1998; McNally, 1994; Plug et al., 1997; Rowan & Eayrs, 1987; Suinn, 1995). This can be explained by means of the following example: fear is the emotion experienced by a person if a car rapidly approaches while he/she is crossing the street. This emotion differs from the vague discomfort a person may experience when meeting new people in an unfamiliar setting (Kaplan & Sadock, 1998).

It is also important to look at duration when differentiating between these two neurophysiological phenomena (Kaplan & Sadock, 1998). Wolman (1994a, p.5) explains that "(w)hereas fear is a momentary reaction to a threat, anxiety is a lasting feeling of unavoidable doom". Plug et al. (1997) support this explanation of Wolman.

2.3.2 SYMPTOMS OF ANXIETY

The symptoms of anxiety will most probably manifest themselves in the domains of mood, cognition and bodily disturbances. However, it is important to keep in mind that disturbance in all three areas is not usually the case. People usually have a tendency to express their anxiety in a

unique way: one person may sweat for instance, while another develops tension pains in a specific area of the musculature (Sims & Snaith, 1988).

Some of the more recognisable symptoms that individuals suffering from anxiety may experience are diarrhoea, dizziness, light-headedness, hyperhidrosis (excessive sweating), hypertension (high blood pressure), palpitations, pupillary mydriasis (excessive widening of the pupils), restlessness, syncope (fainting), tachycardia (abnormal fast heart beat), tingling in the extremities, tremors, upset stomach ("butterflies") and urinary frequency or hesitancy or urgency (Kaplan & Sadock, 1998; Rowan & Eayrs, 1987; Sims & Snaith, 1988).

These are not the only symptoms that people with anxiety may experience. According to Kaplan and Sadock (1998), anxiety also affects their thinking, perception and learning. Other effects of anxiety are that it produces confusion and distortions of perception relating to time and space, as well as people, and the meanings of events. These distortions usually have a negative effect on learning in the following ways:

- lowering of concentration;
- reducing the recall ability; and
- impairing the ability to make associations.

2.3.3 SECTION SUMMARY

As seen from the above discussion, anxiety is a feeling that people would rather avoid. It is also evident that people experience several negative symptoms associated with this disorder. The situations in which anxiety is experienced differentiate general anxiety from computer anxiety. With computer anxiety, the feeling is towards computers or similar technology (see Section 2.4.1) and the person will only feel anxious when they come into contact with these objects. On the other hand, a person with general anxiety feels anxious all the time. Although these individuals may experience anxiety when they work on computers, the computers do not initiate these feelings. A person may thus like to work on a computer or have a positive attitude towards computers, but may still experience the negative symptoms of anxiety, without being able to pinpoint the reason.

With regard to the current study, this implies that a person can have low computer anxiety, but still have high levels of general anxiety. Thus, low computer anxiety, as measured by the Computer Attitude Scale (CAS), does not necessarily imply a low score on the general anxiety questionnaire. This means that the two above-mentioned concepts should not be seen as synonymous and therefore will be included as separate predictors in the current study.

The measuring instrument for general anxiety is the IPAT Anxiety Scale (Cattell, Scheier & Madge, 1968) and is discussed in Section 6.3.2.2. In Chapter 7 the statistical procedures pertaining to this factor are presented.

2.4 COMPUTER ANXIETY

The introduction of the personal computer and end-user computing are probably some of the major factors influencing organisations in the past few decades (Ivancevich, Napier & Wetherbe, 1983; Orr et al., 2001). Jawahar and Elango (2001) state that organisations spend a large portion of their information technology budget on end-user computing, because this can influence the success of their business. Torkzadeh and Angulo (1992) warn that the users' acceptance and commitment will determine the success of end-user computing.

As explained in Section 2.1, the reasons why some people have a positive end-user computing experience while others do not, are not always clear. One contributing factor may be the differences in the levels of computer anxiety among people. Kay (1990) and Koslowsky, Hoffman and Lazar (1990) state that attitudes and anxiety regarding computers are factors that may influence users' resistance and commitment to use computers. Negron (1995) says that computer anxiety and computer resistance should be overcome before they actually occur in the workplace. If these aspects are dealt with early in the implementation process, organisations will spend less money than when they react to them later in the implementation process.

In this section the focus is on computer anxiety as one of the contributing factors to poor performance and resistance towards computers. Section 2.3.3 indicates the reason why general anxiety and computer anxiety are not viewed as synonymous in this dissertation. Thus in Section 2.4.1, a description and a definition of computer anxiety are presented, followed by the psychological and physical effects thereof on computer users (see Section 2.4.2). Then specific

reasons for computer anxiety and strategies to minimise it will be discussed in Sections 2.4.3 and 2.4.4, respectively. Finally, Section 2.4.5 concludes the discussion on computer anxiety and relates it to computer proficiency.

2.4.1 DEFINING COMPUTER ANXIETY

Computer anxiety is not one of the easiest concepts to explain. Orr et al. (2001) indicate that there are several terms used to describe the negative feelings that people have toward computers, such as computer anxiety, cyberphobia, computerphobia or technophobia.

From the two definitions presented in Section 2.3.1, it is clear that anxiety is something that people will try to avoid. People do not like to feel anxious and will therefore try to avoid situations or objects that may lead to a state of anxiety. One may thus infer that people with computer anxiety will try to avoid the use of computers in their social, occupational or other important areas of functioning.

Clarke (2000, p.12) presents the following definition on computer anxiety:

> "...evidence of one or more of the following: (a) anxiety about present or future interactions with computers or computer related technology, (b) negative global attitudes about computers; and/or (c) specific negative conditions or self critical internal dialogues during present computer interactions or when contemplating future computer interaction."

This definition shows that computer anxiety has basically the same attributes and make up of general anxiety, but with the difference that it is aimed at a specific object, namely computers or the use of computer systems. It is also evident that computer anxiety is a component of attitude. Therefore, the Computer Attitude Scale (CAS), as described in Section 6.3.2.1, adheres to this requirement, because computer anxiety is included as one of the sub-scales of computer attitude.

Computer anxiety is very common in South Africa. Clarke (2000) found that although South Africans have a higher degree of technological experience than expected, they still have high levels of computer anxiety.

Rakes (1989) suggests that anxiety is one of the most prevalent emotions experienced by individuals who are required to use computer technology in the workplace. Because computer anxiety is considered to be only a temporary emotional state rather than a permanent personality trait, the remedy for computer anxiety is positive computing experiences (Cambre & Cook, 1987).

Torkzadeh and Angulo (1992) emphasise that despite the fact that young people receive computer training and exposure at an early age, in high schools and colleges it will still be inadequate. The problem of computer anxiety will not just disappear when these young people move into the workforce. Training programmes should become even more comprehensive, because the current proliferation of computers and the increasing demand for strategic use of computer applications place an even greater demand on computer literacy and training.

The fact that computers become more important (in the business world, as well as the everyday lives of people) as time goes by, means that the level of properly managed training should also be adjusted. What is good enough today will not necessarily be good enough tomorrow. This is especially true in a country like South Africa, where the population is made up of several different cultures. Clarke (2000) states that very little research has been done to measure people's fear of computers and related technology in South Africa. Because of the rapid expansion of computer and Internet use in South Africa (Chivhanga, 2000), more time, money and research should be spent and conducted on alleviating factors like computer anxiety among the different cultures of South Africa.

In the next section the psychological and physical effects of computer anxiety will be discussed.

2.4.2 EFFECTS OF COMPUTER ANXIETY

People are different and therefore the effects and symptoms of computer anxiety will vary among them. According to the diagnostic criteria presented in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), computer anxiety can be classified under the group “Specific Phobia”. In turn, “Specific Phobia” is a sub-category of the anxiety disorders (American Psychiatric Association, 1994). This means that computer anxiety is a specific type of anxiety. It would therefore be logical to infer that people who experience computer anxiety will also experience anxiety-related symptoms. These symptoms (see Section 2.3.2) can greatly influence or impair a

person's ability to use a computer effectively, for example people who cannot think clearly (a symptom of anxiety) would not be able to achieve to their full potential on computers. These statements were supported by a study of Marcoulides (1988) in which the computer attitudes of college students, enrolled in a required computer information systems course, were measured. He concluded that computer anxiety influenced how effectively the students could utilise the computer and therefore computer anxiety seems to be a good predictor of computer achievement.

One of the goals of this dissertation is to determine if these findings about computer anxiety are also true in a South African environment. Therefore, the findings of this research will determine if computer anxiety can be used as part of a battery of predictors for computer proficiency (see Section 1.3.1). The hypothesis that computer anxiety changes as a user gains more experience on computers will also be investigated (see Section 1.3.2). The statistical results for the above-mentioned research are presented in Chapter 7.

If it is found that computer anxiety plays a predictive role on the computer proficiency of the students enrolled for a basic computer literacy course, lecturers and training personnel could develop strategies to minimise and alleviate the symptoms of computer anxiety (see Section 2.4.4), by good user support strategies, for instance. However, Price and Lynn (1986) and Louw (1989) state that anxiety is often the symptom of a deeper underlying problem. This may also be applicable to computer anxiety. A student might previously have encountered a bad experience with computers or similar technology: while playing on his/her parents' computer, he/she may accidentally have deleted important files and as a result been scolded, for example. If the lecturer becomes aware of this reason he/she should tell the student what he/she did wrong on the computer and how it could have been prevented or fixed, e.g. the files could perhaps have been recovered from the recycle bin. In section 2.4.1 it is also stated that the remedy for computer anxiety is good computer experiences. Thus, this specific student should work on a computer as much as possible while a trainer, a lecturer or a student assistant helps him/her with possible problems. In this manner the student will understand that he/she should not be afraid of computers and should as a result experience less and less computer anxiety. This would be even more relevant if the results of the secondary study indicate that computer anxiety decreases as students gain computer experience.

2.4.3 REASONS FOR COMPUTER ANXIETY

Torkzadeh and Angulo (1992) say that there are many forms of computer anxiety and that they can be related to a number of common fears. They also state that there are three perspectives of computer anxiety, namely psychological, sociological and operational. Firstly, the psychological perspective of computer anxiety manifests itself in the following ways:

- Users fear that they will damage the computer.
- Users' egos are bruised, because they think that sitting at a computer is unprofessional or they feel threatened to ask younger workers for help.
- Users feel that they are losing control, because computers are perceived as a threat to one's power and influence or as things over which one has no control.

Secondly, the sociological perspective of computer anxiety manifests itself in the following ways:

- People have the need for social contact with other people and because computers can change these existing social patterns, they find it unbearable.
- People may have the fear that computers will replace them.
- People may feel that it is not worth trying to catch up with technology, because they are already so far behind.

Thirdly, the operational perspective of computer anxiety manifests itself in the following ways:

- People may experience a feeling of fear, because of their inability to type and to use the keyboard in order to communicate with a computer.
- People want to avoid embarrassment connected with their inability to operate the computer and thus avoid the use of computers.
- The complexity and sophistication of computer systems and procedures may be too overwhelming for users.

Downton (1993) asserts that anxiety is often promoted by a user's fear of failure in using an unfamiliar system and may be exacerbated by repeated errors, overloading of the short-term memory with details of the system and perceived external pressure to use a system.

The above perspectives suggest that computer anxiety is caused by the fears of people, their perceived ideas about their own abilities, their insecurities, their needs and their ideas about the impact that computers will have on their lives. Some students may be afraid of computers, because they are unfamiliar with electronic technology, for instance students who have grown up in informal settlements (squatter camps). These students are not used to electricity and electronic devices such as televisions, video recorders, microwave ovens and so forth. As a result they feel afraid to work on computers, because they cannot type, they do not know how to communicate with the computer, or they are embarrassed about their lack of knowledge about technology. It is also possible that older students experience more computer anxiety because they feel that the younger students will laugh at them or because they are reliant on the help of much younger student assistants. Asking for help tends to bruise their egos, because often they are the leaders or managers in their companies and now they are obligated to ask for the help of someone younger and "less experienced" than they perceive themselves to be.

It is clear that there are many causes and reasons for computer anxiety and therefore strategies to minimise computer anxiety, and the effects that computer anxiety has on people, should be attended to by organisations. Fortunately studies have been conducted on this subject and will be discussed in the next section.

2.4.4 STRATEGIES TO MINIMISE COMPUTER ANXIETY

As indicated above, computer anxiety has been found to have an influence on the performance of computer users, as well as on the resistance that people have toward computers. Cambre and Cook (1987) state that computer anxiety is considered a temporary emotional state rather than a permanent personality trait and therefore it can be remedied through positive computing experiences.

For this reason it is important to find strategies and ways to minimise computer anxiety among computer users. Appelbaum and Primmer (1990) suggest that any strategy to minimise the anxiety of computer users should involve the following:

- Easy-to-use and relatively simple computer systems.
- Training for computer users, because computer instructions are not always easy to understand.

- Good user support, e.g. good manuals, consultants, user groups and computer specialists.

Thus, it is important to understand that computer anxiety is something that will not just disappear on its own. Managers, trainers and human resources personnel should actively develop strategies to minimise computer anxiety. Negron (1995) states that training programmes must be developed with the belief that proper management can overcome computer anxiety.

Henderson et al. (1995) identify variables that are predictive of computer anxiety. The most important variable is self-efficacy, with expectations in the second place. They suggest that training programmes should focus on these two variables. Firstly, to develop a positive sense of self-efficacy a training programme should be based on two expectations, namely that a particular response will be effective in a given situation and that the individual is able to carry out the particular response. Secondly, training programmes should focus on developing positive expectations from a system by using written, verbal, video and audiotape information presentations.

The above-mentioned aspects of minimising computer anxiety receive a great deal of attention at the University of the Free State as well as at other tertiary organisations. The computer systems and programmes that are used for training are relatively easy to use with good user interfaces, e.g. Microsoft Word and Excel. Training standards are also of a high level with weekly classes led by experienced lecturers, as well as practical classes under the supervision of student assistants. The user support is also very good, because each student has a manual as well as the opportunity to contact their lecturers and student assistants with problems they may have.

As we can see above, strategies are in place to minimise computer anxiety among students at the University of the Free State. For the purpose of this study, the above-mentioned strategies are not that important, however, because the aim of the study is not to minimise or decrease computer anxiety levels among students, but to see what influence computer anxiety has on the computer proficiency of students.

2.4.5 SECTION SUMMARY

The motivation why general anxiety and computer anxiety are included as separate constructs for predicting computer proficiency are presented in Section 2.1. However, although the causes of

general anxiety and computer anxiety are different, the symptoms experienced by the person are the same. It was indicated that computer anxiety has a negative effect on the computer achievement of students (see Section 2.4.2). These results will be compared to the findings of the current study in Chapter 8. The current study will also reveal whether efforts to alleviate computer anxiety among computer students are necessary, because the secondary study will show whether computer anxiety is influenced by computer experience. If it is found that computer anxiety is a predictor of computer proficiency and that it does not decrease as students gain computer experience, the strategies to minimise computer anxiety, as stated in Section 2.4.4, are very important.

This section was an in-depth discussion on computer anxiety. In Section 2.5 the other two components of computer attitude, namely computer liking and computer confidence will be discussed.

2.5 COMPUTER LIKING AND COMPUTER CONFIDENCE

As stated in Section 2.2.6, apart from computer anxiety, the other two components of computer attitude are computer liking and computer confidence (Loyd & Gressard, 1984a). Computer liking or the enjoyment of working with computers is presented by ten items on the Computer Attitude Scale (CAS), as shown in Appendix A. These items include statements such as "I would like working with computers", "Once I start to work with the computer, I would find it hard to stop" and "I don't understand how some people can spend so much time working with computers and seem to enjoy it". On the other hand, computer confidence (confidence in the ability to use or learn about computers) is also presented by ten items on the CAS. These items include statements like "I am sure I could do work with computers", "I'm not the type to do well with computers", and "I could get good grades in computer courses".

Loyd and Gressard (1984b) administered the CAS to high school and college students. From these results it was found that computer experience was significantly related to computer liking and computer confidence. In another study with teachers attending a staff development programme designed to provide hands-on experience with computers, Gressard and Loyd (1985) found that the programme enhanced computer liking and confidence. These results were duplicated for computer confidence in a study conducted by Gressard and Loyd (1986) on teachers participating in a staff development programme. However, the influence of the programme on their scores was not

statistically significant on the computer liking sub-scale. The fact that the teachers were already quite positive at the beginning of the program was presented as a possible reason for this result.

Thus, with the exception of the last example, it seems as if computer experience has a positive effect on computer liking and confidence. In other words, the more computer experience people acquire, the higher their computer liking and confidence will be. In the current study, these results will be verified for students enrolled for an introductory computer literacy course at the University of the Free State. The concepts of computer liking and confidence will also be included as possible predictors of computer proficiency. The results of these studies are presented in Chapter 7.

2.6 SPATIAL 3D AND SPATIAL VISUALISATION ABILITY (SVA)

The Spatial 3D sub-test, which forms part of the Senior Aptitude Test (see Section 6.3.2.3), measures the general reasoning and visualisation factor of a person. The Spatial 3D sub-test also forms part of a combination of tests (pattern completion, figure series, spatial 3D and spatial 2D) which is an indication of a person's visual-spatial reasoning. From the factor loadings, it is evident that of all four tests spatial 3D has the greatest influence on visual-spatial reasoning (Fouché & Verwey, 1978).

Discussions on spatial 3D are not readily available in the literature. However, research and discussions on spatial visualisation ability (SVA) are more regularly found. Although these concepts are not the same, they are closely related in that both refer to a person's ability to visualise three-dimensional objects in a two-dimensional space. Therefore, previous research regarding the influence of SVA on users' computer performance and attitude will be discussed.

A person's SVA is defined as the ability to manipulate or transform the image of spatial patterns into other arrangements (Ekstrom, French & Harmon, 1976). In other words, it is the ability of a person to mentally rearrange objects and recognise links between objects without seeing the links physically.

In previous research, Norman (1994) found that SVA was a cognitive factor that correlated strongly with people's computer performance. In another study, Vicente, Hayes and Williges (1987) reported similar results. They investigated 21 possible predictors of performance in finding

information in a computerised database. Only two predictors, one of which was SVA, stood out significantly. The researchers found that participants with low SVA took twice as long to find the correct information as those with high SVA. They also found that participants with low SVA took longer to locate a target in a hierarchical file system. Eventually these participants got lost in their search. Norman and Butler (1989) and Butler (1990) also found that SVA and computer related tasks, such as menu selection and database searches, were highly correlated.

Blignaut (1999) found that people with low SVA have a tendency to experience higher levels of computer anxiety than people with high SVA. Apart from this, Blignaut reported that people with low SVA did not like to work with computers as much as people with high SVA. Their computer performance and confidence were also lower.

The previous research indicates that SVA is highly related to a user's computer proficiency. Thus, the Spatial 3D sub-test was included as a possible predictor of computer proficiency in the current study. The results pertaining to spatial 3D are presented in Chapter 7, while a description of the test can be found in Section 6.3.2.3.2.

2.7 CHAPTER SUMMARY

The effects of computer attitude on end-user performance are not as clear and obvious as would be expected. This is evident from the inconsistent results from previous research. Some research found a positive and others no correlation between computer attitude and end-user performance. One possible reason for these inconsistencies may be that researchers had a different focus with regard to the components of attitude.

Despite the disagreement on this subject, some researchers found that attitudes toward working with computers were one of the factors influencing the motivation of end-users, which in turn influences their performance. Also, negative attitudes may impede learning and retention of new information and may contribute to resistance towards computers. It is thus evident that computer attitude may have an influence on computer proficiency. For this reason it was included in the current study as a possible predictor of computer proficiency.

From the literature, it seems as if anxiety is a feeling that people try to avoid. There are many unpleasant symptoms associated with anxiety. Some of these symptoms, like lowering of concentration, reduction in recall ability and impairment in the ability to make associations, may have a negative impact on computer proficiency. Fortunately, there are treatments available for general anxiety. It is, however, important to remember that anxiety also has a positive component. Low levels of anxiety may help to make us more alert and aware of our surroundings. It was also found that low and moderate levels of anxiety might be advantageous in complex learning tasks and problem-solving.

Specifically, computer anxiety has a growing influence on end-user performance and on people in their social, business and other walks of life. It was shown that computer anxiety is the negative feeling that people have towards computers and the use of computers. These feelings manifest as a feeling of anxiety or fear when people think about computers or have to use computers. Associated with these feelings are several negative physical and cognitive symptoms that may cause people to perform poorly on or even to reject computers.

