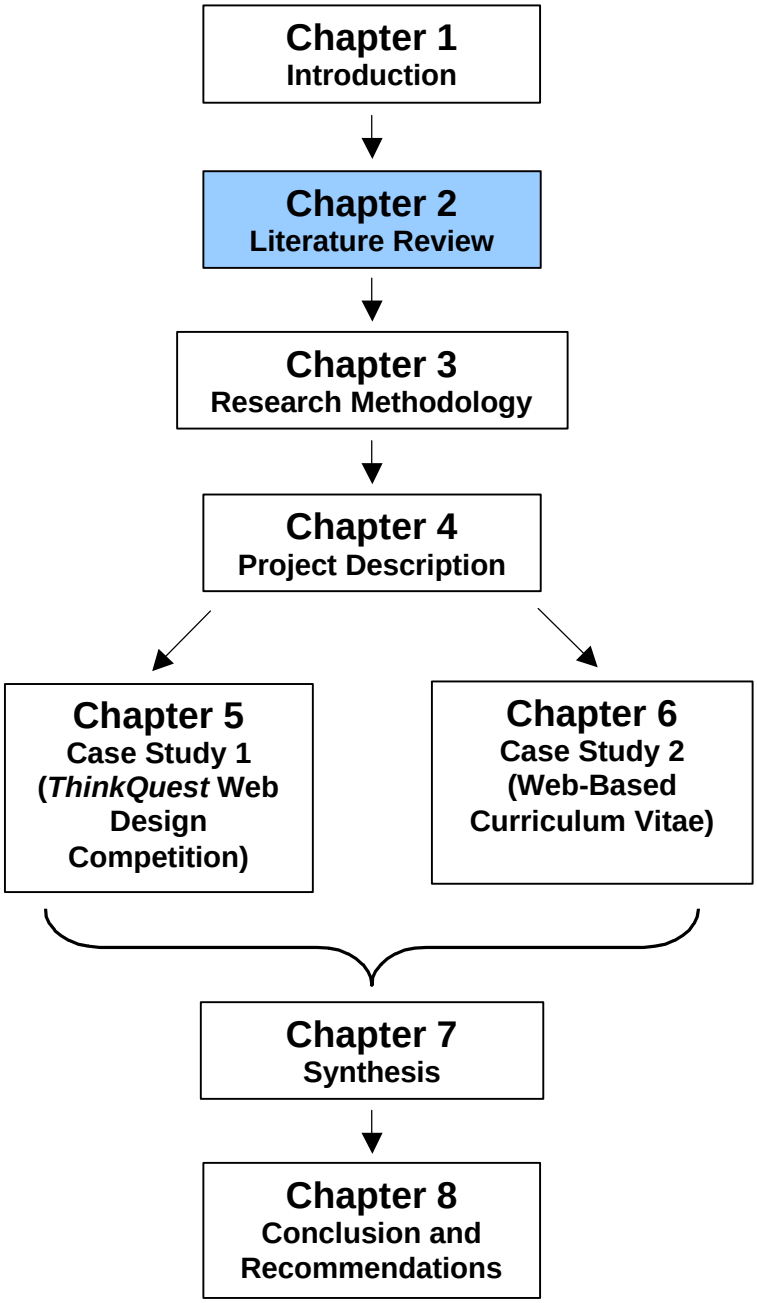
Chapter 2


Chapter 1
Introduction
Chapter 2
Literature Review
Chapter 3
Research Methodology
Chapter 4
Project Description
Chapter 5
Case Study 1
(*ThinkQuest* Web
Design
Competition)
Chapter 6
Case Study 2
(Web-Based
Curriculum Vitae)
Chapter 7
Synthesis
Chapter 8
Conclusion and
Recommendations

Chapter 2 Literature Review: Learners in a digital environment

1 Introduction

The purpose of this thesis is to investigate how South Africa Further Education and Training (FET) learners acquire, recall, process and present information in a digitally enabled environment.

In South Africa there are currently over 3 million FET learners aged 16 and older, of whom over 2 million are found in the secondary school system (Department of Education, 2000, p. 2). This research will focus on the FET learner in the South African secondary school in the state educational system.

This chapter will synthesize the literature in answer to the following questions:

- What is an educational digital information environment?
- How has a changing society and technology influenced the way learners interact with information in an educational environment, including a South African FET environment?
- What is meant by cognitive, affective and physical perspectives with reference to interaction with information?
- How do learners interact with information in a digital information environment from cognitive, affective and physical perspectives?

Finally a profile of a South African FET learner in a digital information environment is created, based on the findings of the literature review.

2 Digital information environment in education

This research investigates how South African FET learners interact with information in a digital information environment. Table 2 - 1 defines *digital information environment* and *electronic information environment*. The information in the table has been synthesised from the works of a number of authors.

Table 2 - 1 Definitions of digital and electronic information environment

Key word	Definition
Digital	• Data that is represented as a series of binary digits. • Data that is encoded to receive and transmit information.
Electronic	• That which is produced by using electronic components.
Information	• Knowledge made up of interpreted data.
Digital information	• Knowledge stored and transmitted in digital format, such as that stored on a computer, cell phone, digital watch, etc. • Has a hypermedia format.
Electronic information	• Information produced by the use of electronic equipment.
Environment	• Physical surroundings and conditions, especially as affecting people's lives. • Conditions or circumstances of living.
Digital or electronic information environment	• Primary source of information has a digital nature. • Information produced by the use of electronic equipment. • Environment in which the reader and text can interact; the reader can be guided; the text can have different hierarchical structures; and the text employs new symbolic elements.
Hypermedia	• System that uses links to lead users to related graphics, audio, animation or video files.