From previous research, it seems that computer experience has a positive effect on computer liking and confidence. Previous research also indicates that SVA is highly correlated with users' computer proficiency.

In the present study, the above-mentioned results will be verified for students enrolled for an introductory computer literacy course at the University of the Free State. Although all the mentioned variables are included as possible predictors of computer proficiency, only computer attitude and its components form part of the secondary study where the influence of computer experience on these components are tested. The results pertaining to these studies are presented in Chapter 7.

The next chapter will focus on personality as a possible predictor of computer proficiency.

Chapter 3

Personality

3.1 INTRODUCTION

Anxiety, computer attitude and its components as well as spatial 3D were discussed in detail in the previous chapter. It was indicated how these factors could influence computer proficiency and, for this reason they were included in the current study as possible predictor variables. In this chapter the concept of personality and personality types will be discussed. It will become apparent that there are different schools of thought with regard to this subject and that personality may have an influence on computer proficiency.

The concept of personality is very interesting, because this is one of the most important non-physical factors of people that makes them different from one another. This is not just because everyone does not have the same attributes, but also because the levels of each attribute differ from person to person (Möller, 1993c).

Edwards (1993) states that in psychology the word personality does not implicate particular or special attributes. Psychologists that investigate personality try to avoid attaching classifications, such as bad, good, superior or inferior, to certain personalities. They much rather try to focus on the similarities and differences between the distinctive ways that people think, feel or act in their everyday walks of life.

In Section 3.2 the concept of personality will be defined, followed by a discussion (see Sections 3.3 to 3.8) about the different schools of thought surrounding this concept. This discussion is important, because it allows the reader to better understand personality and why it may influence computer proficiency. In Section 3.8 Holland's six personality types and how they relate to the working environment, will be discussed. This theory indicates that there is a link between certain personality types and working environments. Therefore, the preference that people with certain personality types have towards specific working environments clearly indicates that personality may have an influence on users' proficiency. Thus, personality was included in the current study as a possible predictor of computer proficiency.

3.2 DEFINING PERSONALITY

The concept of personality has different meanings for different people. The general population usually describe personality in terms of an outstanding attribute that a specific person possesses or in terms of a specific social skill that a person possesses and the degree to which the person can evoke favourable reaction from others (Möller, 1993c).

There have been many schools of thought about the meaning and nature of personality, but there is still no agreement on a single definition. The reasons for this are that people are complex and that personality has so many facets to take into account. This makes it difficult to decide which of these are the important ones when constructing a single definition (Möller, 1993c; Phares, 1984).

Möller (1993c) states that the different views of personality can be divided into the following categories:

- Some definitions emphasise the external appearance and attributes of people.
- Other definitions view personality as all the attributes that a person possesses, without considering the relationship between the attributes.
- There is a group of definitions that specifically puts emphasis on the relationships and interaction among personality attributes.
- Other definitions view personality as a mechanism that people use to adapt to their surroundings.
- Some definitions describe personality as those attributes that make a person unique. In this category, the attributes that differ from person to person are important, rather than those attributes that people have in common.
- Finally, there are those who totally reject the concept of personality. They are especially opposed to the idea that personality is something "within" a person. They argue that the reason for people's behaviour can be attributed to environmental factors.

Because of the different views, as explained above, it is not easy to define personality in a single definition. The word itself was derived from the word "persona". It has Greek and Latin roots and referred to the theatrical masks worn by Greek actors.

The following are some of the definitions of personality that can be found in the literature:

- "…the complexity of psychological systems that contributed to unity and continuity in the individual's conduct and experience, both as it is expressed and as it is perceived by that individual and others" (Caprara & Cervone, 2000, p.10).
- "Personality represents those characteristics of the person that account for consistent patterns of feeling, thinking and behaving" (Pervin, 2001, p.4).
- "Personality may be described as a person's characteristic totality of emotional and behavioural traits apparent in ordinary life, a totality that is usually stable and predictable" (Kaplan & Sadock, 1998, p.775).

Meyer, Moore and Viljoen (1988) state that personality points to the totality of all the attributes that determine an individual's behaviour in the interaction with the environment.

If one looks at the definitions closely, one will see that although they are different, they do have things in common. Here are some of the similarities as stated by Möller (1993c):

- Personality refers to attributes and traits that make every person unique.
- Personality gives individuals the ability to adjust to circumstances in their everyday lives.
- Personality also refers to the tendency of people to react in a predictable manner in different situations.

From the definitions above we can see that personality is a non-physical factor that makes people different from one another. It also influences how people will act and react in certain circumstances. Thus, a person's personality may influence the way he/she feels about and react towards computers and the use of computers. For this reason, the researcher will include personality as a possible predictor of computer proficiency in this study.

Besides the fact that there is no agreement on a single definition for personality, there are also several diverse approaches and theories about the precise nature of the composition, functioning and development of personality. The approaches and theories which will be discussed are the psychoanalytical approach (see Section 3.3), the behaviourist and learning theory approach (see Section 3.4), the humanistic approach (see Section 3.5), the trait theory approach (see Section 3.6),

the five-factor model of personality (see Section 3.7) and Holland's personality types (see Section 3.8.1).

3.3 THE PSYCHOANALYTICAL APPROACH

Sigmund Freud is widely acknowledged as the father of the psychoanalytical theory. Freud is one of the most well-known psychologists of all time and with his extensive writings he had a great influence on other theories. His ideas were based on the theories of his mentors, but it was he who systemised the theories and made them popular and widely acknowledged (Edwards, 1993; Meyer & Van Ede, 1998; Meyer, Moore & Viljoen, 1997). Freud's theory will therefore be used to describe the basic and fundamental principals of the psychoanalytical approach towards personality.

Initially, Freud divided the human consciousness into three categories namely the conscious, the preconscious and the subconscious. This theory was later revised and the structure of personality was described in terms of three dimensions namely, the id, the ego and the superego (Meyer et al., 1997; Möller, 1993b).

The Id – This part of personality has no knowledge or sense of objective reality. It refers to the primitive, instinctive and inherited aspects of personality, e.g. to eat, sleep or kill. The id has no social refinements and derives its energy directly from bodily processes (Hjelle & Ziegler, 1992).
The Ego – This part of personality develops out of the id to deal with the outside world. The ego has to comply to the needs of the id by finding suitable objects to satisfy these urges. The ego dimension of personality can distinguish between the things in the mind and things in the outside world (Hall & Lindzey, 1985).
The Superego – This part of personality develops out of the ego and represents the ideals and values of society. The superego forces the ego to adhere to these rules, ideals and values. Humans are not born with a superego and children must acquire it through interactions with their parents (Meyer et al., 1997; Phares, 1984).

Möller (1993b) states that it is important to remember that the id, the ego and the superego should not be seen as real entities or "small people inside a person" that control a person's personality. They are just simple concepts and abstraction without any reality of their own.

3.4 THE BEHAVIOURIST AND LEARNING THEORY APPROACH

Meyer et al. (1997) state that although behaviourism is an American school of thought, its background can be traced back to the classical Greek philosophers.

This theory differs from psychoanalysis in that it is based on the assumption that behaviour is learned (Meyer & Van Ede, 1998). According to the learning-behavioural approach it is the environment, rather than internal mental events, that shapes a person. Therefore the learning-behaviouristic theorists put the emphasis on the external environment as the main determinant of a person's behaviour (Hjelle & Ziegler, 1992).

According to Meyer et al. (1997) extreme behaviourists like Watson and Skinner argued that the attributes and behaviour of an individual are the result of the influences of the environment and that genetic factors played a very small role.

The behaviourists also believe that all spiritual contents are made up of elements which are linked together. These elements are individual experiences which are associated to one another by certain laws. The law of contiguity states that two ideas which are often experienced directly after each other, like lightning and the roar of thunder, would be associated with each other. Thus, when someone thinks about lightning, they will also automatically think about the roar of thunder. The behaviourists use this to explain that all behaviour is basically made up of small parts, namely stimuli and responses. These are associated with one another on the grounds of certain laws of learning (Meyer et al., 1997; Pervin, 1993, 2001).

Pervin (1993, 2001) contends that according to the learning-behavioural approach an organism's behaviour can be manipulated by manipulating variables in the environment. In short, the psychoanalytic theory states that an organism's behaviour can be explained by aspects inside the organism, e.g. instincts, defences and self-concept. On the other hand, learning theories state that organisms behave in a specific way because of causes that are in the external environment. Therefore, the learning-behavioural theory posits that to change an organism's behaviour, stimuli in the external environment should be manipulated, e.g. food rewards given, rather than concepts that cannot be manipulated, in other words, the self, the ego and the unconscious.

This means that a person's behaviour towards computers can be changed or manipulated by manipulating or guiding the experience the person has with computers or similar technology. Positive encouragement and feelings of achievement will thus ensure that individuals will show a positive behaviour change towards computers. Lecturers, training personnel and student assistants should therefore be actively involved in the training of computer students, for instance sufficient qualified student assistants should be available to help students to complete their practical assignments with success.

3.5 THE HUMANISTIC APPROACH

De Vos (1993) states that Abraham Maslow may be considered the father of the humanistic revolution. This theory was a theoretical alternative to the other two mainstream schools of thought, namely psychoanalysis and behaviourism. Thus, it became known as the third force in psychology (Hergenhahn, 1984; Hjelle & Ziegler, 1992; Phares, 1984).

A fundamental theme in the humanistic theory of Maslow is that for too long psychologists only focused on segments of human behaviour. According to him the study of people as an integrated, unique and organised whole, had been left behind. A common metaphor to describe this is that psychologists tend to study the trees instead of the forest (Hjelle & Ziegler, 1992; De Vos, 1993).

This holistic view is described by Maslow (1970, pp.19-20) in the following way:

> "In good theory there is no such entity as a need of the stomach or mouth, or a genital need. There is only a need of the individual. It is John Smith who wants food, not John Smith's stomach. Furthermore, satisfaction comes to the whole individual and not just to a part of him. Food satisfies John Smith's hunger and not his stomach's hunger ... when John Smith is hungry, he is hungry all over."

Bugenthal (1964) says that humanistic psychology can be better described by the following points of reference:

- A human being is more than the sum of his/her parts. This means that a scientific study of the individual functions of a human being does not lead to any comprehension of a human being in his/her totality.
- A human being is only human if one looks at him/her from a human context. This means that if we want to understand humans better, the interpersonal experiences of human beings cannot be ignored.
- A human being is a self-conscious creature. The emphasis was on unconscious aspects and environmental variables for too long. Thus, there was not enough emphasis on the self-consciousness of a human being. The fact that a human being is a self-conscious creature is of utmost importance to the humanistic psychologists.
- A human being has choices. This means that a human being has the freedom of choice to independently accomplish his/her own potentials. A human being is not just a spectator in his/her own life, but an active and creative sculpture of his/her own life.
- A human being is an intentional creature. Human beings are actively busy to give meaning to their surroundings and to set goals for themselves. This means that humans tend to give meaning to things.

The core of Maslow's personality theory is about the motivational processes that drive people. According to him humans never reach a state of complete and total satisfaction. If a specific need is satisfied, another need surfaces and commands the person's attention (Abramson, 1980; Hjelle & Ziegler, 1992). These needs, as stated by Hjelle and Ziegler (1992), are the following (ordered from strongest to weakest):

- Physiological needs, e.g. hunger and thirst.
- Safety and security needs, e.g. long-term survival and stability.
- Belongingness and love needs, e.g. affiliation and acceptance.
- Self-esteem needs, e.g. achievement and recognition.
- Self-actualisation needs, e.g. realisation of potential.

Basically, the above-mentioned hierarchy of needs can be divided into two groups, namely growth needs and deficiency needs (see Figure 3.1). The lower needs must be satisfied first before an individual becomes aware of the higher needs. At first the lower needs are in the foreground, but the moment the individual satisfies these needs, they move into the background and a higher need moves into the foreground. This process, as depicted by Figure 3.1, starts with the physiological needs and moves progressively through the hierarchy to the self-actualisation needs.

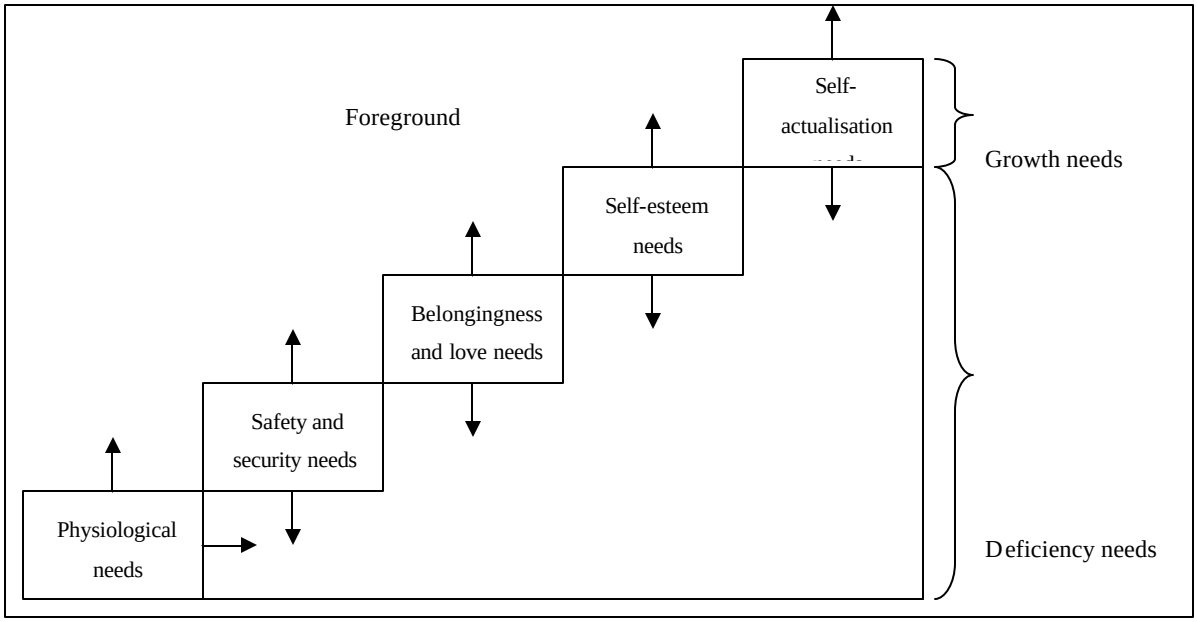

FIGURE 3.1 Maslow's hierarchy of needs (De Vos, 1993, p.227)

Basically, this means that if a person wants to achieve better on a computer or pass a computer exam (self-actualisation need), his/her lower needs should be satisfied first. This means that lecturers, training personnel and student assistants should help and encourage students to work on computers. If the student receives enough help and therefore is able to complete the computer task, his/her self-confidence will increase. By also encouraging and congratulating a student on a task well done, the lecturer recognises the student's achievement and the student's self-esteem needs are fulfilled and the need to realise his/her potential (self-actualisation need) moves to the foreground. Therefore, the student will try to increase his/her computer proficiency. Another aspect that may be applicable is that before students can reach their full potential on a computer, their lower needs should be fulfilled first. This means that to increase a student's computer achievement, the lower needs like typing or mouse skills should receive attention first.

3.6 THE TRAIT THEORY APPROACH

While the psychoanalysts view human functioning as the result of interplay among forces and the behaviourists focus mainly on the learning of behaviour, the trait theorists, according to Edwards (1993), try to classify people according to personality attributes called traits. This method of classifying the personalities of people dates back to Hippocrates, the well-known Greek medical man. Möller (1993a) mentions that Gordon Allport was a well-known trait theorist. He received various awards for his work and can be seen as the greatest contributor in making personality an academic field of study.

Allport (1961, p.347) states that a trait can be defined as a:

> "…neuropsychic structure having the capacity to render many stimuli functionally equivalent, and to initiate and guide equivalent (meaningfully consistent) forms of adaptive and expressive behaviour."

Hjelle and Ziegler (1992, p.242) say that in simpler terms this definition means that:

> "...a trait is a predisposition to act in the same way in a wide range of situations."

Basically this means that there is stability in the way a person will behave over time and in different situations. If a person, for example, is shy, he/she will usually be withdrawn in a variety of situations, e.g. sitting in class or shopping with friends, for instance. In contrast with this, if a person is more of a socialiser, he/she will usually be talkative and outgoing in the same situations as mentioned above (Hjelle & Ziegler, 1992). From this example we can see that people with different traits will act differently in the same situation. Hergenhahn (1984) explains that the same stimulus may result in different reactions among people, because different traits are involved. Thus, trait influences the way a person will handle different situations (see Figure 3.2).

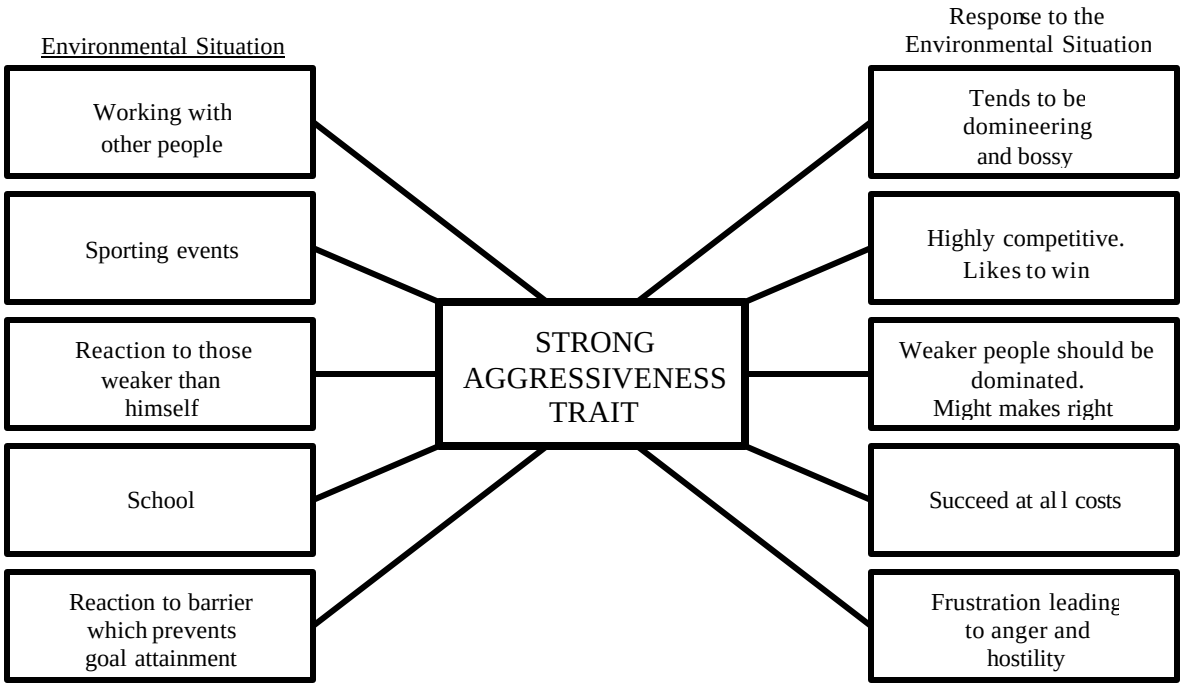

FIGURE 3.2 How one might react to various situations if one had a strong aggressiveness trait (Hergenhahn, 1984, p.130)

According to Meyer et al. (1997), Allport distinguished between two types of traits, namely individual traits and common traits. These two types of traits are exactly what their names imply. Individual traits are those which are possessed by an individual. Each trait is therefore unique. On the other hand, common traits are those which are shared by a number of people. They therefore indicate the attributes which we use to compare people with each other. This distinction between individual and common traits is very important to Allport, because, according to him, psychological tests only focus on common traits. The trait "charitableness" can be used to enlighten the difference between individual and common traits. Although different individuals can be described as charitable (common trait), each individual has a unique way of expressing this charitableness (individual trait).

Later in the evolution of Allport's theory, he renamed the term "individual trait" as "personal disposition", but retained the term "common traits". He did this to remove the confusion between the two original terms (Hergenhahn, 1984; Hjelle & Ziegler, 1992).

According to Hergenhahn (1984), Allport was dedicated to the study of personal dispositions. In his studies he found that not all dispositions had the same impact on personality. Therefore, he made a distinction between cardinal, central and secondary dispositions (Pervin, 1993, 2001). A

cardinal disposition is one that is very pervasive and almost every act in a person's life can be traced to its influence, e.g. Napoleon's pursuit of power. Central dispositions are those that tend to be highly characteristic of a person, e.g. honesty, kindness and assertiveness. Most people usually have five to seven central dispositions which are easily identifiable, because they are so conspicuous. Secondary dispositions are less conspicuous and do not have such a great influence on a person's life. Examples of these are preferences for particular kinds of food and clothing and specific attitudes (Liebert & Spiegler, 1990; Meyer et al., 1997; Pervin, 1993, 2001).

Apart from Allport there were also other trait theorists like Cattell and Eysenck. They used factor analysis to reduce the number of behaviours, dispositions and traits into a smaller number of core traits. They believed that these were the basic structure of personality (Abramson, 1980; Hergenhahn, 1984).

Like Allport, Cattell divided the concept of trait into categories, namely surface traits, source traits, environmental traits, constitutional traits, ability traits, temperament traits and dynamic traits (Abramson, 1980; Hergenhahn, 1984; Hjelle & Ziegler, 1992; Pervin, 1993, 2001; Phares, 1984). Surface traits are those which are readily observable to everyone, whereas source traits are not observable from the outside. The latter traits are the basic, underlying structures which can be viewed as the building blocks of personality. The following two traits, namely environmental and constitutional traits, are subdivisions of source traits. Cattell argued that environmental traits existed in a person, because of the influence of the environment on people, whereas constitutional traits are inherited. Ability traits are those which influence and determine our special skills, how effective we are in achieving our goals and how competent we are. Temperament traits are those which determine a person's emotional adjustment. Lastly, those traits which motivate an individual are called dynamic traits.

Abramson (1980) states that Cattell believed that the source traits were the basis of personality and therefore most of his work revolved around the factor-analytic studies of the core source traits. His factor analytic studies led to the identification of sixteen core personality traits. Cattell used this to develop the Sixteen Personality Factor (16 P.F.) Questionnaire (Pervin, 1993, 2001).

Abramson (1980) concludes that a very important consequence of Cattell's work is that he is the person who stimulated the interest in mathematical approaches to personality.

3.7 THE FIVE-FACTOR MODEL OF PERSONALITY

In the previous section the trait theory of personality was discussed. It was indicated that the theorists agreed that traits are the fundamental building blocks of personality. However, Pervin and John (2001) state that their views regarding factor analysis and the number of basic trait dimensions to be used in the description of personality, were different. Goldberg (1990) asserts that although the variety of individual differences is boundless, humans identified differences which are more important to them than others. According to Liebert and Spiegler (1990), factor analysis was used to develop five-factor models of personality which were designed to capture the major dimensions in personality. Some of these five-factor models were based on Cattell's variable set, while other sets of variables were not derived directly from Cattell's list (Pervin, 1990).

As different researchers include different variables in their models, a variety of five-factor models came to light and this created confusion. In spite of the variation in factor names chosen by different researchers, it does not necessarily mean that the factors are different. These differences occur because researchers focus on different parts of a factor's total range of meaning (Pervin, 1990).

In relation to this study, the NEO Five-Factor Inventory will be used to evaluate the personalities of the participants in this study. This inventory is based on the five factors identified by Costa and McCrae (1992), namely Neuroticism (N), Extraversion (E), Openness (O), Agreeableness (A) and Conscientiousness (C) (see Table 3.1).

The discussion on the NEO Five-Factor Inventory is presented in Section 6.3.2.4. In Chapter 7, the results are presented on the question of whether the factors of personality, as indicated in the previous paragraph, have an influence on computer proficiency.

TABLE 3.1 The Big Five Trait Factors and illustrative scales (Costa & Mcrae, 1992 in Pervin & John, 2001)

Characteristics of the High Scorer	Trait Scales	Characteristics of the Low Scorer
	NEUROTICISM (N)	
Worrying, nervous, emotional, insecure, inadequate, hypochodriacal	Assesses adjustment vs. emotional instability. Identifies individuals prone to psychological distress, unrealistic ideas, excessive cravings or urges and maladaptive coping responses.	Calm, relaxed, unemotional, hardy, secure, self-satisfied
	EXTRAVERSION (E)	
Sociable, active, talkative, person-oriented, optimistic, fun-loving, affectionate	Assesses quantity and intensity of interpersonal interaction; activity level; need for stimulation and capacity for joy.	Reserved, sober, unexuberant, aloof, task-oriented, retiring, quiet
	OPENNESS (O)	
Curious, broad interests, creative, original, imaginative, untraditional	Assesses proactive seeking and appreciation of experience for its own sake; toleration for and exploration of the unfamiliar.	Conventional, down-to-earth, narrow interests, unartistic, unanalytical
	AGREEABLENESS (A)	
Soft-hearted, good-natured, trusting, helpful, forgiving, gullible, straightforward	Assesses the quality of one's interpersonal orientation along a continuum from compassion to antagonism in thoughts, feelings and actions.	Cynical, rude, suspic ious, unco-operative, vengeful, ruthless, irritable, manipulative
	CONSCIENTIOUSNESS (C)	
Organised, reliable, hard-working, self-disciplined, punctual, scrupulous, neat, ambitious, persevering	Assesses the individual's degree of organisation, persistence and motivation in goal-directed behaviour. Contrasts dependable, fastidious people with those who are lackadaisical and sloppy.	Aimless, unreliable, lazy, careless, lax, negligent, weak-willed, hedonistic

3.8 THE RELATION BETWEEN PERSONALITY AND WORKING ENVIRONMENT

Coetzer and Schepers (1997) state that productivity and the degree in which people are satisfied with their jobs can be increased by ensuring that the job requirements agree with the personality profiles of people in that specific job situation. In this connection, Holland's research and theory about personalities and working environments are very important and prominent. He was a counselling psychologist who worked as a student and career counsellor from 1950 to 1956. During this time he realised the need for an approach that explained the relation between interest profiles and careers. He also became frustrated with the fact that the career classification system was so clumsy and comprehensive. With this background, he developed a new theory which will be discussed in the following section (Nel, 1993).

3.8.1 HOLLAND'S PERSONALITY TYPES

Contrary to the previously mentioned theories, Holland's theory is not a true personality theory, but rather provides parameters within which career behaviour and choice can be explained. This theory stipulates that personality and the working environment can be divided into broad classes. These personality and environment types are interactive and have an influence on one another (Nel, 1993).

Gevers, Du Toit and Harilall (1992) and Nel (1993, 1999) mention that the theory of Holland has the following supporting assumptions and principles:

- The choice of a specific occupation is the expression of an individual's personality.
- People's occupational interests can be interpreted as dimensions of their personality.
- Stereotypes and views about occupations have reliable and important psychological and sociological meaning, e.g. carpenters are practical people, sales personnel are very convincing and auditors are accurate and precise workers.
- People with the same occupations have the same personality attributes and corresponding histories of personality development.
- People in the same occupations have the same response to specific situations and problems.
- The degree of similarity between an individual's personality and working environment determines that person's occupational satisfaction, stability and achievements.

On the basis of these supporting assumptions Holland identified six personality types, namely realistic (R), investigative (I), artistic (A), social (S), enterprising (E) and conventional (C) (Nel, 1993, 1999). These personality types and suitable occupations for each, will now be discussed:

- *Realistic type*. These people are physical and practical and tend to avoid occupations that require social skills. Examples of occupations that these people would prefer are that of electrician, land-surveyor, plumber, farmer and mechanic (Blignaut, 1993; Gevers et al., 1992; Nel, 1993, 1999).
- *Investigative type*. These people are usually intellectually and academically orientated and like to observe and investigate physical, biological or cultural phenomena systematically. Examples of occupations that these people would prefer are that of geologist, mathematician, physicist, chemist and biologist (Blignaut, 1993; Gevers et al., 1992; Nel, 1993, 1999).
- *Artistic type*. These people prefer aesthetical activities, rather than conventional occupations. They are usually creative, expressive, emotional, independent and spontaneous. Examples of occupations that these people would prefer are that of artist, journalist, interior decorator, actor and musician (Blignaut, 1993; Gevers et al., 1992; Nel, 1993, 1999).
- *Social type*. These individuals usually have good verbal and interpersonal skills and are kind, generous, idealistic and cooperative. They prefer human orientated occupations, such as teacher, social worker, psychologist and nurse (Blignaut, 1993; Gevers et al., 1992; Nel, 1993, 1999).
- *Enterprising type*. These people are fast-paced, energetic, ambitious, adventurous, independent and attach value to economic and political achievements. Because enterprising people have good verbal skills, they prefer occupations in politics, sales, law and management (Blignaut, 1993; Gevers et al., 1992; Nel, 1993, 1999).
- *Conventional type*. These people prefer systematic and precise work with distinct procedures and like to work with numbers and to do clerical tasks. They prefer occupations where the work is structured, like bank tellers, clerks, accountants and secretaries (Blignaut, 1993; Gevers et al., 1992; Nel, 1993, 1999).

According to Holland's theory a child inherits some genetic attributes from his parents, but the personality types of the parents also influence the development of the child's interests. This is because the child is exposed to this environment and it has an influence on his/her likes and dislikes. As time goes by, the child starts to spend more time on certain interests and neglects

others. Thus, the child starts to differentiate between interests, preferred activities, skills and values and this leads to the development of a personality type. This means that every individual primarily belongs to one personality type, but he/she also has attributes from the other personality types. Holland decided, for practical reasons, that personalities would only be described with regard to the three most dominant types (Gevers et al., 1992; Holland, 1985). An example would be that an SIA-type person would be someone who primarily corresponded with the social type (S), then secondarily with the investigative type (I) and then with the artistic type (A) (Nel, 1993, 1999).

The reason for discussing Holland's personality types is that his theory just strengthens the presumption that personality has a predictive input on computer proficiency. Although there are questionnaires that determine Holland's personality types, they could not be used, because it would take too long to administer the test to students. Because of the fact that the students completed the questionnaires during the first half of their first practical period, a shorter questionnaire, based on the five-factor model of personality (see Section 3.7) was used.

3.8.2 HOLLAND'S ENVIRONMENT TYPES

Besides the six personality types, Holland also divided the working environment into six different types, namely realistic, investigative, artistic, social, enterprising and conventional environments. Usually, each environment's corresponding personality types would dominate that working environment (Holland, 1985). This means that the realistic personality type would usually dominate the realistic environment, the investigative personality type would dominate the investigative environment, and so on.

3.9 CHAPTER SUMMARY

This chapter clearly indicates that there are several views or schools of thought surrounding the concept of personality. However, it is a very interesting subject, because the concept of personality is one of the biggest non-physical factors that make people different from one another. This is not just because everyone does not have the same attributes, but also because the levels of each attribute differ from person to person.

The fact that there are so many different views on the subject makes it very difficult to define personality. However, the definition of personality is not the only point of disagreement among the different schools of thought; the precise nature of the composition, functioning and the development of personality are also contentious issues.

The psychoanalytical approach states that the structure of personality can be explained in terms of the id, the ego and the superego. The behaviourist and learning theory approach differs from psychoanalysis in that it is based on the assumption that behaviour is learned. The external environment, rather than internal mental events, is the main determinant of a person's behaviour. The core of the humanistic approach is that people are driven by their needs. These needs, which form a hierarchy, can never reach a state of complete and total satisfaction, because the moment a specific need is satisfied, another need surfaces and commands the person's attention. The trait theory approach attempts to classify people according to personality attributes called traits. These traits cause stability in the way a person will behave over time and in different situations. The five-factor model of personality is based on the trait theory approach. Researchers used factor analyses to identify five basic traits which capture the major dimensions in personality. Lastly, Holland's personality types were discussed. According to this theory, the six personality types and working environments are interactive and have an influence on one another.

Despite the disagreement between the different schools of thought, they do agree that personality refers to the tendency of people to react in a predictable manner in different situations (see Section 3.2). Holland's theory of personality also provides parameters within which career behaviour and choice can be explained. This means that a person's personality might influence how he/she will react when working on computers. Thus, personality was included in the current study as a possible predictor of computer proficiency and the results are presented in Chapter 7.

The next chapter discusses learning styles as another possible predictor of computer proficiency.

Chapter 4

Learning Styles

4.1 INTRODUCTION

In the preceding chapter personality and all the schools of thought surrounding this topic were discussed. In this chapter the focus will be on learning styles and the relevance thereof for students and lecturers.

Learning styles are the different ways that people learn new things, as well as the strategies that they may use in the process. As will become apparent in this chapter, learning styles differ from person to person. Because a novice computer user has to learn how to work on a computer, it is obvious that the method used to gain such knowledge (learning style), may have an influence on the user's computer proficiency. Knowledge about learning styles is not only important for the students, however, but also for the lecturers and training personnel, as they are the people that usually facilitate the learning of students. In this chapter the possibility that learning styles might influence and predict the computer proficiency of students is explored.

In Section 4.2 the concept of learning is defined, followed by the definition and a short discussion of learning styles in Section 4.3. In Section 4.4 Kolb's theory on learning styles is presented. Section 4.4.2 shows that there are four learning modes, which define how a person learns. In Section 4.4.3 it is indicated that these learning modes are grouped together in pairs, called learning styles. Finally, in Section 4.5 the significance of learning styles, for both lecturers and students, is explained.

4.2 DEFINING LEARNING

Before learning styles can be defined, it is important first to focus on learning in general. What does the concept of "learning" actually mean? Does the word "learning" only refer to the action of sitting behind books and trying to memorise facts or is there more to it?

Shuell (1986) defines learning as an enduring change in behaviour or in the capacity to behave in a given fashion, which results from practice or other forms of experience. According to this definition, the term learning means that people should develop new actions or modify existing ones. This in turn means that a person should develop the capability to do new things that are different from what they could do earlier (Plug et al., 1997; Schunk, 1996). Another criterion that is inherent to this definition is that the change in behaviour should endure over time. This means that temporary changes such as slurred speech, brought about by factors such as alcohol or drugs, do not constitute learning, because they are only temporary. On the other hand, it is important to remember that a change in behaviour does not have to last for a long time to be classified as learned, because people forget the things they have learned (Schunk, 1996). The third criterion for learning is that it occurs through practice or other forms of experience, e.g. observing others. However, this criterion excludes behavioural changes that are caused by the genetic constitution of the organism, such as changes in maturing children like crawling and standing (Plug et al., 1997; Schunk, 1996).

The previous paragraph stipulates the meaning and criteria for the concept of learning. By examining these criteria closely, it is evident that the process that students at the Department of Computer Science and Informatics undergo, can be described as "learning". Firstly, the students learn new computer programs and skills. Thus, they develop the capability to do things in a different manner than they were used to before, e.g. instead of writing a letter they would use a word processing programme to type the letter. Secondly, these newly acquired skills or behavioural changes will endure over time, because students will use these computer skills in their everyday tasks in the future: they may complete assignments on the computer or apply their computer skills in their future careers. Thirdly, these computer skills are acquired through practice and also studying the theory behind programmes, e.g. by attending practical and theoretical classes or studying for tests and exams.

Now that the concept of "learning" is defined, the focus will be on the meaning of "learning style" and what it consists of.

4.3 DEFINING LEARNING STYLES

There are a variety of definitions that can be found in the literature to describe the term "learning styles". Entwistle (1981) defines a learning style as a general tendency to adopt a particular strategy towards learning content. Carrier, Dalgaard and Williams (1988) describe the learning style of a student as the individual's characteristic mode of gaining, processing and storing information during the educational experience. Another, more comprehensive, definition is the following:

> "Learning styles are cognitive, affective, and physiological traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment." (Keefe, 1986, p.44)

These definitions are self-explanatory, but it is important to stress that each student has his/her own individual learning style in which he/she gathers, analyses, interprets and memorises information presented in lectures, practical sessions or books. According to Conti and Welborn (1986) it also influences such things as the setting in which people wish to learn, the kinds of things they want to learn about and how they will approach learning situations. Lemmer and Squelch (1993) suggest that students learn best in classroom environments that are compatible with their own learning styles.

It is important to remember that the potential value of understanding learners' learning styles and preferences, for the improvement of learning, has been increasing over the years (Burden, 1996; Dunn, 1990; Heikkinen, Pettigrew & Zakrajsek, 1985; O'Brien, 1989; Wilson, 1988). Thus, it is imperative for teachers and lecturers to familiarise themselves with the variety of learning styles displayed by their students and to develop teaching and instructional strategies to accommodate this diversity.

Several researchers indicate that knowledge of learning styles can be of great benefit to the learner as well as to the teacher. Since students and learners are the people primarily concerned, the first step is to help them discover their particular style of learning and to help them to recognise their strengths and limitations (Brandt, 1990; Scheirer, 1990; Smith & Holliday, 1987; Sternberg, 1990). According to Lemmer and Squelch (1993), if teachers and lecturers ignore the learning styles of students, some students will not succeed as well as others. However, when teachers

accommodate different learning styles and preferences, academic achievement, attitudes and behaviour are enhanced.

Shade (1989) suggests that the most effective use of learning styles lies in more effective individualisation of instruction. Teachers must work toward developing the methodology that taps and utilises the perceptual strengths of students and must critically examine the focus of some of their basic programmes.

Knowledge about learning styles is not just important for students, but also for lecturers, training personnel and student assistants at training and tertiary institutions. The students in the computer courses should be in touch with their personal learning styles and preferences. This will enable them to know what their strong and weak points are. Such knowledge is necessary, because certain learning styles are better suited to the theoretical sessions while other styles are better suited to the practical sessions. By understanding these differences, a student can improve his/her personal learning style in the category in which he/she falls short, and as a result, improve computer proficiency. Knowledge about learning styles is just as important for the training personnel. Lecturers can use this knowledge to improve their instruction methods and also to understand why some students do not progress as quickly as other students.

4.4 KOLB'S THEORY

Since Kolb's Learning Style Inventory was used in this study to assess the learning styles of first-year students at the University of the Free State, this section will focus on Kolb's learning style theory. This theory is primarily based on the experiential learning theory (Kolb, 1984).

4.4.1 THE EXPERIENTIAL LEARNING THEORY

According to Kolb (1984), this theory places emphasis on the central role that experience plays in the learning process. This is what differentiates experiential learning theory from other theories such as the rationalist and other cognitive theories of learning as well as from the behavioural learning theories. Rationalist and cognitive theories of learning tend to give primary emphasis to acquisition, manipulation and recall of abstract symbols. On the other hand, behavioural learning theories deny any role for consciousness and subjective experience in the learning process.

Kolb (1984) states that his experiential learning model is based on the works of Dewey, Lewin and Piaget. In his view, there is a great deal of similarity among the models of these three people. Kolb used these three models to define the characteristics of experiential learning, namely:

- *Learning is best conceived as a process; not in terms of outcomes.* This means that ideas are formed and re-formed through experience and are not fixed and immutable elements of thought. Thus, the process, from which concepts are derived and continuously modified by experience, describes learning. This means that since experience always intervenes, no two thoughts are ever the same.
- *Learning is a continuous process grounded in experience.* This means that if people enter a learning situation, they have more or less articulated ideas about the topic at hand. These ideas were formed through previous learning experiences and although they may be crude and incorrect, the people may use these new experiences to learn new ideas. This implies that all learning is actually relearning.
- *The process of learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world.* This means that learning is by its very nature a tension and conflict filled process. Learning requires abilities (namely concrete experience abilities, reflective observation abilities, abstract conceptualisation abilities and active experimentation abilities, which are discussed in Section 4.4.2) that are polar opposites. Thus, the learner must continually choose which set of learning abilities he or she will bring to bear in any specific learning situation.
- *Learning is a holistic process of adaptation to the world.* This means that the concept of learning is much broader than is commonly associated with a classroom. Basically, learning can be seen as the major process of human adaptation to any situation or environment.
- *Learning involves transactions between the person and the environment.* In short this means that situations in the environment have an influence on what people learn. On the other hand, knowledge gained through learning determines individuals' actions and reactions and therefore influences situations in the environment.
- *Learning is the process of creating knowledge.* Knowledge is the result of the transaction between social knowledge (objective accumulation of previous human cultural experience) and personal knowledge (accumulation of subjective personal life experiences) in a process called learning.

According to Kolb (1984) the characteristics of the experiential learning process can be summarised by the following working definition of learning:

> "Learning is the process whereby knowledge is created through the transformation of experience." (Kolb, 1984, p.38)

Stewart (1990) indicates that Kolb's Experiential Learning Model offers clues for developing specific learning abilities through the design of interventions that tap into individual style preferences and abilities.