(Hutchinson, 1997*; Oxford Modern English Dictionary,* 1995; Reinking, n.d.)

An electronic information environment is a much broader information environment than just a digital information environment, including tape recordings, film, radio, electronic mail or email, electronic banking, the World Wide Web, computers, etc. As indicated in the Glossary, for the purposes of this research the words *digital* and *electronic* are used interchangeably.

Information in a digital environment is of a hypermedia format. This research aims to describe how South African FET learners interact with information in a digital environment where the information is of a hypermedia format. The hypermedia format differs markedly from the print or oral format, as tabulated in Table 2 - 2. However the formats of information found in an educational institution are mixed.

Table 2 - 2 Characteristics of language forms

Print	Oral	Hypermedia
non-interactive	interactive	interactive
permanent	impermanent	impermanent
static	dynamic	dynamic
linear	non-linear	non-linear
narrative	narrative / episodic	episodic
single voiced	single / multi-voiced	multi-voiced
graphic / text	audio	all symbol systems

(Eagleton, 1999)

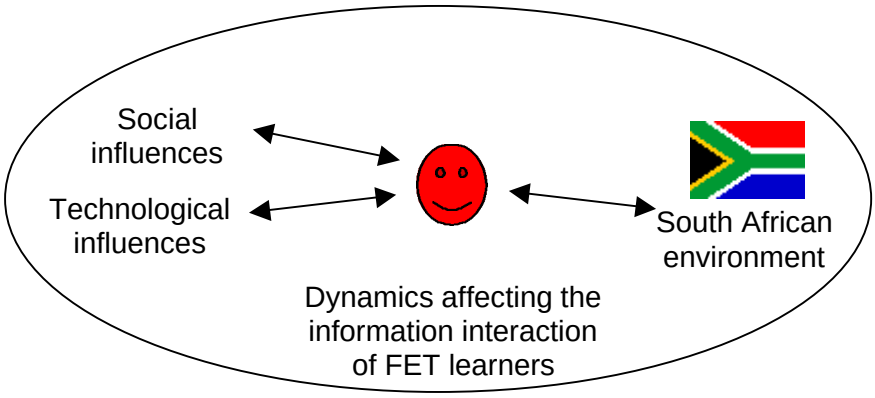
3 Changing society and technology and the influence on information processing in an educational environment, including a South African Further Education and Training environment

For the purpose of this literature review the dynamics between South African FET learners and information are examined by a number of factors that include

- *social* changes;
- the influence of *technology;* and
- living in a *South African* environment.

Figure 2 - 1 provides a schematic overview of the thesis with the South African FET learner in a uniquely South African context, influenced by social change and technology. These factors are examined to determine the dynamics of the learners' interaction with information.

Figure 2 - 1 Dynamics affecting information interaction of South African FET learners



For the purpose of this literature review the social influences are categorised in generations. The *Oxford Modern English Dictionary* (1995, p. 441) defines generation as 'all the people born at a particular time, regarded collectively' as well as 'the average time in which children are ready to take the place of their parents (usually reckoned at about 30 years)'. For the purpose of this study, a generation is reckoned at about 20 years. Sociologists use the term 'generation' to describe groups of people characterised by similar qualities and attitudes. It is not possible to generalise accurately but trends and generational attitudes can be discerned (Codrington, 1997, online).

Young people of the latter half of the 20th century have been described and categorised by the demographics, trends and attitudes in which they live and the trends and attitudes which develop as a result of this cohabitation. Table 2 - 3 is a list of the popular categories used to define the generations of the late 20th century. These characteristics are mainly applicable to American youth but with globalisation are also applicable to many sectors of South African society (Codrington, 2000, p. 35).

Table 2 - 3 Categories of generations

Category	Description
1 *Generation X* (*Xer*)	People born between 1961 and 1981.
2 Generation Y	Children born at the end of the 1970s.
3 Millennial Generation	Children born since the early 1980s.
4 *Oh-Oh* teens	Children who are teenagers during the Oh-Oh[1] (2000 - 2009) years and born mainly between 1989 and 1994. Howe and Strauss (Howe and Jackson, 1998) referred to this group as the *Millennial Generation.*
5 Net Generation	Many of those born between 1977 and 1997 have become the *Net Generation* influenced by intensive Internet usage.
6 Nintendo Generation	Children between the ages of three and 18, and entering school in the 1990s influenced by *Nintendo* technology.
7 *Children of the Chaos* Generation	Children influenced by a non-linear culture, probably since the middle 80s.

(Cobb, 1998; Howe & Jackson, 1998; Lankard, 1995; Nintendo, 1999; Rushkoff, 1999; Tapscott, 1999; Zoba, 1997)

Table 2 - 4 illustrates the categories of generations showing when the generations discussed in Table 2 - 3 were born and the time span.

Table 2 - 4 Adolescents born in the different generations (shaded areas indicate birth years)

Generation 19	60	65	70	75 19	80	85	90	95 20	00	05
Generation X	■	■	■	■	■					
Generation Y				■						
Millennial Gen.					■					
Oh-Oh Gen.						■	■			
Net Gen.				■	■	■	■	■		
Nintendo Gen.				■	■	■	■	■		
Child of Chaos						■	■	■		

[1] Oh-Oh - Years that have two 00s in them, such as 2000, 2001, 2002, through to 2009.