The definition presented above, suggests that students enrolled for computer courses gain their knowledge through the experience they have with computers. Therefore, the more positive these experiences are, the better a student will learn. In turn, the better a student learns, the faster he/she becomes computer proficient and the more computer proficient he/she becomes. The definition also means that students will learn better if they experience computer technology in more than one way. This aspect already receives attention at the University of the Free State, because the students attend theoretical classes led by a qualified lecturer. The information is also presented in books and they attend practical sessions where they practise computer concepts and learn new programmes. It is evident that the same information is experienced in more than one way and therefore it enhances the learning process of students.

4.4.2 THE FOUR BASIC LEARNING MODES

In the previous section experiential learning theory was described. This section will focus on the four adaptive learning modes which define how people learn. These learning modes are relevant to the current study, because Kolb's Learning Style Inventory (Kolb, Rubin & McIntyre, 1979) are based on it (see Section 6.3.2.5). The results obtained from the inventory will be used to determine whether learning modes, which are the underlying building blocks of learning styles (see Section 4.4.3), have a predictive input on computer proficiency (see Chapter 7).

According to Kolb (1984) the four learning modes are concrete experience (CE), reflective observation (RO), abstract conceptualisation (AC) and active experimentation (AE).

TABLE 4.1 The four basic learning modes (Kolb, 1984)

Concrete Experience	Reflective Observation	Abstract Conceptualisation	Active Experimentation
Focuses on: - Being involved in experiences. - Dealing with immediate human situations in a personal way.	**Focuses on:** - Understanding the meaning of ideas and situations by carefully observing and impartially describing them.	**Focuses on using:** - Logic. - Ideas. - Concepts.	**Focuses on:** - Actively influencing people. - Changing situations.
Emphasises: - Feeling as opposed to thinking. - A concern with the uniqueness and complexity of present reality as opposed to theories and generalisations. - An intuitive, "artistic" approach as opposed to the systematic, scientific approach to problems.	**Emphasises:** - Understanding as opposed to practical application. - A concern with what is true or how things happen as opposed to what will work. - Reflection as opposed to action.	**Emphasises:** - Thinking as opposed to feeling. - A concern with building general theories as opposed to intuitively understanding unique, specific areas. - A scientific as opposed to an artistic approach to problems.	**Emphasises:** - Practical applications as opposed to reflective understanding. - A pragmatic concern with what works as opposed to what is absolute truth. - Doing as opposed to observing.
Values: - To relate to people. - To be involved in real situations. - An open-minded approach to life.	**Values:** - Patience. - Impartiality. - Considered and thoughtful judgement.	**Values:** - Precision. - The rigor and discipline of analysing ideas. - The aesthetic quality of a neat conceptual system.	**Values:** - To have an influence on the environment around them. - To see results.
In general these people: - Enjoy and are good at relating to others. - Are good intuitive decision-makers. - Function well in unstructured situations.	**In general these people:** - Enjoy intuiting the meaning of situations and ideas. - Are good at seeing the implications of situations and ideas. - Are good at looking at things from different perspectives. - Are good at appreciating different points of view. - Like to rely on their own thoughts and feelings to form opinions.	**In general these people enjoy and is good at:** - Systematic planning. - Manipulation of abstract symbols. - Quantitative analysis.	**In general these people:** - Enjoy and are good at getting things accomplished. - Are willing to take some risk in order to achieve their objectives.

Table 4.1 describes the four basic learning modes as presented by Kolb (1984). The first mode, concrete experience, involves learning through taking hold of tangible experiences with events. Reflective observation involves learning by the transformation of experience through the intellectualisation of information, while abstract conceptualisation involves learning through the grasping of experience by reliance on symbolic representation of events. Lastly, active

experimentation involves learning by the transformation of experience through the behavioural extension of information (Marshall, 1987).

In addition to the four basic learning modes, the extent to which an individual's way of learning is more abstract than concrete can be determined by subtracting the CE score from the AC score. A high positive score thus shows a preference to abstract learning, while a high negative score relates to concrete learning. Similarly, a high positive score derived from AE minus RO shows a learning preference towards action as opposed to reflection, while a high negative score relates to the opposite (Kolb, 1984).

4.4.3 THE BASIC LEARNING STYLES

Kolb (1984) states that for analytical purposes the abstract-concrete (AC-CE) and active-reflective (AE-RO) dimensions are negatively related. Therefore it is possible to create a two-dimensional map of learning space that can be used to characterise differences empirically in the elementary forms of knowing. Depending on how individuals respond to each learning mode (CE, RO, AC, AE) they can be classified as Convergers, Divergers, Assimilators and Accommodators (see Figure 4.1).

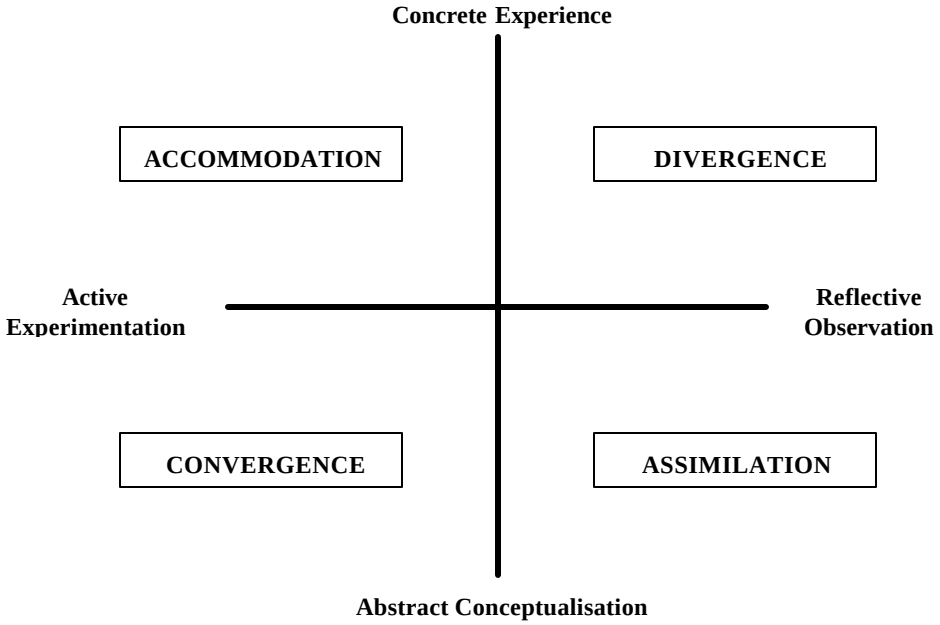

FIGURE 4.1 Kolb's two-dimensional representation of learning styles (Adapted from Kolb, 1984, p.42)

In Sections 4.3 and 4.5 the importance of the four learning styles for students as well as lecturers, are presented. The strengths, attributes and areas of expertise of these four learning styles are discussed in Sections 4.4.3.1 to 4.4.3.4.

4.4.3.1 CONVERGENT LEARNING STYLE

People with this learning style are classified as convergers and primarily rely on the basic learning modes of abstract conceptualisation and active experimentation. Their greatest strengths are problem solving, decision making and the practical application of ideas. They tend to be rather unemotional and prefer to deal with technical tasks and problems rather than people and social circumstances. These people are highly organised and they tend to make use of hypothetical-deductive reasoning. People with this learning style seem to do best in situations like conventional intelligence tests, where there is only one solution to a problem. These people tend to specialise in physics and engineering (Kolb, 1984).

4.4.3.2 DIVERGENT LEARNING STYLE

People with this learning style are classified as divergers and primarily rely on the basic learning modes of concrete experience and reflective observation. The greatest strengths that these people possess are their imaginative ability and awareness of meaning and values. They tend to be people-orientated and emotional. These people usually view concrete situations from many perspectives and they are good at organising many relationships into a meaningful whole. People with this learning style seem to do best in situations that call for the generation of alternative ideas, e.g. brainstorming sessions. These people tend to specialise in the humanities and the liberal arts and enter fields such as counselling, personnel management and organisational development (Kolb, 1984).

4.4.3.3 ASSIMILATION LEARNING STYLE

People with this learning style are classified as assimilators and primarily rely on the basic learning modes of abstract conceptualisation and reflective observation. Their greatest strengths are inductive reasoning and the ability to create theoretical models. They tend to be interested by ideas and abstract concepts, but are less interested in people. People with this learning style focus on the

soundness of ideas or theories and not so much on the practical application thereof. These people tend to specialise in science, maths and often work in research planning (Kolb, 1984).

4.4.3.4 ACCOMMODATIVE LEARNING STYLE

People with this learning style are classified as accommodators and primarily rely on the basic learning modes of concrete experience and active experimentation. Their greatest strengths lie in doing things, carrying out plans and tasks and getting involved in new experiences. They are at ease with people, but are often impatient or even “pushy”. These people tend to seek out opportunities and to take risks. People with this learning style tend to use their intuitive feeling to solve problems and very often make use of a trial and error method. These people do well in institutions where they must adapt to meet new circumstances and tend to specialise in action-oriented jobs such as sales and marketing (Kolb, 1984).

4.5 SIGNIFICANCE OF LEARNING STYLES

The preceding sections described the concepts of learning, the experiential learning theory and learning styles. Now the following questions may arise: "Why do we have to know and study these concepts?" or "Is it relevant to understand these concepts?" or "Who benefits from the knowledge gained by researching learning styles?". These questions will be answered by the six statements that follow.

4.5.1 KNOWLEDGE OF LEARNING STYLES BRINGS AWARENESS TO LEARNERS

Dixon (1985) states that learners may or may not be consciously aware of the learning process they are using. If they are not aware of their learning style, their preference can become the only way they learn. This is not because of the inability to learn through other ways, but because the individual is not aware that other possibilities exist.

This means that if students are not aware of their personal learning style or that other learning styles exist, they may not reach their full potential. This may be especially true if students are studying for computer related courses, because of the fact that these courses often consist of a practical and a

theoretical part. It may be necessary to utilise more than one learning style to master both of these components.

The moment that individuals become knowledgeable about themselves as learners they are capable of making informed decisions about the methodology and resources that can best meet their learning needs (Dixon, 1985). Furthermore, if learners and students gain knowledge about their learning style it may assist them in recognising why some past learning activities were more worthwhile than others and what learning activities were less meaningful to them (James & Galbraith, 1985).

4.5.2 IT IS IMPORTANT FOR LECTURERS TO BE KNOWLEDGEABLE ABOUT LEARNING STYLES

It is imperative that lecturers have sound knowledge about learning styles. According to James and Galbraith (1985), the learning process can be facilitated by placing individuals in particular learning activities that address their respective dominant styles. Furthermore, learning style information can provide lecturers with the basis for the selection of diversified materials and methods, procedures for grouping and ways to individualise instruction during the instructional process.

This means that lecturers of computer literacy courses should try to accommodate the learning styles of the students attending their classes. Some of these issues are already being dealt with in classes, e.g. students receive information in a theoretical way (books and transparencies), an auditory way (lecturers explain the theory) and a visual and practical way (overhead projectors project the image of the lecturer's computer screen onto a board in the front of the class).

4.5.3 THE CONCEPT OF LEARNING STYLES HAS AN IMPACT ON THE METHODOLOGY FOR FACILITATING LEARNING

According to James and Galbraith (1985) the concept of learning styles provides flexibility for facilitators, enabling them to serve as a resource that enables students to identify and to utilise their own unique ways of learning.

This means that lecturers should have a sound knowledge of learning styles to ensure that they are able to transfer information to the students by using a technique that encompasses a variety of learning styles. By doing this, the lecturer facilitates the students in identifying specific learning techniques that they can use at home when studying specific material. Thus, each student develops his/her own unique learning style that is a unique combination of specific components from the main learning styles. Therefore, if computer students observe how lecturers present information, they may derive new techniques for studying computer related material, e.g. they may use a more assimilation orientated learning style technique for theoretical material, and a more accommodative orientated learning style technique for their practical classes or their practical assignments.

4.5.4 INDIVIDUAL LEARNERS CAN UTILISE KNOWLEDGE OF LEARNING STYLES TO THEIR BEST ADVANTAGE

It is very important that not only lecturers, but also students and learners have a wide knowledge about learning styles. This will help students to better understand themselves and to improve their learning skills. James and Galbraith (1985) state that learners can increase their skills in utilising appropriate methodologies for self-directed learning efforts by concentrating on the dominant learning styles. Individual learners will be better equipped to pursue their personal learning projects in a more effective and efficient manner if their knowledge of learning style information is sufficient.

By developing better study techniques students will be able to master other skills that would have otherwise been impossible to acquire with their previous leaming styles. An example would be that those students that previously only focused on theoretical subjects and courses, can now also acquire skills from courses that are more practically orientated (computer programming) and vice-versa. By doing so, they are broadening their skills and knowledge and are better trained when applying for jobs in the future.

4.5.5 THE LEARNING STYLE INSTRUMENTS CAN BE USED AS TOOLS FOR ASSESSING THE INDIVIDUALITY OF LEARNERS

According to Dixon (1985), learning style instruments are best used as tools to create awareness that learners differ and as a starting-point for each individual's continued investigation of the self as

a learner. This means that learning style instruments, such as questionnaires, should be used to determine the unique learning styles of students. These results may help to better identify the needs of students. According to Kissick and Grob (1988), education that is based on learning styles can help teachers design programmes to fit learners instead of fitting learners into uniform programmes.

Stewart (1990) states that by analysing the results of, for example, the learning style inventory of Kolb, a co-ordinator can personalise particular interventions to facilitate an individual student's development and learning experience. It is important that the co-ordinator understand that students differ, depending upon learning style preferences. This means that what may be challenging for one student may prove to be less challenging for another.

In practice this means that students should complete learning style questionnaires to determine their individual learning style preferences. This will assist lecturers in identifying students that may need assistance in specific study areas, because the nature of that material (abstract, theoretical, practical, etc.) does not comply with the learning style of some students. Lecturers can also try to adjust their teaching techniques to conform to the learning styles of the majority of the students in their classes, so that if the majority of students in a classroom utilise the accommodative learning style technique, the lecturer may adjust his/her classes to be more practically orientated.

4.5.6 KNOWLEDGE OF LEARNING STYLES MAY IMPROVE THE QUALITY OF INSTRUCTION

James and Galbraith (1985) argue that learning styles provide a means for making the quality of the instruction-learning process more effective and efficient. They also potentially enable instructors to reach each and every learner or student. Dixon (1985) says that learning style information can be seen as a promising way to improve teaching effectiveness.

This means that if lecturers understand learning styles better, they will have a better understanding of how students learn. In turn, this will help them to develop better teaching techniques and as a result help more students to achieve their goals.

4.6 CHAPTER SUMMARY

In this chapter learning styles were explained, commencing with an exposition of the concept of learning. According to the definition of learning, it means that people should develop new actions or modify existing ones. This means that a person should develop the capability to do new things that are different from what they could do earlier. Other criteria for learning are that learning should endure over time and that it should occur through practice or other forms of experience.

Learning style on the other hand can be seen as the general tendency to adopt a particular strategy towards learning content. It can also be seen as the manner in which a person gains, processes and stores information. Apart from this, learning styles also influence the environment in which people want to learn, the kinds of things they want to learn about and how they will approach learning situations. It is therefore proposed that people learn best in environments that are compatible with their own learning styles.

Kolb's learning style theory places emphasis on the central role that experience plays in the learning process. The four adaptive learning modes which define how people learn are concrete experience (CE), reflective observation (RO), abstract conceptualisation (AC) and active experimentation (AE). These learning modes were used to create a two-dimensional map of learning space that can be used to classify individuals as Convergers (AC-AE), Divergers (CE-RO), Assimilators (AC-RO) or Accommodators (CE-AE).

Several researchers indicate that a knowledge of learning styles can be of great benefit to the learner as well as to the teacher. Knowledge of learning styles brings awareness to learners and helps them to increase learning. It is also important for lecturers to be knowledgeable about learning styles, because this has an impact on the methodology for facilitating learning and can help lecturers to improve the quality of instruction.

In the current study, the different learning modes, as determined by Kolb's Learning Style Inventory (LSI), were included as possible predictors of computer proficiency. While the discussion on the LSI takes place in Section 6.3.2.5, the results of the statistical procedures are provided in Chapter 7.

In the next chapter the concept of culture and how it relates to the current study is discussed.

Chapter 5

Culture

5.1 INTRODUCTION

In the previous chapter learning styles as a possible predictor of computer proficiency were discussed. In this chapter the focus will be on culture and how it might influence the prediction models for computer proficiency.

Culture and cultural differences are important aspects that affect everyday life in many ways. Businesses, churches, politicians, individuals, managers and workers have to deal with culture, cultural differences and cultural clashes every day.

However, how many people really know the meaning and attributes of culture? Is it only skin colour or language that divides people into different cultural groups? The definitions in Section 5.2 indicate that the word culture means much more than just grouping people together according to their language or skin colour.

Culture also manifests itself strongly in the computer world. This is especially true for a country like South Africa with its wide spectrum of cultures. The background and way of life of each different culture group provide unique requirements for computer programs and interfaces, especially now that more people have access to computers (see Section 1.1). In the same way culture may have an influence on the specific predictors of computer proficiency. This increases the importance of culture for the current research topic, because specific predictors of computer proficiency for students from different cultures, enrolled for an introductory computer course at the University of the Free State, will be investigated.

Thus, in this chapter the focus will be on the meaning and constructs of culture (see Section 5.2). Furthermore, the characteristics of culture will be depicted in Section 5.3. Culture also has an effect on communication, and this will receive attention in Section 5.4.

5.2 THE MEANING OF CULTURE

The Reader's Digest Oxford Complete Wordfinder defines culture as, amongst other things "…the arts and other manifestations of human intellectual achievement regarded collectively…" and as "…the customs, civilization and achievements of a particular time or people…" (Tulloch, 1993, p.348). Haviland (1999) defines culture as the ideals, values and beliefs that members of a society share to interpret experience and generate behaviour and that are reflected by their behaviour. Haviland's definition of culture is based on a specific society. According to him the word "society" means people who have a common homeland and are independent. From this we can infer that a specific culture is based on geographic location, in other words, displayed by people living in a specific region or state. Such people think differently and do things differently from other people in other regions or states. They are therefore unique in their way of life.

This definition of culture may work in certain circumstances, but in a country like South Africa it does not make sense. The reason for this is that not all the people in South Africa (they share a common homeland and are independent) are perceived to be of the same culture. With regard to this, Hicks and Gwynne (1994) give a more satisfying definition of culture. They define culture as all the things people think, do, say and make, in other words, all the ideas, behaviours, languages and artefacts of a specific group of people. The following can be included under this definition:

- Institutions e.g. marriage
- Political ideas e.g. democracy
- Religious beliefs e.g. witchcraft
- Customs e.g. decorating Christmas trees
- Rituals e.g. saluting the flag
- Art styles
- Games
- Stories

The preceding definition differs from the definition presented by Haviland in that culture may also divide people living in a common homeland. According to this definition, people that share a specific idea, interest, way of life, etc. can also belong to a specific culture.

These aspects may influence the manner in which a specific culture experiences, relates to and thinks about computers. This means that some cultures may perceive computers as a threat, which, may cause them to experience more anxiety towards computers. In turn, an elevated anxiety level may impede their learning ability, which may lead to less computer proficiency than other cultures achieve for the same task at hand. Since this dissertation attempts to determine a battery of predictors for computer proficiency, culture may play an important role. For certain cultures different variables may serve as predictors of computer proficiency than for others. Therefore, the concept of culture will be taken into account by determining separate predicting models for the cultural groups in the current study (see Sections 7.3.1 and 7.3.2).

According to Hofstede (1997), there are two components of culture that he identifies as "culture one" and "culture two". Culture one is where culture is seen as a civilisation, with its distinguishable education, art and literature. This is basically the same idea as presented in the two definitions stated above. Hofstede however adds another dimension namely "culture two". Culture two can be described as the collective programming of the mind which distinguishes the members of one group or category of people from another. In the last instance a group refers to a number of people that are in contact with each other while category refers to people that have something in common, without necessarily having contact. This means that culture describes more than just people of a specific race or geographic location. It can also describe people sharing the same work e.g. women managers, computer programmers or people born before 1940. There are things that these people have in common and that differentiate them from other people. Therefore this view of culture transcends the traditional definition.

If one looks at this explanation of culture, it implies that students attending a computer class at the University of the Free State may be regarded as a specific culture on their own. In this sense it would mean that although there are Black, White and Asian people in the group, they would think or act alike, because they belong to the same culture, namely "computer students".

Rosman and Rubel (1981) also state that culture is more than just the behaviour of a society. They say that it is a set of rules that guides people's behaviour e.g. what a person eats, when a person eats and how a person eats. Most western cultures eat with a knife and fork, while the Chinese and Japanese eat with sticks. These rules can sometimes be defined, but in other cases are difficult to verbalise.

Hofstede (1997) emphasises that it is very important to distinguish between culture, human nature and personality. It is important to note that culture is learned and not inherited. Therefore it is not derived from a person's genes, but from a person's social environment. From this we can derive that if a family from a specific culture adopts a baby from another culture, that baby will adapt and learn the new culture e.g. a Chinese baby brought up by an American family will have an American culture. Singer (1987) agrees with this statement in stating that if a totally non-English-speaking family raises the son of an English-speaking family, since birth, the boy may never speak English. On the other hand, human nature is inherited with one's genes and is not learned. Hicks and Gwynne (1994) state that a person's nature cannot be changed. Hofstede (1997) says that the ability to feel fear, anger, love, joy, sadness, the need to socialise with other people and so on, are examples of human nature. It is very interesting to know that the way we handle these feelings, how we express joy, fear, etc., is modified by culture. This means that an American person will probably express love in a different way from a Japanese, Xhosa or Australian person. Personality differs from one person to another. It is unique to a specific person and is not shared with any other human being. A person's personality is partly inherited and partly influenced by culture as well as unique personal experiences. The concepts of human nature, culture and personality are illustrated in Figure 5.1 (Hofstede, 1997, p.6).

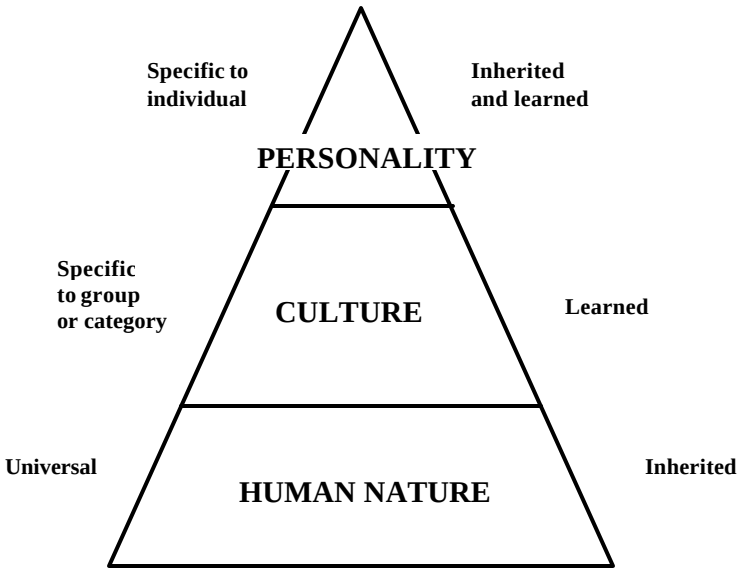

FIGURE 5.1 Schematic comparison of personality, culture and human nature

5.3 CHARACTERISTICS OF CULTURE

It is very difficult to describe the exact meaning of culture, but because it may influence the prediction of computer proficiency, the characteristics of culture will be included in this study.

The following characteristics of culture will help to develop a clearer mental picture of this comprehensive concept.

- Culture is learned. Culture is passed from generation to generation. This means that culture is not biologically inherited. People learn their culture by growing up with it and the process where culture is passed from one generation to the next generation is called enculturation (Haviland, 1999). Examples of this characteristic are mentioned in Section 5.2.

- Culture is based on symbols. Symbols play a very large part in culture. Things like a Christian cross, a Jewish star of David or any other object that stands for a whole philosophy or brings something to mind when a person sees or thinks about the object, can be regarded as a symbol. Language is the most important symbolic aspect of any culture, because it enables people to transmit culture from generation to generation (Haviland, 1999).

  This characteristic of culture is very important, because it means that language can be one of the criteria for dividing people into different cultures. With regard to the research at hand, the black students at the University of the Free State usually indicate that their home language is Sotho, Xhosa or one of the other African languages. The white students on the other hand speak Afrikaans or English.

- Culture is collective. The ideas, actions or things that an individual says, cannot be classified as culture, because culture belongs to a group. This means that culture consists of all the customs, languages, ideas and artefacts that are shared with and learned from other people. These aspects of culture are passed from generation to generation (Hicks & Gwynne, 1994). Haviland (1999) presents a very similar characteristic when saying that culture is shared.

- Culture is compulsory. If individuals want to blend in with and get along with their society, they must take their society's culture into account when dealing with others. If individuals do

not agree with or accept some of the aspects of a specific culture, they must still behave the way other people of that culture behave. If they fail to do so, the penalty could be stiff (Hicks & Gwynne, 1994).

- Culture is essential for social life. Culture helps people to solve problems. It is not only used when members of a group want to cooperate, but also enables them to do the following:

  - to establish families and form communities,
  - to communicate with one another,
  - to work cooperatively to make a living,
  - to maintain order in their lives,
  - to give meaning to life by believing in something,
  - to express themselves creatively, and
  - to raise new generations of people who continue to live and work together (Hicks & Gwynne, 1994).

- Culture is integrated. Culture is complex and is made up of many and a wide variety of aspects. However, it is important to understand that all of these aspects are interconnected and work as a whole. It can be compared to an engine where all the parts are different, but they work together to keep the car running (Haviland, 1999; Hicks & Gwynne, 1994).

- Culture is dynamic. Culture is not static, it is dynamic. Certain aspects of culture change over time. These changes influence other aspects of culture. Therefore, if one aspect of culture changes it may produce much broader cultural changes. Again the car engine can be used to exemplify this. If one part of an engine changes, perhaps because of wear and tear, the whole engine may operate differently (Hicks & Gwynne, 1994).

- Culture is unique to humans. Culture is part of the human species. Animals do not possess a culture although it can be argued that they form societies because they live in groups, e.g. troops of baboons (Hicks & Gwynne, 1994).

5.4 CULTURE AND COMMUNICATION

Intercultural communication is a very complex process. Therefore, as indicated earlier, cultural diversity is an important aspect when conducting research on a group of people. Nakakoji (1996) presents guidelines to overcome the cultural divide in the software development process. The two steps, namely internationalisation and localisation, can also be made applicable to the research at hand. Internationalisation refers to the avoidance of as many cultural specifics as possible. Localisation refers to the fact that different cultures use different languages, date formats, number formats and graphical representations.

The concepts of internationalisation and localisation are applicable to the current study. The operating systems and application software used at the computer departments of tertiary organisations are originally developed in the western first world countries. Therefore the user interface might not accommodate the needs of the different culture groups in South Africa. Therefore, aspects like metaphors, graphical representations and symbols do not necessarily convey the intended message or information to the African users. Difficulty in grasping the layout of the interface may thus be experienced by these groups, which might lead to slower progression and less computer proficiency. Therefore, if one considers the predictors of computer proficiency, it is necessary to deal with the values, tastes and history of the user's culture. The cultural factor was taken into account by determining separate prediction formulas for the white (see Section 7.3.1) and black (see Section 7.3.2) culture groups.

5.5 CULTURE AND TECHNOLOGICAL EXPERIENCE

If one considers the personal disposable income of the different races in South Africa, the average per capita income of white and black people, as measured in 2000, was R50 804 and R7 567 per annum, respectively (Koenderman, 2003). This means that black people in South Africa have much less money to spend and as a result have fewer resources to buy and own technology, e.g. computers, television sets, etc. This statement is supported by a statistical analysis that found that over a 4-week period only 1.3% of black people accessed the Internet in contrast to 20.7% of white people in South Africa (Koenderman, 2003).

It is thus clear that white and black students are likely to differ in their familiarity with computers, because of differences in their school, economic and socio-economic backgrounds. This, together with the cultural differences mentioned in Section 5.4, make it necessary to perform analyses separately for white and black students.

5.6 CHAPTER SUMMARY

In this chapter it was indicated that culture is a very comprehensive concept. Cultures are not just defined by people of a different skin colour or language. They can be seen as all the things people think, do, say and make. This means all the ideas, behaviours, languages and artefacts of a group of people may classify them as being a part of a specific cultural group.

On the other hand, culture can also be described as the collective programming of the mind which distinguishes the members of one group or category of people from another. This view of culture transcends the traditional definition. It means that culture describes more than just people of a specific race or geographic location. It can also describe people sharing the same work, e.g. teachers, accountants or people born between 1960 and 1970. There are things that these people have in common and that differentiate them from other people.

Another important aspect of culture is the fact that it is a set of rules that guides people's behaviour. These rules can sometimes be defined, but in other cases they may be difficult to verbalise.

It is thus important to understand that culture influences many aspects of our everyday lives. For this reason, culture may also influence the predictors of computer proficiency. This means that different sets of predictors may be optimal for different groups. By separating the predictor models for the different cultural groups, many more accurate predictors may be identified for the different groups.

In the same way as in the preceding paragraph, culture may also influence the outcome of the secondary study, e.g. computer anxiety may decrease as black users' computer experience increases. This conclusion may be the opposite for white computer users.

In the next chapter the methodology as well as the statistical procedures used for the research at hand, will be presented.

Chapter 6

Research Methods

6.1 INTRODUCTION

The first five chapters of this dissertation presented an extensive literature overview with regard to the predictor variables pertaining to the current research. In this chapter the focus will be on the investigative methodology, with specific reference to the following:

- Composition of the research group
- Measuring instruments
- Data collection process
- Statistical methods and procedures

As stated in Chapter 1, the primary goal of the current research is to determine the degree to which computer proficiency can be predicted on the grounds of several predictors, namely personality type, learning style, general anxiety, spatial 3D, numerical ability, computer attitude, grade 12 final examination mark and mathematical ability. Thus, according to Huysamen (1993), a non-experimental prospective design was used in the study.

In Sections 5.4 and 5.5 it was illustrated that the cultural diversity of the South African population should be taken into account in the statistical procedures of the research. Therefore, culture was taken into account as a moderator variable. Cultural groups can be distinguished by several denominators (see Section 5.2), such as race, language, work environment, etc. In this study, race will however be used as the basis for dividing the research participants into groups. The reason for this is that people from the same race may broadly be regarded as having the same background and ideas regarding computers and technology.

6.2 RESEARCH GROUP

The total research group consisted of 324 first-year students, enrolled for a basic computer literacy course at the University of the Free State. Of this group 17 students indicated that they were

coloured while only one indicated that he was Asian. Of the other 306 students, 155 indicated that they were white, while 151 indicated their population group as black. It was decided to use only the latter two groups, because the coloured and Asian groups were too small to use in the analysis. Table 6.1 indicates the distribution of the 306 students with regard to their gender and home language. The information is displayed for the total group, as well as for the white and black population groups, separately.

TABLE 6.1 Frequencies with regard to the biographical variables for the white and black, as well as the total group of students

Biographical variables	White		Black		Total	
	N	%	N	%	N	%
Gender:						
Male	71	45.8	51	33.8	122	39.9
Female	84	54.2	100	66.2	184	60.1
Home language:						
Afrikaans	139	89.7	0	0.0	139	45.4
English	16	10.3	10	6.6	26	8.5
Sotho or Tswana	0	0.0	141	93.4	141	46.1

The information in Table 6.1 shows that the two genders are fairly equally distributed for the white students, while the majority of the black students (66.2%) are female. The majority of white students (89.7%) have Afrikaans as their home language, while the majority of black students (93.4%) are Sotho or Tswana speaking. English was by far in the minority with only 10.3% of white and 6.6% of black students indicating it as their home language.

The average age for the total group as well as for the white and black students respectively, is presented in Table 6.2.

TABLE 6.2 Average ages for the white and black, as well as the total group of students

Group	Age	
	$\overline{X}$	s
Total group	21.18	4.06
White students	19.68	1.05
Black students	22.71	5.27

From Table 6.2 it is evident that the average age of the black students is considerably higher than that of the white students. The standard deviation of the white students is small as opposed to the relatively high standard deviation of the black students. This is an indication that the ages among the black students differ to a fairly large extent. For this group, the youngest student is 17 years old

while the oldest student is 43 years of age. For the white students, the ages vary from 18 to 24 years. Thus, it is evident that there are substantial differences, with regard to age, between the two population groups and this may have an influence on the results.

6.3 MEASURING INSTRUMENTS

In this section the measuring instruments for the different variables will be discussed. Firstly, the criterion variable (academic achievement) that signifies computer proficiency will be presented (see Section 6.3.1) after which the predictor variables and the instruments to measure them will be discussed (see Section 6.3.2). The contribution of all these predictor variables to the ability of a person to become computer proficient is determined in Chapter 7.

6.3.1 CRITERION VARIABLE – COMPUTER PROFICIENCY

The basic computer literacy course at the University of the Free State (BRS 111) is composed of a practical as well as a theoretical component which is set up to improve the computer skills and competence of students through training and practice. Because the primary goal of this course is to form and improve the computer proficiency of students, the final mark in BRS 111 was used to represent computer proficiency (criterion variable).

This mark has a minimum value of zero and a maximum of 100. The higher the score, the more computer proficient the student is.

The final semester mark is calculated in the following way:

Students have to hand in four compulsory practical assignments. The separate totals of the scores obtained for these assignments are added and processed to a mark out of 100. Apart from this, students also write three compulsory tests throughout the semester of which the third carries the most weight. By using a fixed formula (see below) to account for the weight differences between the scores, the final BRS 111 mark is calculated.

$$10\%(\text{Final practical mark}) + 20\%(\text{Test 1}) + 20\%(\text{Test 2}) + 50\%(\text{Test 3}) = \text{BRS111 final mark}$$

6.3.2 INSTRUMENTS FOR MEASURING THE PREDICTOR VARIABLES

Different predictor variables are included in the current study as possible predictors of computer proficiency. Some of these are sub-scales of questionnaires and inventories while others are single scores.

The relevant predictor variables that are sub-scales of questionnaires and inventories are presented in the next paragraph.

- Computer anxiety, computer liking and computer confidence, which are the sub-scales of the Computer Attitude Scale (CAS) (see Section 6.3.2.1). The literature reviews on these concepts are presented in Sections 2.2, 2.4 and 2.5.
- Q_3(-), C(-), L, O and Q_4, which are the sub-scales of the IPAT Anxiety Scale (see Section 6.3.2.2). A discussion on general anxiety can be found in Section 2.3.
- Spatial 3D and calculations, which are two sub-scales of the Senior Aptitude Test (see Section 6.3.2.3). A discussion on spatial 3D can be found in Section 2.6.
- Neuroticism (N), Extraversion (E), Openness (O), Agreeableness (A) and Conscientiousness (C), which are the five domains of the NEO Five-Factor Inventory (NEO-FFI) (see Section 6.3.2.4). The literature review on the Five-Factor model of personality is presented in Section 3.7.
- Concrete experience (CE), reflective observation (RO), abstract conceptualisation (AC) and active experimentation (AE), which are the four modes of the Learning Style Inventory (LSI) (see Section 6.3.2.5). A discussion on these learning modes can be found in Section 4.4.2.

The predictor variables that represent a total score and are not sub-scales, are the following:

- Grade 12 final examination mark (see Section 6.3.2.6)
- Mathematical ability (see Section 6.3.2.7)

The measuring instruments of the above-mentioned predictor variables will now be discussed in Sections 6.3.2.1 to 6.3.2.7. Examples of the CAS and the LSI are presented in Appendix A and B, respectively. Because copyright laws prohibit the publication of the IPAT Anxiety Scale, the Spatial 3D and Calculations sub-scales as well as the NEO-FFI, these tests are not included in the appendix.

6.3.2 1 COMPUTER ATTITUDE SCALE (CAS)

As computers play an expanding role in society and the necessity for an appropriate index for measuring computer-related attitudes arose, Gressard and Loyd (1986) developed the CAS (see Appendix A). According to Francis, Katz and Jones (2000), this instrument is steadily emerging as the most popular choice among researchers for measuring computer attitude. A discussion on computer attitude can be found in Section 2.2.

The CAS is a Likert-type instrument consisting of 30 items which present positively and negatively worded statements of attitudes toward computers and their use. This instrument was designed to assess each of three areas by means of 10-item sub-scales, namely computer anxiety, computer confidence and computer liking. These items are distributed alternately throughout the instrument.

According to Loyd and Gressard (1984a), the 30-item scale usually takes less than ten minutes to administer, but in this research it was found that participants took approximately 14 minutes to complete the scale. In response to the statements, examinees indicate which one of four ordered responses from "strongly agree" to "strongly disagree" most closely represents the extent to which they agree or disagree with the ideas expressed. Only one response can be marked per statement.

Depending on the response of an examinee, a value between one and four is allocated to an item. These item responses are coded so that a higher score reflects a *lower* degree of anxiety and a *higher* degree of confidence and liking. The values of the marked responses for each sub-scale are then summed to determine the three sub-scale scores. The three sub-scales are comprised of the following items:

Computer anxiety:	Items 1, 4, 7, 10, 13, 16, 19, 22, 25 and 28
Computer confidence:	Items 2, 5, 8, 11, 14, 17, 20, 23, 26 and 29
Computer liking:	Items 3, 6, 9, 12, 15, 18, 21, 24, 27 and 30

Each sub-scale score ranges from 10 to 40. The total score of an individual's computer attitude is calculated by summing the three sub-scale scores. This total ranges from 30 to 120. A higher score on any of the sub-scales or on the total scale thus indicates a more positive attitude toward learning about or using computers. The three sub-scale totals as well as the grand total for computer attitude

are raw scores and were used in the statistical computations during the secondary study. However, in the primary study the raw scores of only the three sub-scales were used.

According to Gressard and Loyd (1986), the coefficient alpha reliabilities are 0.89, 0.89, 0.89 and 0.95 for Computer anxiety, Computer confidence, Computer liking and the total score, respectively. The reliability coefficients of the three sub-scales suggest that these scores are sufficiently defined to be used as separate scores (Gressard and Loyd, 1986).

6.3.2.2 IPAT ANXIETY SCALE

As different manifestations of anxiety frequently arise in our world and environment, a measuring instrument such as the IPAT Anxiety Scale has become a necessity. This test is a relative short, clinically valid test that is more objectively scored than an individual interview and therefore ensures a greater amount of honesty and objectivity on the part of the examinees (Cattell et al., 1968). It was specifically chosen during this research as it is appropriate when time is limited, does not put the examinees under pressure and is suitable for determining the difference in anxiety levels after time has passed. The literature review on general anxiety is presented in Section 2.3.

According to Cattell et al. (1968), the IPAT Anxiety Scale is a 40-item scale that measures five different components of anxiety. These components are divided according to the contribution that each personality factor makes to the total anxiety level. The five sub-scales that form the different components of the anxiety scale are as follows:

- Q_3(-) Insufficient integration, lack of self-sentiment.
- C(-) Weak ego, low ego strength.
- L Suspiciousness or a paranoid feeling of insecurity.
- O Tendency toward guilt feelings.
- Q_4 Tension as a result of frustration or pressure from the id.

Table 6.3 presents the weight that each sub-scale contributes to the total anxiety scale. It also identifies which items make up each sub-scale.

TABLE 6.3 Items that represent each sub-scale (Cattell et al., 1968, p.3)

Sub-scales	Weight (Number of items)	Identification of items according to number on the test	
Q_3(-)	8	1, 2, 3, 4	21, 22, 23, 24
C(-)	6	5, 6, 7	25, 26, 27
L	4	8, 9	28, 29
O	12	10, 11, 12, 13, 14, 15	30, 31, 32, 33, 34, 35
Q_4	10	16, 17, 18, 19, 20	36, 37, 38, 39, 40
		A-SCORE Unconscious (Latent)	**B-SCORE Conscious (Symptomatic)**

From Table 6.3 it is evident that the first 20 items are an indication of the latent anxiety (A-score) of the examinees, while the last 20 items measure the more observable and conscious anxiety (B-score). In turn the total anxiety score can be determined by adding the above-mentioned A and B-scores (total of all 40 items).