Table 2 - 4 indicates that in the years 2000 and 2001 (year of the case studies) young people aged between 13 and 19 can be expected to have characteristics of the *Y*, *Millennial*, *Oh-Oh*, *Net*, *Nintendo* and *Children of Chaos* generations. While some adolescents may be the tail end of the *Y Generation*, it is not anticipated that many young people aged between 13 and 19 in the year 2001, the year of the case study investigation, showed characteristics of the *X Generation*.

For the purpose of this literature review, the different generations have been divided into main three groups based on their major influences and will be discussed as indicated in Table 2 - 5. Factors that influence their interaction with information are discussed separately and then synthesised into one table.

Table 2 - 5 Format of discussion on groupings

Grouping	Generation
Social Generations	*1 Generation X* 2 Millennial grouping which includes the *Y*, *Millennial* and *Oh-Oh Generations*
Technology Generations	*3 Net* *4 Nintendo* *5 Child of Chaos*
South African Generation	6 Profile of the South African teenager

3.1 Social Generations grouping

The effects of a changing society have been the main influence on this generation grouping. The ways in which information processing was influenced by those changes are examined.

3.1.1 *Generation X*

Generation X (*Xer*) reflects the effects of a changing society on a generation. These young adults born between 1961 and 1981 have different life experiences to those in previous generations. Social, economic and political events have had a large impact on their lives and, ultimately, their education. These are the parents of the generation under investigation in this research. Their years of birth in comparison to other generations are illustrated in Table 2 - 4.

The factors of character, family life, the future, peers and technology which have an impact on the information processing of *Xers* are tabulated in Table 2 - 6.

Table 2 - 6 Factors that impact on the interaction with information of *Generation X*

Factor	Impact
Character	• As they spent so much time on their own or with their peers they became used to doing things for themselves, hence *Generation X* persons tend to be independent problem solvers and self-starters. • Compelled to improvise in order to survive, they are thus resourceful. • Want support and feedback but do not want to be controlled. • Suffered from information overload and, because of it, did not experience any of the real conflicts presented on television.
Family life	• Families lived away from relatives capable of providing support and a haven for family members. • Grew up as latchkey children deprived of their parents, both of whom worked outside the home. • Children took their social cues from their own peer group. • Few older role models. Relationships with adults limited, and not grounded in fear or respect.
Future	• Aware that securing jobs, and job security, may be a problem. • As a result of limited career positions, when they attended university they studied career courses, such as nursing or computer sciences, in preference to general culture courses.
Peers	• Many of their friends grew up in single parent homes (children of divorced parents), therefore committed to spending time with own age group to whom they became very supportive.
Technology	• First generation to grow up with television's constant presence in the home and the rapid onslaught of other media. • Not afraid of technology. • Home alone with TV has resulted in *Xers* with short attention spans, capable of attending to multiple input and suffering from information overload. • Used to instant gratification from technology.

(Brown, 1997; Kalata, 1996; Lankard, 1997)

As a consequence of the changed *family life* described in Table 2 - 6 (Brown, 1997; Kalata, 1996; Lankard, 1997)

- *Xers* were forced to become self-sufficient, independent problem solvers: they needed autonomy to complete the task;
- they needed a variety of instructional methods in interaction with information ranging from video recordings, interactive CDs to self-paced modules; and
- as their relationships with adults were limited, they did not know authority.

As *Xers* spend so much time with their *peers* with whom they are supportive, as described in Table 2 - 6 (Brown, 1997; Kalata, 1996; Lankard, 1997),

- they were able to work co-operatively with other young people; and
- learning is a social activity as solving problems is a social activity.

As a result of the changing society, particularly the access to *technology,* as tabulated in Table 2 - 6 (Brown, 1997; Kalata, 1996; Lankard, 1997), *Xers*

- have become surfers and scanners of information, i.e. they move from one point to another quickly;
- have the ability to assimilate information quickly and focus on multiple ideas at once (therefore the layout of information should be very accessible with charts, graphics, text and photos included on a single page);
- want immediate response from their sources of information; and
- crave stimulation.

Therefore, based on the above, *Generation X* came to be characterised as independent problem solvers, self-starters, responsive, focused, ambitious, fearless and technologically literate.

3.1.2 Millennial Generations grouping

For the purpose of this study the Millennial Generation grouping influenced by changes in society include the *Y*, *Millennial* and *Oh-Oh* generations. Their years of birth in comparison to the other generations are illustrated in Table 2 - 4.

The following are important points to consider in this grouping:

- There is less authority in defining the *Y Generation* group than other groups. They are those born at the end of the 1970s (Tapscott, 1998, p. 33).
- The *Millennial Generation* are young people who come of age just before or after the turn of the millennium (Pirie & Worcester, 1999, online) or those born after 1982 (Howe, 1998, online).
- The *Oh-Oh Generation* are teenagers in the Oh-Oh years and born mainly between 1989 and 1994 (Cobb, 1998, online).

The factors of character, family life, the future, peers and technology that have had impact on their information processing are tabulated in Table 2 - 7.