For each item three possible answers are given and respondents have to choose the answer which suits them best. Possibilities such as “True, In between, False” or “Yes, In between, No” or “A, In between, B” or “Sometimes, Seldom, Never” exist.

Before the test is administered, the instructions are explained to the examinees. It is important that the test administrator does not tell the examinees that this test measures their level of anxiety. Two practice examples are also completed to ensure that they understand what to do and where to answer the questions.

This test can be administered individually or in a group and is suitable for children (older than 14 years) and adults. Although no time limit exists, respondents usually take between five and 10 minutes to complete this test. However, in this research respondents took approximately 15 minutes.

A scoring stencil is used to mark the IPAT Anxiety Scale. On the scoring stencil a value between zero and two is allocated to the three possible answers of a specific item. The values that correspond with the examinees’ marked responses are then summed to give three possible groups of scores:

- Each individual sub-scale – computed by adding the specific items that make up a sub-scale (see Table 6.3).
- The A and B-scores – computed by adding the first 20 and second 20 items, respectively.
- The total anxiety score – computed by adding the A and B-scores.

The following are possible minimum and maximum scores found on the IPAT Anxiety Scale:

	Minimum Score	**Maximum Score**
Q_3(-)	0	16
C(-)	0	12
L	0	8
O	0	24
Q_4	0	20
A-Score	0	40
B-Score	0	40
Total Score	0	80

For all the above-mentioned scales a higher score pertains to a higher level of anxiety. Raw scores were used in the current study.

Cattell et al. (1968) report two-week test-retest reliabilities of 0.83 and 0.86 for Afrikaans-speaking boys and girls and 0.87 and 0.88 for English-speaking boys and girls, respectively. They also state that the reliability of the test, investigated by means of internal consistency and homogeneity, is satisfactory. The split-half reliabilities, calculated by the Kuder-Richardson 20 formula as adapted by Ferguson (1951), are depicted in Table 6.4.

TABLE 6.4 Split-half reliabilities of the IPAT Anxiety Scale

Group	**Q_3(-)**	**C(-)**	**L**	**O**	**Q_4**
297 Afrikaans speaking boys	0.43	0.33	0.62	0.61	0.56
250 Afrikaans speaking girls	0.36	0.38	0.66	0.53	0.56
300 English speaking boys	0.41	0.34	0.70	0.58	0.62
400 English speaking girls	0.37	0.27	0.66	0.52	0.46

6.3.2.3 SENIOR APTITUDE TEST (SAT)

According to Fouché and Verwey (1978) aptitude can be regarded as the potential which a person has and which enables him/her to attain a specific level of ability with a given amount of training and/or practice.

The SAT was compiled for measuring a number of aptitudes of senior high school students and of adults. It is a widely used test that comprises of the following 12 sub-scales, namely Verbal Comprehension, Calculations, Disguised Words, Comparison, Pattern Completion, Figure Series, Spatial 2D, Spatial 3D, Memory (paragraph), Memory (symbols), Co-ordination and Writing Speed. These 12 tests can be combined into groups to obtain measurements of six wider fields of aptitude (Fouché & Verwey, 1978). As these fields have no bearing on the current research they will not be explained further.

For this specific research study the Calculations and Spatial 3D sub-tests formed part of the predictor variables. Therefore, only these sub-tests will be discussed.

6.3.2.3.1 CALCULATIONS

Although this sub-test requires that a person mentally solve simple mathematical calculations quickly and accurately, this ability does not necessarily correlate with advanced mathematical proficiency or with complicated mathematical reasoning (Fouché & Verwey, 1978).

The calculations sub-test is a 40-item speed test that must be completed within five minutes. This time limit should be strictly adhered to when the test is administered. Each item consists of a numerical calculation which should be computed mentally. For each item five possible answers are given and the examinee should choose the correct option.

Before the test is administered, four practice examples are done with the examinees to ensure that they understand what to do and where to answer the questions.

A scoring stencil is used to mark the calculations test and one mark is allocated to each correct answer. These values are summed and represent the final raw score for this sub-test. The score obtained can range from zero to 40, with a high score indicating good numerical ability and a low

score the opposite. According to the Fouché and Verwey (1978), this numerical ability refers to the ability to work quickly and correctly with figures. Raw scores were used in the current study.

Fouché and Verwey (1978) calculated the reliability of the calculations sub-test (calculated according to the Kuder-Richardson Formula 8) to be 0.921. By using numerous factor analyses they also confirmed the construct validity of this test.

6.3.2.3.2 SPATIAL 3D

The spatial 3D sub-test (see Section 2.6 for literature overview on spatial 3D and SVA) is a 30-item speed test which consists of two sections. The first section is made up of 25 items and the second section of five. Both these sections must be completed within 11 minutes. This time limit should be strictly adhered to when the test is administered.

In the first section, each item consists of a block with an opening or openings. The examinee is presented with five other blocks with projecting points. From these five blocks the examinee must choose the one whose projecting point/points fit exactly into the block with the opening/openings. For the second section, the drawings of five cubes for each item are presented. The examinee must find the one block that does not belong with the other four (Fouché & Verwey, 1978).

On a separate answer sheet the examinee marks the space across the letter which corresponds to the letter below the block that he/she has chosen (pertaining to the whole test). There is only one correct answer to each question.

Before the test is administered, one practice example (pertaining to section one of the test) is done with the examinees to ensure that they understand what to do and where to answer the questions. No practice example is given for the second section of the test as it is expected of the examinees to read and understand the instructions without any help.

A scoring stencil is used to mark the spatial 3D test and one mark is allocated for each correct answer. These values are summed and represent the final raw score for this sub-test. The total score can range from zero to 30, with a high score indicating good spatial 3D ability and a low score

the opposite. According to Fouché and Verwey (1978), this spatial 3D ability refers to the ability of general reasoning and visualisation. Raw scores were used in the current study.

Fouché and Verwey (1978) calculated the reliability of the spatial 3D sub-test (calculated according to the Kuder-Richardson Formula 8) to be 0.838. By using numerous factor analyses they also confirmed the construct validity of this test.

6.3.2.4 NEO FIVE-FACTOR INVENTORY (NEO-FFI)

The NEO-FFI, developed by Costa and McCrae (1992), is a shortened version of the NEO-Personality Inventory (NEO-PI-R). It provides a brief, comprehensive measure of five domains of personality, namely Neuroticism (N), Extraversion (E), Openness to experience (O), Agreeableness (A) and Conscientiousness (C) (Costa & McCrae, 1992). These five domains are based on the Five-Factor Model of personality which is discussed in Section 3.7. During this research the NEO-FFI rather than the NEO-PI-R was used as this test is appropriate when testing time is limited and a general view on personality is considered sufficient.

The NEO-FFI is a 60-item inventory consisting of five 12-item scales. Although there is no time limit for the NEO-FFI, most respondents require 10 to 15 minutes to complete it. However, older respondents and those with limited reading skills may take longer (Costa & McCrae, 1992). The latter finding probably explains why in the current research the examinees took approximately 20 minutes to complete this inventory.

The NEO-FFI is a Likert-type scale that consists of 60 statements and can be administered individually or in a group. These items are answered on a five-point scale which varies from "Strongly Disagree" to "Strongly Agree".

Depending on the response of an examinee, a value between zero and four is allocated to an item. The values of the marked responses for the first column (i.e., items 1, 6, 11, 16, 21, 26, 31, 36, 41, 46, 51 and 56) are then summed to determine a value for the Neuroticism domain. An analogous procedure is then applied to calculate the remaining domain scores. These values are raw scores and were applied in the statistical processing during the current research.

A maximum score of 48 and a minimum of zero can be obtained for each domain. A high score for a specific column pertains to a high standing on that specific factor, while a low score reflects the opposite.

By scoring the NEO-FFI scales from the NEO-PI-R data, Costa and McCrae (1992) estimated the three-month retest reliability of the NEO-FFI scales. From this, reliability coefficients were calculated at 0.79, 0.79, 0.80, 0.75 and 0.83 for Neuroticism (N), Extraversion (E), Openness to experience (O), Agreeableness (A) and Conscientiousness (C), respectively.

In cognitive tests reliabilities of 0.8 or higher are acceptable. Although the reliabilities measured for the NEO-FFI are not as high as desired, it should be kept in mind that this is a non-cognitive test. As these scales measure broader constructs, lower reliabilities are therefore acceptable (Foster and Parker, 1999).

6.3.2.5 KOLB'S LEARNING STYLE INVENTORY (LSI)

The LSI (see Appendix B) is a simple self-descriptive test that is designed to measure learners' strengths and weaknesses (Kolb, Rubin & McIntyre, 1979). A literature overview on learning styles and modes is presented in Section 4.4.

The LSI is a nine-item self-explanatory questionnaire that can be administered and marked in a short period of time. According to Spangenberg (1990), this test takes 10 minutes to complete, but in this research it was found that it took approximately 19 minutes.

There are nine sets of four descriptions listed in this inventory. The examinee has to rank order each set of four words. A four (4) is placed next to the word that is the most like you, a three (3) next to the description that is second most like you, a two (2) next to the description that is the third most like you and a one (1) next to the description that is least like you. It is important to assign a different rank number to each of the four words in each set - ties should not be made.

The four columns of words correspond to the four learning modes, namely concrete experience (CE), reflective observation (RO), abstract conceptualisation (AC) and active experimentation

(AE). From the 36 words in the LSI, only 24 (six from each column) are used. The designated words for the columns are the following:

CE: Column 1 → Lines 2, 3, 4, 5, 7 and 8
RO: Column 2 → Lines 1, 3, 6, 7, 8 and 9
AC: Column 3 → Lines 2, 3, 4, 5, 8 and 9
AE: Column 4 → Lines 1, 3, 6, 7, 8 and 9

To compute the score, the rank numbers for the designated items of each column should be added up. A score ranging from 6 to 24 can be obtained for each column. Because of the ipsative measurement procedure, it is impossible for the same person to obtain a maximum score of 24 for more than one learning mode. A high score on a specific learning mode indicates a preference for that mode. Raw scores rather than standardised scores were used in this research.

Geller (1979) states that the LSI supplies only relatively reliable scores for the functions that it is supposed to measure. Kolb (1976) also mentions investigations where LSI scores were correlated with, among others, achievement tests and personality tests. He admits that the results are not as desired.

According to the split-half reliability (Spearman-Brown) Kolb (1976) found the following reliability coefficients:

Concrete experience (CE)	0.55
Reflective observation (RO)	0.62
Abstract conceptualisation (AC)	0.75
Active experimentation (AE)	0.66
Concept formation (AC - CE)	0.74
Structure conformation (AE – RO)	0.82

Kolb (1976) also presents test-retest reliabilities that ranged from 0.30 to 0.73. These results were obtained by testing four sub-populations over a period of three to seven months. In turn, Geller (1979) reports the following test-retest reliabilities for 50 medical students over a 31-day interval:

Concrete experience (CE)	0.56
Reflective observation (RO)	0.52
Abstract conceptualisation (AC)	0.59
Active experimentation (AE)	0.61
Concept formation (AC - CE)	0.70
Structure conformation (AE – RO)	0.55

Torbit (1981) tested intern-counselling psychologists over a period of ten days and found a reliability coefficient of 0.71, while Welman (1991) found an alpha-coefficient of 0.63 and 0.55 for concept formation and structure conformation, respectively.

As stated earlier, reliability coefficients lower than 0.8 are acceptable for non-cognitive tests (see Section 6.3.2.4). As the LSI is a non-cognitive test, the lower reliabilities are therefore acceptable (Foster and Parker, 1999).

6.3.2.6 GRADE 12 FINAL EXAMINATION MARK

Each research examinee had to enter his/her grade 12 final examination symbol in a space on the biographical questionnaire. These marks were also obtained from the University of the Free State's administration department and were cross-referenced (by using their student numbers) to ensure that the examinees entered the correct information. However, each examinee's symbol was processed and quantified as a percentage (see Table 6.5). This processed score was used in the statistical analysis.

TABLE 6.5 Grade 12 final examination symbols and corresponding processed scores

Grade 12 Final Exam Symbol	A	B	C	D	E	F	FF	G	H
Processed Score	80	70	60	50	40	30	20	10	0

6.3.2.7 MATHEMATICAL ABILITY

Information regarding each examinee's mathematical achievement was obtained from the biographical questionnaire. Each person had to enter his/her mathematics symbol, obtained in the grade 12 final examination, in a space on the biographical questionnaire. This symbol was processed and quantified according to Table 6.6. This processed score was used in the statistical analysis.

TABLE 6.6 Grade 12 mathematics symbols and corresponding processed scores

Grade 12 Mathematical Achievement Symbol	A	B	C	D	E	F	FF	G	H
Processed Score	80	70	60	50	40	30	20	10	0

6.3.3 BIOGRAPHICAL QUESTIONNAIRE

The biographical questionnaire (see Appendix C) was handed out together with the other questionnaires. The examinees completed this questionnaire before they continued with the other questionnaires. It requires information about student number, date of birth, date, race, language, age and gender.

6.4 GATHERING OF DATA

Information for this research project was gathered in two stages. During the first stage the following tests were administered, namely IPAT Anxiety Scale, Computer Attitude Scale (CAS), NEO Five-Factor Inventory (NEO-FFI), Kolb's Learning Style Inventory (LSI), Senior Aptitude Test – Spatial 3D and Senior Aptitude Test – Calculations. These tests were administered to the students before they had any experience on computers. The results from these tests, as presented in Chapter 7, will be used to determine which predictor variables correlate adequately with the criterion variable (computer proficiency).

During the second stage (four months later) the CAS was the only test that was repeated. As already described, this test consists of three sub-scales measuring computer anxiety, computer proficiency and computer liking. A pretest-posttest design was thus used to determine whether a

significant difference existed between the scores of an individual before and after gaining computer experience. The three sub-scale scores, as well as the total score of the CAS will be used in the secondary study.

6.5 STATISTICAL PROCEDURE

As already shown, the regression equations will be determined separately for the white and black students. Stepwise regression-analysis (with the aid of the forward selection procedure) will be performed to determine these equations. In forward selection of the independent/predictor variables, the predictor variable that has the highest correlation with the criterion score will be added to the equation first, provided that the corresponding F-value lies in the critical region for significant correlation. Next, the predictor variable with the second highest partial correlation will be added to the equation. This process is repeated until none of the remaining predictor variables has a significant contribution to the predictor model.

During regression analysis a multiple correlation coefficient (R) is obtained by correlating the observed and predicted Y-scores. The squared multiple correlation coefficient (R^2) is known as the coefficient of determination and shows the proportion variance in the criterion that is jointly declared by the predictor variables. R^2 will also increase as predictor variables are added to the regression equation. However, it must be kept in mind that, as additional predictors are added to the equation, it does not necessarily mean that the predicting model will improve.

Consequently the number of predictors that can be sensibly used in the model, are determined by investigating the increase in the variance from the first to the last step of the model. This will be done by using the F-test (Steyn, Smit, Du Toit & Strasheim, 1994). If a significant increase (on the 5% level of significance) in variance occurs, the next equation (as defined by step 2) is compared to the last step. This procedure is repeated for the subsequent steps until the specific regression equation of which the variance does not differ significantly from the last equation, is found.

The utilitarian value of the regression equation cannot be satisfactorily evaluated by looking at the size of the multiple correlation coefficient only. Some of the most important external aspects that also play a role are the selection proportion (number of selected participants in relation to the number of applicants) and the success rate (number of students that passed according to the

criterion in relation to the number that actually passed). The latter provides an indication of the selection battery's criterion validity. If criterion scores are available, a minimum requirement can be established according to which the success rate can be determined.

6.6 CHAPTER SUMMARY

In this chapter the composition of the research group, the measuring instruments, the process of data collection and the statistical methods and procedures were discussed. The criterion variable as well as the different predictor variables that might play a role in predicting computer proficiency were also mentioned and explained.

The results of the statistical methods will be presented and discussed in the next chapter.

Chapter 7

Results and discussion of results

7.1 INTRODUCTION

In the previous chapter the research methodology was discussed. In this chapter the results acquired through the statistical procedures, as described in Chapter 6, are discussed.

The contents of this chapter are divided into three main sections. In Section 7.2 the descriptive statistics of the criterion and predictor variables are presented. The results of the stepwise regression analysis follow in Section 7.3 after which the results of the secondary study are discussed.

7.2 DESCRIPTIVE STATISTICS

The descriptive statistics (means, standard deviations and correlations), with respect to the predictor variables and the criterion for the group as a whole is presented in Table 7.1. The following table, Table 7.2, shows the same information, but separates the two population groups.

TABLE 7.1 Means and standard deviations for the total research group

Variable	Section Reference	N	$\overline{X}$	s
Computer proficiency	6.3.1	306	62.98	11.75
Grade 12-score	6.3.2.6	268	62.09	10.36
Grade 12-mathematics	6.3.2.7	270	55.15	15.73
IPAT: Q_3	6.3.2.2	306	5.56	2.96
IPAT: C	6.3.2.2	306	4.27	2.35
IPAT: L	6.3.2.2	306	3.80	1.85
IPAT: O	6.3.2.2	306	11.15	3.94
IPAT: Q_4	6.3.2.2	306	9.16	4.02
NEO-FFI: N	6.3.2.4	306	23.05	7.51
NEO-FFI: E	6.3.2.4	306	30.36	5.77
NEO-FFI: O	6.3.2.4	306	23.92	5.63
NEO-FFI: A	6.3.2.4	306	28.93	5.89
NEO-FFI: C	6.3.2.4	306	33.41	6.34
LSI: CE	6.3.2.5	306	15.15	3.01
LSI: RO	6.3.2.5	306	14.16	2.90
LSI: AC	6.3.2.5	306	15.09	3.10
LSI: AE	6.3.2.5	306	16.72	3.17
SAT: Calculations	6.3.2.3.1	306	15.33	7.41
SAT: Spatial3D	6.3.2.3.2	306	15.34	6.22
CAS: Anxiety	6.3.2.1	306	31.51	5.61
CAS: Confidence	6.3.2.1	306	30.25	5.46
CAS: Liking	6.3.2.1	306	28.34	5.55

It is important to keep in mind that the students' academic achievement in the BRS111 course was used to represent their computer proficiency, as expressed in Table 7.1 and 7.2. An unpaired t-test revealed that the difference in mean computer proficiency between the white students (68.36%) and the black students (57.46%) was highly significant ($df = 304$, $t = 9.14$, $p < 0.001$). This justifies the separation of the two groups in the subsequent analyses. The difference between these two groups' academic achievement of more or less 11% corresponds to what is generally found at other departments of the University of the Free State (informal observations).

From Table 7.2 it is also evident that the same occurrence, as stated above, is true for the means of the grade 12 final examination marks as well as the grade 12 mathematics marks. The means of these aforementioned scores also differ by about 10% and 9%, respectively.

TABLE 7.2 Means and standard deviations for the white and black students separately

	White			Black		
Variable	**N**	$\overline{X}$	**s**	**N**	$\overline{X}$	**s**
Computer proficiency	155	68.36	9.46	151	57.46	11.33
Grade 12 score	153	66.27	9.93	115	56.52	8.06
Grade 12 mathematics	146	59.38	14.73	124	50.16	15.46
IPAT: Q_3	155	5.86	3.17	151	5.26	2.72
IPAT: C	155	3.90	2.23	151	4.64	2.43
IPAT: L	155	3.38	1.78	151	4.23	1.82
IPAT: O	155	10.16	3.78	151	12.17	3.86
IPAT: Q_4	155	7.90	3.87	151	10.46	3.76
NEO-FFI: N	155	22.68	8.06	151	23.42	6.91
NEO-FFI: E	155	31.73	5.20	151	28.95	6.00
NEO-FFI: O	155	24.26	5.35	151	23.58	5.90
NEO-FFI: A	155	30.44	5.94	151	27.38	5.42
NEO-FFI: C	155	33.86	6.01	151	32.94	6.65
LSI: CE	155	15.19	3.06	151	15.11	2.96
LSI: RO	155	13.34	2.90	151	15.00	2.65
LSI: AC	155	15.35	3.33	151	14.81	2.83
LSI: AE	155	16.75	3.45	151	16.68	2.86
SAT: Calculations	155	19.19	7.02	151	11.37	5.45
SAT: Spatial3D	155	19.15	4.89	151	11.43	4.87
CAS: Anxiety	155	31.32	5.76	151	31.70	5.48
CAS: Confidence	155	28.85	5.61	151	31.69	4.92
CAS: Liking	155	26.06	5.39	151	30.68	4.68

Table 7.3 shows the correlation matrixes between the predictor variables and the criterion for the white and black students, separately. Significant ($\alpha = 0.05$) and highly significant ($\alpha = 0.01$) correlations are indicated with * and **, respectively.