Table 2 - 7 Factors that impact on the interaction with information of the Millennial Generations grouping

Factor	Impact
Character	• They are in need of continual 'hits' as they have been bombarded by frequent images. • They are jaded, and having a 'been there / done that' attitude, nothing shocks them. • They seem to be self-confident and self-dependent. • They are used to customising things.
Family life	• Peer pressure is important, leading to peers helping peers. They reach out to people and have a strong desire to be connected and collaborate with others. One-quarter to one-third comes from single parent homes. • As both parents work outside the home they are dependent on their peers. • In the absence of parents, digital technology has given them an artificial and superficial home, i.e. they are a cyber-suckled community.
Future	• They aim high and do not think themselves limited by their background.
Peers	• As they are left with others of their own age so much, they have learned to work together and on their own. • In high schools there is no one group that asserts an influence over all the others but many small groups, as they are not united by a common culture. They live in a fragmented culture with no common experience apart from media being the common influence between them.
Technology	• They are children of the digital age as they have grown up with a burgeoning software industry. • They have grown up in front of tubes, screens or boxes, as baby sitters, that have defined their perceptions of reality. • Technology has made them more individualistic; hence they are not a homogenous group. • To this group the remote control has symbolised their reality: change is constant; their focus is fragmented. • Many of these young people have their own computers.

(Beck, 1997; Cobb, 1998; Pirie & Worcester, 1999; Thomson, 1999; Zoba, 1997)

As a result of the changing society tabulated in Table 2 - 7, young people of the Millennial Generations grouping

- work with their peers or groups in preference to adults;
- need quick responses to activities;
- are creative thinkers able to customise things to their needs;
- need to do things;
- need to reach people of their own age; and
- are achievement orientated.

3.2 Technology Generations grouping

The Technology Generations grouping comprises the *Net*, *Nintendo* and *Child of Chaos* generations. The digital environment, rather than economic, social and political factors, has influenced this generation grouping. The ways in which information processing was influenced by the digital environment are examined. The birth years of the Technology Generations grouping are tabulated in Table 2 - 4.

As tabulated in Table 2 - 8, the changed sources of information in hypermedia format are the major influence on this generation, having moved from a mainly linear form to a non-linear form.

Table 2 - 8 Linear and non-linear forms of information

Linear Old	Non-linear New
• User has little control of the flow of information. • Examples include books, films, magazines, newspapers and radio.	• User has the ability to redirect the flow of information, to explore information in 3D format. • Examples include digital compact disks (CD-ROMs), Internet (in all its many forms), video cassette players and video games.

3.2.1 *Net Generation*

The *Net Generation*, influenced by the digital environment, have a degree of fluency with digital media (Tapscott, 1998, p. 3), particularly the Internet. They use the Internet for entertainment, communicating, shopping and more activities as new digital technologies are moving towards the Net (Tapscott, 1998, p. 3). These people have new tools for inquiry, analysis, self-expression, influence and play via the Internet, by means of chatrooms, email, web pages, gaming, etc. In general, according to Tapscott (1998, p. 7), digital media is creating an environment where child development is being accelerated with the evolution of motor, language and social skills. The influences of the digital world on the *Net Generation* are summarised in Table 2 - 9. The cognitive, affective and physical perspectives used in Table 2 - 9 to examine the influences were selected by myself and not suggested by the literature review.

Table 2 - 9 Influences of the digital world on the information processing capabilities of the *Net Generation*

Influences	Impact
Cognitive influences	Using the Net they have to • develop critical skills to judge if the information has any value; • develop critical skills as they interact with each other in chat rooms or via email; • develop evaluation skills to see if the information is fact or fiction; • develop investigative skills to find the required information; • develop thinking skills to maintain an online conversation; • develop thinking skills to find required information; • develop writing skills in online chat and email; • question the implicit values contained in the information, as there is so much information; and • search for their own information.
Affective influences	• The *Net Generation* enjoys using the Net. • As young people hungry for expression, discovery and their own self-development, they use the Net. • They control the media, creating their own environment, developing their own feeling of autonomy and sense of values. • They learn social skills and social responsibility in chat rooms.
Physical influences	• Using the Net, this generation is active, they participate, inquire, argue, play, shop, criticise, ridicule, fantasise, seek and inform. • They want to be users, not just viewers or listeners.

(Tapscott, 1998)

As a result of the *cognitive influences,* the consequences for information processing in an educational environment are as follows:

- The content matter must be of a high quality, i.e. learning materials must be linguistically and factually of a high standard.
- Learners need content matter to evaluate and criticise, i.e. a single source of information is not stimulating enough.
- Learners must have the opportunity to find their own information.

As a result of the *affective influences,* the consequences for information processing in an educational environment are as follows:

- Information presented in such an environment must be as stimulating as that found on the Internet.
- Learners need to control the creation of their own information.
- Learners need autonomy in finding and evaluating their own information.

As a result of the *physical influences,* the consequence for information processing in an educational environment is that the learner

- needs to be active and cannot be expected to passively absorb information.

3.2.2 *Nintendo Generation*

The *Nintendo Generation,* who have grown up with computers and information technologies, have been immersed in non-linear digital equipment, such as video games, digital compact disks, video cassette players, etc. (Nintendo, 1999, online).

This generation comprises children able to

- interact with information;
- interrupt and redirect the flow of information;
- modify the complexity of information; and
- alter the communication speed of information.