From Table 7.3 it seems that, for both the white and black population groups, the two sub-scale scores of the Senior Aptitude Test, namely Calculations and Spatial 3D, correlate with computer proficiency (criterion). This correlation is significant on the 1% level. It is furthermore evident that, for the white students, there are significant (on the 1% level) correlations between the previous academic achievement (grade 12 final examination mark and grade 12 mathematics mark) and their level of computer proficiency. These correlations, although positive, were not significant for the black students. The latter group's IPAT Anxiety Scale scores indicate a negative relation with computer proficiency. Although all the scores for this scale were negatively related, only the sub-

scale scores for L and Q_4 correlated significantly. On the other hand, the IPAT scores have no significant correlations for the white group. It is interesting to note that neither of the NEO-FFI or the Learning Style Inventory scores have any significant correlations with computer proficiency for either of the population groups. Lastly, all three sub-scales (computer anxiety, computer confidence and computer liking) of the Computer Attitude Scale correlated significantly with the white students' computer proficiency. This leads to the conclusion that computer attitude may also significantly correlate with computer proficiency for the white students. For the black students all three of the computer attitude sub-scales correlated positively, but only the correlation for computer confidence was significant.

TABLE 7.3 Correlation matrix for the white andblack students separately

	Computer Proficiency	
Predictor Variable	**White**	**Black**
Grade 12 score	0.50**	0.20
Grade 12 mathematics	0.34**	0.15
IPAT: Q_3	0.04	-0.003
IPAT: C	0.03	-0.15
IPAT: L	0.01	-0.24**
IPAT: O	0.04	-0.18
IPAT: Q_4	-0.02	-0.25**
NEO-FFI: N	-0.01	-0.14
NEO-FFI: E	-0.01	0.01
NEO-FFI: O	0.10	0.12
NEO-FFI: A	0.07	0.11
NEO-FFI: C	0.07	0.13
LSI: CE	-0.02	-0.10
LSI: RO	-0.001	-0.11
LSI: AC	0.20	0.16
LSI: AE	-0.08	0.02
SAT: Calculations	0.30**	0.29**
SAT: Spatial3D	0.26**	0.32**
CAS Anxiety	0.22**	0.18
CAS: Confidence	0.32**	0.21**
CAS: Liking	0.28**	0.17

** $p <= 0.01$

It is important to keep in mind that all the significant correlations were reached on the 1% level of significance. Already at this stage, from the results in Table 7.3, it seems as if different variables will form part of the prediction equation for the white and black population groups.

7.3 REGRESSION EQUATIONS

In this section, the focus is on the regression equations, which will be determined separately for white (see Section 7.3.1) and black students (see Section 7.3.2).

7.3.1 WHITE STUDENTS

Table 7.4 provides information concerning the multiple correlations (R), the total variance and the additional variance whic h can be explained by the variables.

TABLE 7.4 Results of stepwise regression for the white students

Step	Predictor variable	R	Total variance	Additional variance	F
1	Grade 12 score	0.509	0.259	-	6.95**
2	CAS: Confidence	0.587	0.345	0.086	4.05**
3	LSI: AC	0.599	0.359	0.014	4.19**
4	LSI: CE	0.619	0.383	0.024	3.58*
5	Grade 12 mathematics	0.632	0.399	0.016	3.38*
6	NEO-FFI: C	0.642	0.412	0.013	3.50
7	CAS: Liking	0.653	0.426	0.014	-

** $p <= 0.01$
* $p <= 0.05$

From Table 7.4 it is evident that seven variables were included in the regression equation for the white students. However, when the F-values are taken into account, it is evident that the last predictor's (CAS: Liking) contribution to the variance in the criterion is not significant on the 5% level of significance at least. Thus, it was omitted in the analyses that follow. The other six variables' contributions to the variance in the criterion were significant on the 5% level at least. The six predictors jointly explain approximately 41.2% ($R^2 = 0.4121$) of the white students' academic achievement in the BRS111 course (see Table 7.5), which is an indication of their computer proficiency. This multiple correlation ($R = 0.642$) provides an F-value of 16.01 that is significant on the 1% level.

The regression equation for the white students is as follows:

Y' = 0.4(Grade 12 score) + 0.1(Grade 12 mathematics) – 0.2(NEO-FFI: C) + 0.6(LSI: CE) + 0.6(LSI: AC) + 0.6(CAS: Confidence) + 8.5

Hierarchical regression analyses were performed for the white students to investigate the unique contribution of each predictor to the explanation of variance in computer proficiency. The R^2 value for the whole model was determined during these analyses. Subsequently, each predictor variable was excluded to determine the percentage of criterion variance explained uniquely by that particular predictor. The effect sizes (f^2) were also calculated and give an indication of a specific predictor's contribution to R^2 in terms of the proportion of unexplained variance of the full model. The results for the white students appear in Table 7.5.

TABLE 7.5 Contribution made by the different predictors to R^2 for the white students' equation

Variables in equation	Variable omitted	R^2	Contribution to R^2	f^2
Gr12f+Gr12m+Neoc+Lsce+Lsac+Casc		0.4121		
Gr12f+Gr12m+Neoc+Lsce+Lsac	Casc	0.3122	0.0999	0.17*
Gr12f+Gr12m+Neoc+Lsce+Casc	Lsac	0.3741	0.0380	0.06
Gr12f+Gr12m+Neoc+Lsac+Casc	Lsce	0.3846	0.0275	0.05
Gr12f+Gr12m+Lsce+Lsac+Casc	Neoc	0.3988	0.0133	0.02
Gr12f+Neoc+Lsce+Lsac+Casc	Gr12m	0.3815	0.0306	0.05
Gr12m+Neoc+Lsce+Lsac+Casc	Gr12f	0.2925	0.1196	0.20*

Key: [Gr12f = Grade 12 final examination mark; Gr12m = Grade 12 mathematics mark; Neoc = NEO Five-Factor Inventory: C; Lsce = Learning Style Inventory: CE; Lsac = Learning Style Inventory: AC; Casc = Computer Attitude Scale: Confidence]

* = medium to large effect size

From Table 7.5 it is evident that the predictor "grade 12 final examination mark" explains approximately 12% of the variance in the students' computer proficiency. On its own, the predictor "Computer Attitude Scale: Confidence" explains approximately 10% of the mentioned variance. These two predictors' effect sizes are medium to large, which indicate that their contributions may also be regarded as of fairly great practical significance.

In order to bring the external aspects (see Section 6.5) into account, probability tables were drawn up for the equation. This was done by calculating total scores according to the equation for each student and by dividing the cumulative frequencies of the total score into ten intervals with equal percentages in each. An indication of the expected success of each interval group is also presented.

Since the mean on the criterion is 68.4 with a standard deviation of 9.46 for the white students, it was decided to use 60% as the cut-off mark when determining the success rate (only three of the 144 students obtained a final score lower than 50% on the criterion).

The theoretical probabilities for the equation, based on the correlation and success rate (Lawshe & Balma, 1966), appear in Table 7.6.

TABLE 7.6 Probability for white students to pass the BRS111 course with a mean score of 60% according to their prediction model

Predicted score	Probability of success (%)
³ 78.0	100
74.8 – 77.9	99
72.8 – 74.7	99
71.0 – 72.7	98
69.2 – 70.9	96
68.2 – 69.1	94
67.0 – 68.1	92
64.8 – 66.9	86
61.8 – 64.7	79
£ 61.7	57

r = 0.65
N = 144
Success rate = 0.84

The information in Table 7.6 indicates that the regression equation can be used with great success in practice during selection and counselling. It seems that approximately 57% of the group with the lowest predicted score have a chance of being successful as opposed to 100% of the group with the highest predicted score. This information is based on a success rate of 0.84 since 121 (of the 144) students obtained a score of 60% or higher on the criterion while 135 (of the 144) students obtained a predicted score of 60% or higher according to the regression equation.

The following example can be used to indicate the utilitarian value of the equation. Suppose a prospective white student achieves the following scores on the relevant predictors:

Grade 12 final examination mark	(C-symbol)	60
Grade 12 mathematics mark	(D-symbol)	50
NEO Five -Factor Inventory: C		33
Learning Style Inventory: CE		14

Learning Style Inventory: AC	12
Computer Attitude Scale: Confidence	35

According to the regression equation the predicted score for this student will be calculated in the following manner:

$$Y' = 0.4(60) + 0.1(50) - 0.2(33) + 0.6(14) + 0.6(12) + 0.6(35) + 8.5$$
$$= 24 + 5 - 6.6 + 8.4 + 7.2 + 21.0 + 8.5$$
$$= 67.5$$

This student's predicted score (academic mark) indicates that he/she will achieve approximately 68% at the end of the BRS111 course. According to Table 7.6, the student's chance of passing the course with a mark of 60% or higher, is approximately 92%.

7.3.2 BLACK STUDENTS

The results applicable to the regression equation for the black students are shown in Table 7.7. It provides information concerning the multiple correlations (R), the total variance and the additional variance which can be explained by the variables.

TABLE 7.7 Results of stepwise regression for the black students

Step	Predictor variable	R	Total variance	Additional variance	F
1	SAT: Spatial3D	0.298	0.089	-	7.20**
2	IPAT: L	0.389	0.151	0.062	5.90**
3	IPAT: Q_4	0.417	0.174	0.023	6.33**
4	IPAT: Q_3	0.476	0.227	0.053	4.20*
5	CAS: Confidence	0.502	0.252	0.025	3.40*
6	LSI: AC	0.519	0.269	0.017	-

** $p <= 0.01$
* $p <= 0.05$

From Table 7.7 it is evident that six variables were included in the regression equation for the black students. It is also clear that all the variables' contributions to the variance in the criterion were significant on the 5% level at least. The six predictors jointly explain approximately 26.8%

($R^2 = 0.2682$) of the black students' academic achievement in the BRS111 course (see Table 7.8), which is an indication of their computer proficiency. This multiple correlation ($R = 0.519$) provides an F-value of 5.59 that is significant on the 1% level.

The regression equation for the black students is as follows:

$$Y' = 1(\text{IPAT: } Q_3) - 0.5(\text{IPAT: } Q_4) - 0.8(\text{IPAT: L}) + 0.6(\text{SAT: Spatial3D}) + 0.5(\text{LSI: AC}) + 0.4(\text{CAS: Confidence}) + 36.4$$

Hierarchical regression analyses were also performed for the black students to investigate the unique contribution of each predictor to the explanation of variance in computer proficiency. The results for the black students appear in Table 7.8.

TABLE 7.8 Contribution made by the different predictors to R^2 for the black students' equation

Variables in equation	Variable omitted	R^2	Contribution to R^2	f^2
Ipq_3+Ipq_4+Ipl+Sats+Lsac+Casc		0.2682		
Ipq_3+Ipq_4+Ipl+Sats+Lsac	Casc	0.2439	0.0243	0.03
Ipq_3+Ipq_4+Ipl+Sats+Casc	Lsac	0.2601	0.0081	0.01
Ipq_3+Ipq_4+Ipl+Lsac+Casc	Sats	0.1760	0.0922	0.13*
Ipq_3+Ipq_4+Sats+Lsac+Casc	Ipl	0.2461	0.0221	0.03
Ipq_3+Ipl+Sats+Lsac+Casc	Ipq_4	0.2442	0.0240	0.03
Ipq_4+Ipl+Sats+Lsac+Casc	Ipq_3	0.2442	0.0240	0.03

Key: [Ipq_3 = IPAT Anxiety Scale: Q_3; Ipq_4 = IPAT Anxiety Scale: Q_4; Ipl = IPAT Anxiety Scale: L;
Sats = Senior Aptitude Test: Spatial3D; Lsac = Learning Style Inventory: AC; Casc = Computer Attitude Scale: Confidence]

* = medium to large effect size

From Table 7.8 it is evident that the predictor variable "Senior Aptitude Test: Spatial 3D" has a medium effect size. This predictor, on its own, explains about 9% of the criterion variance.

In order to bring the external aspects (see Section 6.5) into account, probability tables were also drawn up for this equation. This was done by calculating total scores according to the equation for each student and by dividing the cumulative frequencies of the total score into ten intervals with equal percentages in each. An indication of the expected success of each interval group is also presented. The 50% cut-off mark for determining the success rate was decided upon for the black students. This group's mean on the criterion is 57.46 with a standard deviation of 11.33.

The theoretical probabilities for the equation, based on the correlation and success rate (Lawshe & Balma, 1966), appear in Table 7.9.

TABLE 7.9 Probability for black students to pass the BRS111 course with a mean score of 50% according to their prediction model

Predicted score	Probability of success (%)
³ 66.9	96
64.7 – 66.8	93
62.7 – 64.6	90
60.9 – 62.6	88
59.7 – 60.8	84
58.7 – 59.6	81
57.5 – 58.6	77
55.8 – 57.4	73
53.2 – 55.7	66
£ 53.1	52

r = 0.47
N = 151
Success rate = 0.80

The information in Table 7.9 indicates that the regression equation can be used with great success in practice during selection and counselling of black students. It seems that approximately 52% of the group with the lowest predicted score have a chance of being successful as opposed to 96% of the group with the highest predicted score. This information is based on a success rate of 0.80 since 121 (of the 151) students obtained a score of 50% or higher on the criterion while 126 (of the 151) students obtained a predicted score of 50% or higher according to the regression equation.

The following example can be used to indicate the utilitarian value of the equation. Suppose a prospective black student achieves the following scores on the relevant predictors:

IPAT Anxiety Scale: Q_3	10
IPAT Anxiety Scale: Q_4	14
IPAT Anxiety Scale: L	4
Senior Aptitude Test: Spatial 3D	12
Learning Style Inventory: AC	18
Computer Attitude Scale: Confidence	35

According to the regression equation the predicted score for this student will be calculated in the following manner:

$$Y' = 1(10) - 0.5(14) - 0.8(4) + 0.6(12) + 0.5(18) + 0.4(35) + 36.4$$
$$= 10 - 7 - 3.2 + 7.2 + 9 + 14 + 36.4$$
$$= 66.4$$

This student's predicted score (academic mark) indicates that he/she will achieve approximately 66% at the end of the BRS111 course. According to Table 7.9, the student's chance of passing the course with a mark of 50% or higher, is 93%.

7.4 SECONDARY STUDY

The secondary goal of this study is to determine whether there are any changes in the computer attitude, computer anxiety, computer liking and computer confidence of students as more computer experience is gained. Therefore, these four constructs were measured during the students' first practical period before they had had any contact with computers. As such the above-mentioned constructs were not influenced by computer experience when they were measured originally. The four tests were then administered approximately four months later (to the same group of students) after computer experience had been gained. These pre- and post-scores were compared with each other and it was again performed separately for the white and black students. During the calculation of the score difference, the post-scores were subtracted from the pre-scores. It is anticipated that the scores for the four concepts will change as the students gain experience. This means that if the above-mentioned procedure is used, a score difference can be expected. Since the scores for the pre- and posttests are related, the t-test for dependent groups (Huysamen, 1983) was used. The results for the two groups appear in Table 7.10.

TABLE 7.10 Separate results of the t-test for the white and black students to determine whether there are changes in computer attitude, computer anxiety, computer liking and computer confidence as students gain experience on computers

Test	Group	N	Pre-score		Post-score		t	p
			$\overline{X}$	s	$\overline{X}$	s		
Computer Attitude	White	155	86.21	14.67	82.77	16.17	4.086	0.0001**
	Black	151	94.07	12.79	89.87	14.31	4.549	0.0001**
Computer Anxiety	White	155	31.32	5.76	29.99	6.19	3.265	0.0014**
	Black	151	31.70	5.47	30.66	5.14	2.375	0.0188*
Computer Liking	White	155	26.06	5.39	24.99	5.72	2.944	0.0037**
	Black	151	30.68	4.68	29.36	5.63	3.389	0.0009**
Computer Confidence	White	155	28.85	5.61	27.80	6.25	3.249	0.0014**
	Black	151	31.69	4.92	29.69	5.22	5.249	0.0001**

** $p <= 0.01$
* $p <= 0.05$

The results in Table 7.10 show that for both the white and black students there is a decrease in the mean scores of the four concepts over time. All the decreases were significant on the 1% level except the computer anxiety of the black students, which was significant on the 5% level. It is also evident that there is not a big difference between the mean scores regarding the pre-figures of computer anxiety for the two population groups. Both groups were thus equally anxious with regard to working with computers before any experience had been gained. However, the other three constructs do show differences between the mean pre-scores of the two population groups. The figures also show that the black students had higher mean scores (although the difference is small for computer anxiety) for both the pre- and posttests of all four of the concepts. This is an indication that the black students overall have a more positive computer attitude than the white students. If the three sub-scales of computer attitude, namely computer anxiety, computer liking and computer confidence, are taken into account, it means that:

- the black students have less computer anxiety than the white students,
- the black students have more computer liking than the white students and
- the black students have more computer confidence than the white students.

7.5 CHAPTER SUMMARY

In this chapter the results of the primary and secondary studies were presented and discussed. Two regression equations were determined for the black and white population groups, respectively. It was found that different variables predict computer proficiency for each group.

In the secondary study the influence of computer experience on computer attitude and its components were examined. The research shows that the computer attitude, computer anxiety, computer liking and computer confidence scores decreased as experience was gained. For this study, it is thus evident that computer experience has a negative effect on computer attitude and its components.

In the next chapter these findings will be interpreted and compared with previous research. Conclusions and recommendations will be made and limitations of the current study will be given.

Chapter 8

Summary and Conclusions

8.1 INTRODUCTION

In Chapter 1 an introduction and general overview of the contents of this dissertation were presented. In the following four chapters a literature overview of the major predictor variables was presented. This literature overview put these variables into perspective with regard to their relevance to the current study and previous research concerning them. In Chapters 6 and 7 the methodology and results pertaining to the current study were presented.

In this chapter the focus is on the summary of the findings and the conclusions drawn from it. This is done with reference to the objectives set in Sections 1.3.1 and 1.3.2 for the primary and secondary studies. Where relevant, the current findings are compared to previous research and possible reasons for differences are presented. In Section 8.4 the limitations of the current research are presented and in Section 8.5 recommendations are made for future research.

8.2 CONCLUSIONS DRAWN FROM THE STUDY

In Section 8.2.1 the conclusions drawn from the primary study are presented. The objective of this study was to determine the effectiveness of certain variables as predictors of computer proficiency for students enrolled in an introductory computer literacy course. In Section 8.2.2 the conclusions drawn from the secondary study are presented. The latter study has the objective of determining whether computer experience influences computer attitude and its three components.

8.2.1 CONCLUSIONS – PRIMARY STUDY

This study resulted in the formulation of two formulas which can be used to predict the computer proficiency of students enrolled for an introductory computer literacy course. In Section 5.4 it was anticipated that culture might have an influence on the predictors of computer proficiency. This expectation was confirmed by the fact that the difference between mean computer proficiency for black and white students is significant (see Section 7.2). Therefore, two separate prediction

formulas for white and black students were developed. The only variables that are shared by both formulas, are computer confidence and the learning mode of abstract conceptualisation (AC).

The prediction formula for the white students is made up of six variables – grade 12 final examination mark, computer confidence, the learning modes of abstract conceptualisation (AC) and concrete experience (CE), mathematical ability and the Conscientiousness (C) domain of personality.

The grade 12 final examination mark was the first variable to be included in the regression equation for the white students and explained 11.96% of the variance in computer achievement for the white students. The second variable added to the regression equation was computer confidence and explained 9.99% of the variance in computer achievement. These two variables are the only ones which have effect sizes that are medium to large, indicating that they have fairly large practical significance. The six variables together explain 41.21% of the variance of white students' computer proficiency in an introductory computer literacy course.

The prediction formula for the black students is also made up of six variables – spatial 3D, the L, Q_3 and Q_4 scores of the IPAT Anxiety Scale, computer confidence and the learning mode of abstract conceptualisation (AC).

Spatial 3D made the largest contribution to the prediction of computer proficiency for the black students. It explained 9.22% of the variance in computer proficiency. This variable is the only one which has a medium effect size. The combined effect of all six variables included in the regression equation explains 26.82% of the variance of black students' computer proficiency in an introductory computer literacy course.