3.2.3 *Child of Chaos*

The *Child of Chaos* is a child born into a non-linear culture mediated by the television and computer (Rushkoff, 1999, p. 3). As with the *Net Generation*, their culture is linear in the form of television, and non-linear in the form of video games, computers, MTV, etc. Their media is many-to-many of call-in radio and the Internet, non-linear and non-verbal.

Children of Chaos are comfortable in a disassembled landscape and seem to create one when it does not exist; for example, with the television remote control, the *Child of Chaos* channel surfs while still following the story lines (Rushkoff, 1999, p. 44). MTV, with its rapid-fire segments and slicing, is aimed at the *Child of Chaos* who seems to prefer disjointed media. *Children of Chaos* understand the underlying order in the apparently disordered postmodern world. As they understand the order in the disordered world, their information processing adapts to the changed environment. The factors of character and cognitive influences that impact on their information processing are described in Table 2 - 10.

Table 2 - 10 Factors of the non-linear digital world that impact on the interaction with information of the *Child of Chaos* generation

Factor	Impact
Character	• Comfortable in a disassembled environment. • Always ready to explore something new. • Do not get too engrossed in any one activity. • Willing to push themselves to the limits, then relax. • Actively participate to piece together information and draw conclusions for themselves. • Able to improvise, willing to test the waters and see what happens.
Cognitive influences	**Time / speed** • Can process visual information quickly. • Broad attention range, short absorption time. • Suspends time constraints of linear reasoning in order to allow for rapid dissemination of ideas and data. • Attention span able to maintain itself over gaps of discontinuity, between channel surfing or from session to session. **Complexity / depth** • Requires images of greater complexity. • Able to multitask, e.g. keep track of many TV shows at once. **Visual literacy** • Develops new language of visual information that depends on the relationship of different images and images within images. • Recognition of the basic elements in the language of visual gestures determines the ability to navigate the non-linear, non-verbal landscape. • Recognises the quality of something from its shape. • Depends on the iconic representation rather than the illustrative depiction. • Skims information. • Communicates with basic symbols and relationships; the rest is filled in by the viewer.

(Rushkoff, 1999)

As a consequence of the changed *character* described in Table 2 - 10,

- the information processing of *Children of Chaos* is active;
- they need multiple modes of input to retain their attention; and
- they do not spend too long on any one task.

Therefore, based on Table 2 - 10, in an educational situation for successful information processing, it would be beneficial

- to keep learners actively involved;
- use many modes of media; and
- not expect *Children of Chaos* to focus on one activity for too long.

As a result of the *cognitive influences* tabulated in Table 2 - 10, the consequences for information processing in an educational environment are that the learners

- get bored quickly and need continual and varied input;
- are better able to process graphic information than textual information;
- have a short attention span and cannot keep track of one type of input for long periods;
- can keep track of many information inputs at once;
- need information organised in a regular pattern, i.e. certain types of information always found in certain places on a page or screen; and
- skim the information sources.

3.3 South African Generation grouping

Unlike the Technology Generation grouping, the profile of the South African teenager is mainly *social* in nature. South African teenagers have different influences to those of the American or European teenager as they are influenced by different factors, but there are similarities due to globalisation. Information in Table 2 - 11 is based on the 1998 Codrington profile of South African teenagers looking at family life, the future, peers and technology (Codrington, 1999, online).

Table 2 - 11 Factors that impact on the interaction with information of South African teenagers

Factor	Impact
Family life	• Family important although there are communication problems. • Perceived insufficient time for family life. • Both parents work outside the home in 72% of households. • Breakup of family life with divorce experienced by 64%.
Future	• Negative feelings about the future by 24%. • Concerned about lack of job opportunities, parents dying, not being a success in life and AIDS. • Negative feelings towards politics.
Peers	• Spend a great deal of time with small groups of close-knit friends. • Lack of rivalry between groups.
Technology	• More than two hours a day spent watching television by 51%. • Dependent on background music in digital format. • Large percentage living in poverty: Africans 57%, Asian 6%, Coloured 19%, White 2%.

(Codrington, 1999)

Table 2 - 11 indicates some trends also found in the Millennial Generations grouping with regard to family and peers. South African teenagers appear to be more negative about their future than the Millennial Generations grouping.

3.3.1 Consequences for the information interaction of South African Further Education and Training learners affected by changes in society and the influence of technology

Based on the preceding discussion, the South African FET learner is influenced by and is a product of the societal Millennial Generations grouping, the Technology Generations grouping and the South African Generation grouping.

Access to technology influences confident computer use (Rosen & Weil, 1995, online). A large percentage of South Africans live in poverty (Table 2 - 11). The result of this is that relatively few South Africans would be considered as belonging to the Technology Generations grouping. Most South African FET learners show similarities with the societal Millennial Generations grouping influenced by society.

Table 2 - 12 tabulates the general consequences and indicates the consequence for information interaction for learners in South Africa today, based on *all* groupings, examining it from cognitive, affective and physical perspectives.

Table 2 - 12 Consequences for the interaction with information by South African FET learners

Type of consequence	General consequences	Information interaction consequence
Cognitive	• Television watching a common activity.	• Learners need material in graphic format.
	• Lack of trust requires autonomy in creating own learning material.	• Learners need to find / create their own learning content.
Affective	• Peers interact, communicate and support each other.	• Learning is social therefore noise is inevitable.
	• Need content matter that has relevance for a career.	• Learners need fast access to learning material, as they have no time to waste. • Learners need learning material that has long-term career value.
	• Motivated when using technology.	• Learners are motivated by technology used in information interaction.
Physical	• Necessity for physical activity during the learning process.	• Learners must do things.

This section of the literature review has looked at how learners today interact with information as a consequence of social, economic, political and technological factors, and concluded with how South African FET learners interact with information. The review continues with how information is acquired, recalled, processed and presented.

4 Cognitive, affective and physical perspectives with reference to interaction with information in an educational environment

The chapter continues with references to cognitive, affective and physical perspectives as learners interact with information. These perspectives are defined in Table 2 - 13 and selected to examine the learners' interaction with information as it provides a means from which to do so. The areas of cognitive, affective and physical perspectives in an education environment encompass the way the learners intellectually interact with information, their emotions as they interact with the information and those around them, and how they physically interact with information.

Table 2 - 13 Definitions of cognitive, affective and physical perspectives

Perspective	Within an educational environment …
Cognitive perspective	the recall or recognition of specific facts, procedures and concepts that serve in the development of intellectual abilities and skills as the learners acquire, recall, process and present information.
Affective perspective	how learners deal with … • one another and information presented as content and as skills; • their emotions, feelings, values, appreciation, enthusiasm, motivation, attitudes and relationships; and • situations … as they acquire, recall process and present information.
Physical perspective	the learners' physical movement, coordination, use of motor skill areas, manipulative or motor skills in acquiring, recalling, processing and presenting information; including the environment in which they work.

(Bloom *et al*, 1956)

5 Interaction with information in an educational digital environment from cognitive, affective and physical perspectives

The aim of this research is to investigate the complex process of how South African FET learners in a digital environment interact with information, i.e. acquire, recall, process and present information. This section will examine

- the formats of information found in a digital environment;
- the effects of a digital environment on the acquisition, processing and presentation of information in general; and then
- interacting with information in a digital environment from the cognitive, affective and physical perspectives.

Although the acquisition, processing and presentation of information in a digital environment are all part of a whole, each will be examined from a different perspective, viz

- acquiring - obtain information mainly by the visual, aural and haptic channels
- processing - form meaning from information mainly by mental processing
- presenting - give expression to or present the information

5.1 Formats of information

The technologies of text, still or animated graphic, movie segments, sounds and music are currently converging in non-linear hypermedia Internet technology

(Tapscott, 1998, p. 3). In a digital environment the major format of information is of a hypermedia nature. Hypermedia encompasses multimedia and hypertext as tabulated in Table 2 - 14.

Table 2 - 14 Formats of information

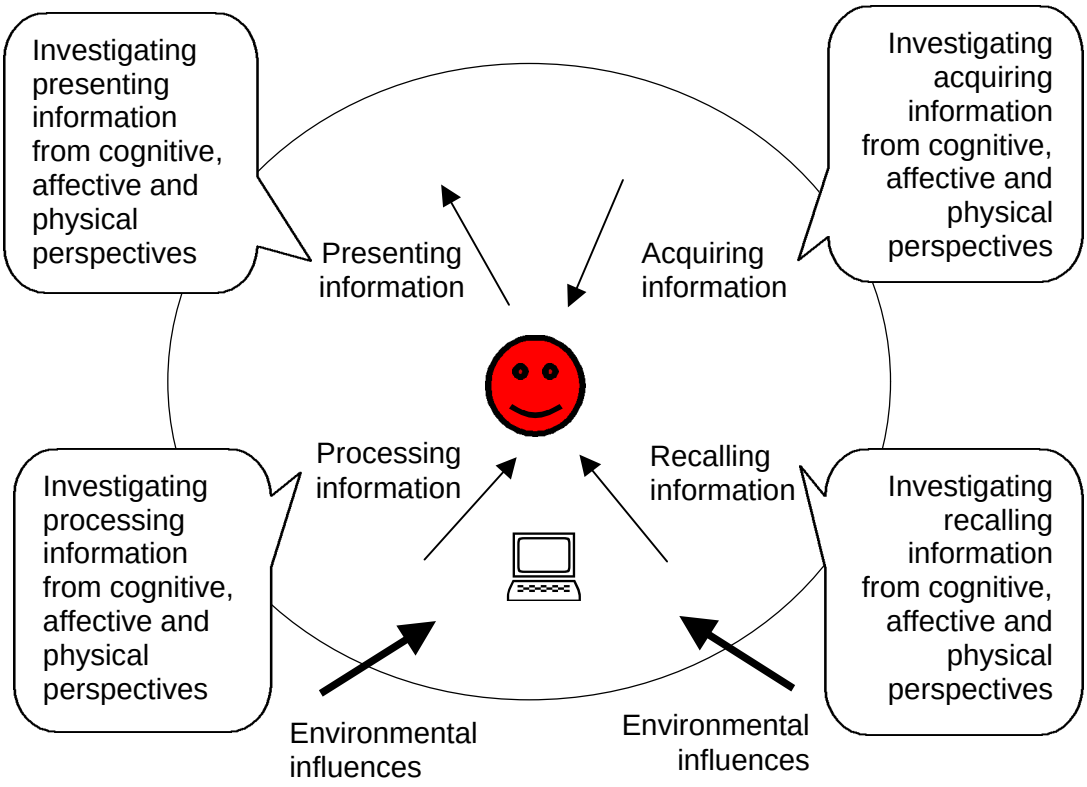
Multimedia	Hypertext	Hypermedia
• Does not necessarily include computer usage.	• Computer-based system.	• Computer-based system.
• Not necessarily interactive.	• Allows interactive linking.	• Allows interactive linking.
• When presented via a computer, may overlap with the term *hypermedia* and *hypertext*, if it includes non-linear interactive links.	• Allows non-linear access to information.	• Allows non-linear access to information.
• Comprises multiple media formats for the presentation of information.	• Textual information including diagrams, tables and pictures.	• Presented in multiple formats that include text, still or animated graphic, movie segments, sounds and music.