8.2.2 CONCLUSIONS – SECONDARY STUDY

The objective of the secondary study (see Section 1.3.2) was to determine if computer attitude and its three components, namely computer anxiety, computer liking and computer confidence, change as users gain more experience on computers. In Section 2.2.2 the findings of previous research pertaining to this question were presented. As already mentioned, it is evident that some research suggests that the relationship between computer experience and computer attitude is positive

(Jawahar & Elango, 1998, 2001; Nickell & Pinto, 1986). This means that as users gain more experience on computers their computer confidence and computer liking increases while their computer anxiety decreases. Other research presented findings that indicated that there is no relationship between computer attitude and computer experience (Kernan & Howard, 1990; O'Quin et al., 1987; Szajna & Mackay, 1995).

In contrast with previous research on the topic, the current research found a negative relationship between computer attitude and computer experience. The statistical results in Section 7.4 indicate that as the students enrolled for the introductory computer literacy course at the University of the Free State gained more experience on computers, their computer confidence and computer liking decreased while their computer anxiety increased. As these three constructs are the components of computer attitude (see Section 2.2.6), it is not surprising that computer attitude also decreased. However, as only one retest was performed, it is unclear whether this change was permanent. It is possible that with further computer experience, computer attitude may improve so that the relationship between these two variables is as depicted in Figure 8.1.

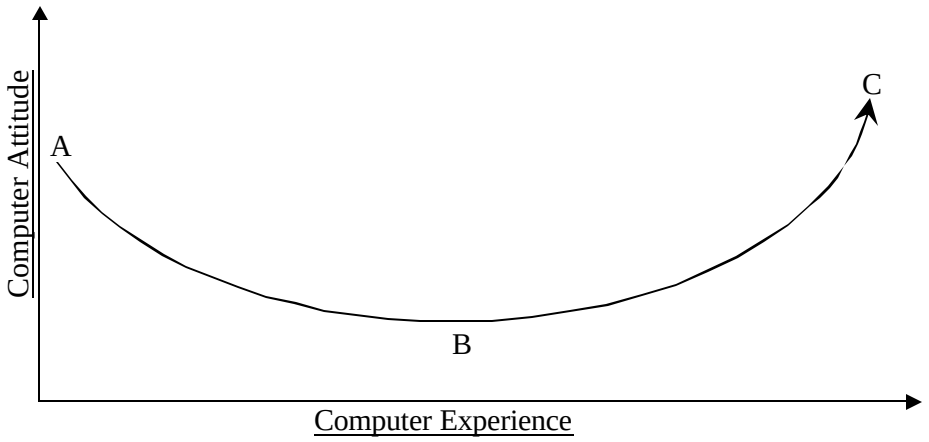

FIGURE 8.1 Possible relationship between computer attitude and computer experience for students attending the basic computer literacy course

Point A represents the students' positive attitudes toward computers when they first enrol for the course. They are confident that they will master computers and believe in their ability to overcome any challenges that the course might entail. However, as the students start to attend the course they realise how little they actually know about computers. Also, the learning curve in the course might be very steep. This implies that before the students become totally familiar with a specific program

they are introduced to the next one. This may confuse them and decrease their confidence in their ability to master computers. In turn, these feelings might have a negative influence on their computer attitude (see Point B on the curve). However, after the students finish the course and gain more experience with the programmes they have learned, they might become more confident with computers, their computer liking might increase and they might experience less anxiety. Thus, their computer attitude starts to increase and may even overtake the initial level after the decline during the steep learning curve during the basic computer literacy course. The BC section of the curve illustrates this situation.

It will be possible to prove the BC section if the posttest for the current study were to be repeated after a longer period of time in which the students could gain more computer experience.

8.3 INSTRUMENT FOR PREDICTING COMPUTER PROFICIENCY

From Chapter 7 it is evident that different variables predict computer proficiency for white and black students. As a result, two different questionnaires can be developed to test the relevant variables for each population group. This means that for the white students a questionnaire can be drawn up consisting of only the subscales measuring the relevant variables as presented in the prediction formula in Section 7.3.1. A similar strategy can be followed to draw up a questionnaire that predicts computer proficiency for the black students from Section 7.3.2. However, it would be risky to select such variables in terms of the results of only one study as the results of stepwise regressions capitalise heavily on chance.

The inclusion of the prediction questionnaires will decrease the time students will take to complete the questionnaires, as only the relevant sub-scales are included. Thus, students do not waste time on completing irrelevant sub-scales and inventories.

As previously mentioned, the attachment of the above-mentioned questionnaires is not permitted in the current study, as copyright laws prohibit the duplication of certain tests and sub-tests which form part of the prediction questionnaires.

8.4 LIMITATIONS OF THE CURRENT STUDY

- As the examinees wrote the tests in the first half of their first practical period, the time available to administer the tests was limited. This restricted the number of tests that could be administered as well as the choice of the questionnaires that were included. Shorter tests were in some circumstances included in the current study as opposed to other longer tests that might have been better.
- The variables included in the current study are not the entire list of possible predictor variables which could have been included. Due to the time constraint for the administration of the tests, only some variables were included in the current study.
- The examinees were not tested as one group on a specific day. As explained, they were tested in their first practical session. The conditions under which the examinees thus wrote the tests were not exactly the same for each group and several external factors could therefore have influenced the test results, e.g. different weather conditions. This means that the room temperature for some groups might have been higher than for other groups, which could have affected concentration and irritation levels. As a result, this might have negatively influenced their ability to answers certain questionnaires which specifically rely on good concentration, e.g. spatial 3D and calculations.

8.5 RECOMMENDATIONS FOR FUTURE RESEARCH

- As this study was conducted on students enrolled for an introductory computer literacy course at the University of the Free State, the replication of the study on students enrolled for similar courses at other South African tertiary institutions may also present useful information.
- Additional variables could be included to those used in the current study to determine if they also have predictive value for computer proficiency.
- Future research could also focus on other questionnaires that test the same constructs as the questionnaires in the current study, e.g. instead of using the NEO Five-Factor Inventory to test the examinees' personality traits, the Sixteen Personality Factor (16 P.F.) Questionnaire may be considered.
- A similar study could also be conducted amongst other South African cultural groups, e.g. Indians, Coloureds and Asians.

- The results of the secondary study presented findings that do not agree with the findings of earlier research. As already explained in Section 8.2.2, this may be the result of a too short lapse of time between the pre- and posttesting of computer attitude. It is therefore recommended that a longer period elapses before the posttest for computer attitude is administered. This will test the hypothesis presented in Section 8.2.2, for the controversial results of the current study.
- Apply the instrument on the next intake of first-year students and compare the final results with the predicted results to cross-validate the findings of this study.

8.6 CONCLUSIONS AND SUMMARY OF THE STUDY

This study was undertaken in an attempt to identify the biographical and psychological predictors of computer proficiency of students enrolled for an introductory computer literacy course. Computer literacy is an important skill as it has a great influence on the career options that are available to students. However, it has been shown in Section 1.2 that although people may use identical training methods, it is very likely that they would end up with different computer abilities.

The current study indicated that the predictor variables pertaining to computer proficiency were different for the white and black students. Both models contain six predictor variables of which only computer confidence and the learning mode of abstract conceptualisation (AC) appear in both. Thus, it is logical to infer that different strategies are necessary to improve the computer proficiency of white and black students. The predictors identified in the current study are very important in the development process of these strategies.

The prediction models, if cross-validated by other student intakes, will also enable training or education institutions to predict whether a student has the ability and personality make-up to complete an introductory computer course successfully. This is very important, for both the students and the training institution will save money that would otherwise have been wasted by students failing the course.

In short, the findings of this study are that the grade 12 final examination mark, computer confidence, the learning modes of abstract conceptualisation (AC) and concrete experience (CE), mathematical ability and the Conscientiousness (C) domain of personality contributed to the

prediction of computer proficiency among white students. On the other hand, spatial 3D, the L, Q_3 and Q_4 scores of the IPAT Anxiety Scale, computer confidence and the learning mode of abstract conceptualisation (AC) contributed to black students' computer proficiency.

The secondary study found that computer experience had a negative effect on computer attitude and its three components, which is in contrast to the findings of other research. However, the precise nature of the introductory computer course at the University of the Free State may have influenced the findings and therefore further research on the topic is necessary.

Many people in South Africa use and come into contact with computers on a daily basis. It is understandable that the need for computer literacy is increasing. The results of this study suggest that by addressing the significant predictors of computer proficiency, a profound contribution may be made to the improvement of computer literacy and proficiency of students from different cultural groups.

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APPENDIX A

COMPUTER ATTITUDE SCALE (CAS)

Instructions
Please answer all of the following questions. **Tick (X) one answer per question**.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. Computers do not scare me at all.				
2. I'm no good with computers.				
3. I would like working with computers.				
4. Working with a computer would make me nervous.				
5. Generally, I would feel OK about trying a new problem on the computer.				
6. The challenge of solving problems with computers does not appeal to me.				
7. I do not feel threatened when others talk about computers.				
8. I don't think I would do advanced computer work.				
9. I think working with computers would be enjoyable and stimulating.				
10. I feel aggressive and hostile towards computers.				
11. I am sure I could do work with computers.				
12. Figuring out computer problems does not appeal to me.				
13. It wouldn't bother me at all to take computer courses.				
14. I'm not the type to do well with computers.				
15. When there is a problem with a computer that I can't immediately solve, I would stick with it until I have the answer.				
16. Computers make me feel uncomfortable.				
17. I am sure I could learn a computer language.				
18. I don't understand how some people can spend so much time working with computers and seem to enjoy it.				
19. I would feel at ease in a computer class.				
20. I think using a computer would be very hard for me.				
21. Once I start to work with the computer I find it hard to stop.				
22. I get a sinking feeling when I think of trying to use a computer.				
23. I could get good grades in computer courses.				
24. I will do as little work on the computer as possible.				
25. I would feel comfortable working with a computer.				
26. I do not think I could handle a computer course.				
27. If a problem is left unsolved in a computer case, I would continue to think about it afterward.				
28. Computers make me feel uneasy and confused.				
29. I have a lot of self-confidence when it comes to working with computers.				
30. I do not enjoy talking with others about computers.				

APPENDIX B

LEARNING STYLE INVENTORY (LSI)

Instructions

There are nine sets of four descriptions listed in this inventory. Mark the words in each set that are the most like you, second-most like you, third most like you and the least like you. Put a four (**4**) next to the description that is most like you, a three (**3**) next to the description that is second most like you, a two (**2**) next to the description that is third most like you and a one (**1**) next to the description that is least like you (**4 = most like you; 1 = least like you**). Be sure to assign a different rank number to each of the four words in each set; **do not make ties**.

Example

0. **4** happy **3** fast **1** angry **2** careful

[Some people find it easier to decide first which word best describes them (**4**) and then to decide the word that is least like them (**1**). Then you can give a **3** to the word in the remaining pair that is most like you and a **2** to the word that is left over.]

1.	___ discriminating	___ tentative	___ involved	___ practical
2.	___ receptive	___ relevant	___ analytical	___ impartial
3.	___ feeling	___ watching	___ thinking	___ doing
4.	___ accepting	___ risk taker	___ evaluative	___ aware
5.	___ intuitive	___ productive	___ logical	___ questioning
6.	___ abstract	___ observing	___ concrete	___ active
7.	___ present -orientated	___ reflecting	___ future-orientated	___ pragmatic
8.	___ experience	___ observation	___ conceptualisation	___ experimentation
9.	___ intense	___ reserved	___ rational	___ responsible

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Items	Items	Items	Items
2 3 4 5 7 8	1 3 6 7 8 9	2 3 4 5 8 9	1 3 6 7 8 9
- - - - - - - - -	- - - - - - - - -	- - - - - - - - -	- - - - - - - -
CE = _____	RO = _____	AC = _____	AE = _____

APPENDIX C

BIOGRAPHICAL DETAILS

Date (e.g. 21 - 02 - 2003) Time (e.g. 10h06)						
Room number						
Student number						
Date of birth (e.g. 23 - 11 - 1979)						
Age	18 - 20	21-24	25-29	30-34	35-39	>40
Gender	Male	Female				
Home language	Afrikaans	English	Sotho or Tswana	Asian	Other ……..	
Race	White	Black	Coloured	Asian		
Grade 12 Average Symbol	A	B	C	D	E	F
Did you have mathematics as one of your subjects in grade 12?	Yes	No	**If "Yes", answer the next two questions**			
Grade 12 Mathematics (HG, SG or LG)	HG	SG	LG			
Grade 12 Mathematics Symbol	A	B	C	D	E	F

SUMMARY

As a result of the proliferation of computers throughout the business world, more and more demands are placed on workers to develop computer skills. There are a variety of training methods by means of which workers can obtain these much-needed skills. It is nevertheless true that with identical training methods, it is quite likely that different people will end up with different computer abilities.

It was thus the primary objective of this study to investigate the role that certain biographical, psychological and cognitive variables play in the prediction of computer proficiency. The variables that were included as possible predictors were personality type, learning style, general anxiety, three-dimensional perceptual ability (spatial 3D), numerical ability, computer attitude, grade 12 final examination mark and mathematical ability. The secondary objective of this study was to determine whether computer attitude and its three components (computer anxiety, computer liking and computer confidence) were influenced by computer experience. Culture was taken into account as a moderator variable in both the primary and secondary studies.

To ensure that all the research participants were on the same level of computer literacy, only students enrolled for the basic computer literacy course at the University of the Free State were used in the study. Because the research was used to develop predictor formulas for computer proficiency, the research participants were tested early in February 2003, before the introductory computer literacy course commenced. This was to ensure that the participants' attitudes, abilities and feelings regarding computers were assessed prior to their exposure to computers.

The only test that was repeated (on the same students) towards the end of the semester course was the so-called Computer Attitude Scale (CAS). Apart from measuring a person's attitude towards computers, the test also contains sub-tests that measure computer anxiety, computer liking and computer confidence. The researcher needed these retest scores to determine whether users' computer attitude, as well as the three mentioned components, had changed as more computer experience was gained.

The primary study resulted in the formulation of two formulas which can be used to predict the computer proficiency of white and black students enrolled for an introductory computer literacy course. The prediction formula for the white students is made up of six variables – grade 12 final

examination mark, computer confidence, the learning modes of abstract conceptualisation (AC) and concrete experience (CE), mathematical ability and the conscientiousness (C) domain of personality. The prediction formula for the black students is also made up of six variables – spatial 3D, the L, Q_3 and Q_4 scores of the IPAT Anxiety Scale, computer confidence and the learning mode of abstract conceptualisation (AC). It was thus found that different variables predict the computer proficiency of white and black students. The only variables that are shared by both formulas are computer confidence and the learning mode of abstract conceptualisation (AC).

In contrast with previous research on the topic, a negative relationship between computer attitude and computer experience was found in the secondary study. The statistical results indicated that as the students gained more experience on computers their computer confidence and computer liking decreased while their computer anxiety increased. As these three constructs are the components of computer attitude, it was not surprising that computer attitude also decreased.

Computers play an integral role in the lives of many individuals and therefore the improvement of computer skills is a continuous and important process. This study provided valuable inputs by identifying predictors of computer proficiency for students enrolled in an introductory computer literacy course.

Key terms: predictors, computer proficiency, personality type, learning style, general anxiety, spatial 3D, numerical ability, computer attitude, grade 12 final examination mark, mathematical ability, computer liking, computer anxiety, computer confidence, cultural differences.

OPSOMMING

As gevolg van die geweldige toename in die gebruik van rekenaars in die sakewêreld, word steeds groter vereistes aan werkers gestel om rekenaarvaardighede te ontwikkel. Daar bestaan 'n verskeidenheid van opleidingsmetodes waardeur werkers hierdie noodsaaklike vaardighede kan bekom. Nogtans is dit waar dat verskillende mense, selfs na identiese opleidingsmetodes, waarskynlik verskillende rekenaarvermoëns sal hê.

Die primêre doel van die navorsing was dus om die rol wat sekere biografiese, psigologiese en kognitiewe veranderlikes in die voorspelling van rekenaarbekwaamheid speel, te ondersoek. Die veranderlikes wat ingesluit is as moontlike voorspellers was persoonlikheidstipe, leermetode, algemene angstigheid, driedimensionele waarnemingsvermoë (ruimtelik-3D), numeriese vermoë, rekenaar-gesindheid, graad 12 finale eksamenpunt en wiskundige vermoë. Die sekondêre doel van die navorsing was om vas te stel of rekenaar-gesindheid en die drie komponente daarvan (rekenaar-vrees, rekenaar-voorliefde en rekenaar-selfvertroue) beïnvloed is deur rekenaar-ervaring. In beide die primêre en sekondêre navorsing is kultuurverskille as 'n gemagtigde veranderlike beskou.

Om te verseker dat al die deelnemers aan die ondersoek op dieselfde vlak van rekenaargeletterdheid is, is slegs studente wat vir die basiese rekenaargeletterdheidskursus by die Universiteit van die Vrystaat ingeskryf is, in die navorsing gebruik. Aangesien die ondersoek gebruik is om voorspeller-formules vir rekenaarbekwaamheid te ontwikkel, is die respondente vroeg in Februarie 2003 getoets, voordat die inleidende rekenaarvaardigheidskursus 'n aanvang geneem het. Dit was om te verseker dat die deelnemers se gesindheid, vermoëns en gevoelens omtrent rekenaars bepaal is voordat hulle daaraan blootgestel is.

Die enigste toets wat teen die einde van die semesterkursus (op dieselfde studente) herhaal is, is die sogenaamde *Computer Attitude Scale (CAS)*. Behalwe dat die toets die persoon se gesindheid teenoor rekenaars getoets het, het dit ook subtoetse bevat wat rekenaar-vrees, rekenaar-voorliefde en rekenaar-selfvertroue gemeet het. Die navorser het die resultate van die hertoetse nodig gehad om te bepaal of die gebruiker se rekenaar-gesindheid, sowel as die drie genoemde komponente, verander het met die toename van rekenaar-ervaring.

Die resultate van die primêre navorsing is die formulering van twee formules wat gebruik kan word om die rekenaarbekwaamheid van wit en swart studente wat vir 'n inleidende

rekenaargeletterdheidskursus ingeskryf is, te voorspel. Die voorspellingsformule vir die wit studente bestaan uit ses veranderlikes – die graad 12 finale eksamenpunt, rekenaar-selfvertroue, die leermetodes van abstrakte begripsvorming, en konkrete ervaring, wiskundige vermoë en die pligsgetrouheidsfaset van persoonlikheid. Die voorspellingsformule van die swart studente bestaan ook uit ses veranderlikes – ruimtelik-3D, die L-, Q_3- en Q_4-tellings van die IPAT-Angsskaal, rekenaar-selfvertroue en die leermetode van abstrakte begripsvorming. Daar is dus gevind dat verskillende veranderlikes die rekenaarbekwaamheid van wit en swart studente voorspel. Die enigste veranderlikes wat by albei formules voorkom, is rekenaar-selfvertroue en die leermetode van abstrakte begripsvorming.

In teenstelling met vorige navorsing oor die onderwerp, is daar 'n negatiewe verband tussen rekenaar-gesindheid en rekenaar-ervaring in die sekondêre navorsing gevind. Statistiese gegewens het aangetoon dat, wanneer die studente meer ervaring met rekenaars opgedoen het, hulle rekenaar-selfvertroue en rekenaar-voorliefde afgeneem het, terwyl hulle rekenaar-vrees toegeneem het. Aangesien hierdie drie konstrukte die komponente van rekenaar-gesindheid is, is dit geensins verbasend dat rekenaar-gesindheid ook afgeneem het nie.

Rekenaars speel 'n integrale rol in die lewens van baie individue en daarom is die verbetering van rekenaarvaardighede 'n deurlopende en belangrike proses. Hierdie navorsing het waardevolle bydraes verskaf deur voorspellers van rekenaarbekwaamheid vir studente wat vir 'n inleidende rekenaarvaardigheidskursus ingeskryf is, te identifiseer.

<u>Sleutelwoorde</u>: voorspellers, rekenaarbekwaamheid, persoonlikheidstipe, leermetode, algemene angstigheid, ruimtelik-3D, numeriese vermoë, rekenaar-gesindheid, graad 12 finale eksamenpunt, wiskundige vermoë, rekenaar-voorliefde, rekenaar-vrees, rekenaar-selfvertroue, kulturele verskille.