5.2 Effects of a digital environment on interaction with information

Figure 2 - 2 depicts the learner in a digital environment and the dynamic interaction with information, the speech bubbles illustrating what is being investigated. There is no South African flag as the investigation is generic.

The following section discusses how learners in a digital environment acquire, recall, process and present information from cognitive, affective and physical perspectives.

Figure 2 - 2 Aspects of a digital environment



5.2.1 Screen dynamics

Screen dynamics, i.e. the way users reach various parts of the screen (Piolat, Roussey & Thunn, 1997, p. 568), influence acquisition, recall and comprehension of information as tabulated in Table 2 - 15. Table 2 - 15 looks at activities done on screen: reading on screen, cognitive processing of material on screen, reading text on the screen, scanning of the screen and reading the screen.

Table 2 - 15 Effects of screen dynamics on acquisition, recall and comprehension of information

Activity	Effect
Reading on screen	• Deep cognitive study is problematic when reading on screen unless there are spatial anchors. Spatial representation is useful when recalling information. When reading, text positional information in the form of x and y co-ordinates is processed and assists in recall. Deep study [of a book or article] requires jumping from one section to another, comparing widely separated statements, analysing graphics in context and making notations: this is problematic on screen without anchors.
Cognitive processing of material on screen	• Cognitive processing on screen is superficial: corrections made in word processing documents are at surface level, not affecting text coherence or organisational design.
Reading text on screen	• Reading text on screen takes longer than reading text from a book. • Text read on screen or on a book page is made more accessible if it is chunked in bite size bits but this leads to learners remembering bytes of information and not the bigger picture.
Scanning of the screen	• Experienced computer users scan the screen: they know where to look for specific information. For example, they scan email message subject lines and are able to keep track of sports scores on television by watching the bottom of the screen.
Reading the screen	• Research on areas of the screen that have been read, indicates that young people read the peripheral areas for long periods, and concentrate on small areas of detail. Their preferred area of content is on the right hand side of the screen.

(Borchers *et al*, 1996; Hackbarth, 1993; Howarth, 1997; Piolat, Roussey & Thunn, 1997; Rushkoff, 1999)

Table 2 - 15 tabulates the influences of reading text on screen as opposed to reading text in printed format: text is read in a different way.

5.2.2 Technological anxiety

Technological anxiety may be described as negative feelings towards technology and computers that impact on the way information is acquired and processed via them. The three main categories of technological anxiety are presented in Table 2 - 16.

Table 2 - 16 Categories of technological anxiety

Category	Effect
Technological anxiety	• Negative attitudinal and affective responses towards technology with associated behavioural consequences, resulting in slower and less accurate performances.
Technophobia	• Anxiety about present or future interactions with computers or computer-related technology.
Computer anxiety	• Fear of computers when using the computer or when considering the possibility of computer use which causes avoidance of computer use. Computer anxiety is influenced by demographic, cultural and psychological factors.

(Brosnan & Lee, 1998; Chua, Chen & Wong, 1999; Weil & Rosen, 1995)

Information in a digital environment is mainly available via computer as tabulated in Table 2 - 16, therefore computer anxiety will greatly impact on the acquisition and processing of information (Tseng *et al*, 1998, p. 599).

Demographic, cultural and ethnic and psychological factors that influence computer anxiety are shown in Table 2 - 17.

Table 2 - 17 Factors that influence computer anxiety

Factor	Influence
Demographic	Main influences: • Prior experience with computers • Utilisation of computers • Accessibility to computers Lesser influences: • Level of computer education • Use of own computer • Economic status of family, i.e. ability to purchase a computer • Urban or rural life, i.e. density of population and access to technology • Family structure, i.e. single parents are not always able to provide the means to purchase computers • Educational level of parents • Time to explore and use the technology of the computer • Age of computer user • Gender of user, with males being less anxious about computer use
Cultural and ethnic	Negative influences: • Culture of the software is not that of the local culture • User interface is not that of the local culture • Language of the computer interface is not the vernacular • Spatial visualisation ability of the users is poor • Computers are so expensive that they inhibit their use • Not enough recreational use of computers • Rote learning in school is encouraged
Psychological	• Perceived ability to use the computer • Learning styles • Motivation

(Al-Khaldi & Al-Jabri, 1998; Amory, Mars & Meyerowitz, 1999; Blignault, McDonald & Tolmie, 2000; Brosnan & Lee, 1998; Burrell, 2000; Chua, Chen & Wong, 1999; Fajou, n.d.; Rosen & Weil, 1995; Weil & Rosen, 1995)

Therefore, based on Table 2 - 17, prior experience with computers and access to computers will greatly influence the level of computer anxiety and impact on the acquisition, recall, processing and presentation of information in a digital environment.

5.2.3 Access-speed

A key feature of the digital environment is access-speed that influences information acquisition and processing as the user engages, searches, scans, processes, touches and communicates in ways indicated in Table 2 - 18.

Table 2 - 18 Effects of access-speed on the acquisition, processing and presentation of information

Activity	Effect
Engage	• Puts learners into a 'flow state' or the pleasurable experience of total absorption in a challenging activity. Anything that is perceived as an interruption to the flow state, receives a negative reaction. Learners are reluctant to reflect on the activity, and rather continue their pleasurable online flow state activity. The result is that learners do not reflect or cognitively engage at a deep level as they move onto the next screen or graphic.
Search	• Allows users to search documents for words and phrases and acquire relevant information on CD-ROMs and computer files quickly, at a distance or nearby, by fast-forwarding or sorting.
Scan	• Forces the learner in a digital environment to scan the screen to find the required information quickly, skim-reading the material.
Process	• Allows users to follow ten or more TV or video programs at once, as they switch from channel to channel just in time to catch important events on each as they quickly visually process the information.
Touch	• Leads to the 'Butterfly Defect' (Salomon, 1997) where a person touches nothing but the headline or soundbite and does not process that information into knowledge.
Communicate	• Affects grammar and literacy, as young people are developing a lexicon of abbreviations and symbols for digital communication use in email and text messages sent by cell phone.

(Csikszentmihalyi, 1990; Hackbarth, 1993; Montgomery, 1996; News24.com, 2000; Rushkoff, 1997; Rushkoff, 1999; Salomon, 1997; Yeo *et al*, 1998)

The access speed of the digital environment influences the acquisition and processing of information leading to greater speed and efficiency on the one hand, and superficial acquisition of information on the other.

5.2.4 Multimedia

Multimedia can include print, sound, animation and digital formats. Multimedia is multiple media formats used for the presentation of information (Hackbart, 1993, p. 57) woven in combinations of text, graphic art, sound, animation and video elements. It conveys information more effectively and powerfully than any single format. Table 2 - 19 summarises the effects of multimedia on the acquisition, processing and presentation of information by helping to build mental models, make meanings, transfer learning, present the world in shorthand, cross from abstract forms to other forms, communicate understanding, lure the reader, promote higher levels of thinking, provide greater access and provide different learning styles.

Table 2 - 19 Effects of multimedia on the acquisition, processing and presentation of information

Multimedia effect	Effect on the acquisition, processing and presentation of information
Builds mental models	• Provides print or still visuals with more impact, realism and immediacy thus helping readers build mental models.
Makes meanings	• Allows people to make meanings through combinations of symbol systems that they could not make, or make as well, through any of the systems on their own such as text or speech.
Transfers learning	• Promotes the transfer of learning to contexts beyond the confines of the classroom.
Presents the world in shorthand	• Presents the world in shorthand, suitable for the speed of access of the digital environment.
Crosses from abstract forms to other forms	• Helps people cross from the literate and abstract forms to other forms of presentation of information.
Communicates understanding	• Provides learners with the opportunity to communicate their understanding of the subject to those around them.
Lures the reader	• Lures the reader to more fascinating visual experiences, continually moving to the next image by using the ability of hypermedia; at the same time negatively influencing information acquisition by not processing the image into knowledge.
Promotes higher levels of thinking	• Creates opportunities for higher levels of thinking. When learners work in a hypertext or hypermedia design the minimum level of cognition attained on Bloom[2]'s Cognitive taxonomy is the level of *Application*.
Provides greater access	• Provides greater access by offering the possibility of greater educational equity for children who, for example, may be more visually than linguistically oriented.
Provides different learning styles	• Meets the needs of different learning styles and different literacy levels.

(Cooper, 2000; Ginn, 1995; Hackbarth, 1993; Lemke, 1992; Mayer & Gallini, 1990; Papert, 1993; Ross, 1993; Salomon, 1997; Wilhelm, 1995)

Table 2 - 19 tabulates the effects of multimedia on interaction with information. It has profound wide reaching effects enhancing the acquisition, recall, processing and presentation of information. In the digital environment multimedia becomes hypermedia that accentuates the interactivity of the information and makes it more attractive to young people.

[2] Bloom's Cognitive Taxonomy has six levels ranging from the lowest level of Knowledge, to Understanding, Application, Analysis, Synthesis to the highest level of Evaluation (Bloom, 1956).

5.2.5 Interactivity

The interactivity of the digital environment assists the learner acquire and process information. The different forms of interactivity found in a digital environment are tabulated in Table 2 - 20 with examples.

Table 2 - 20 Forms of interactivity found in digital environment

Interactivity	Example
Immediate response and feedback	• Accessing information with a click.
Adaptability and flexibility	• Adapting to the needs of individuals.
Feedback with a number of options	• Allows option of moving in non-linear form.
Grain-size waiting periods	• The user is able to interrupt or initiate an action with relatively short access time.
Learner control	• Handing some degree of responsibility to the user, i.e. self-pacing.
Object interactivity	• Activating objects by using a mouse or another pointing device.

(Borsook & Higginbotham-Wheat, 1991; Simms, 1995)

The above table illustrates how the many forms of interactivity in the hands of the user make the digital environment so attractive.

Vaughan (1998, p. 3) claims that by weaving together the sensual elements of multimedia - dazzling pictures and animations, engaging sounds, compelling video clips - you can electrify the thought and action centres of people's minds. Add the ability to control what and when those elements are delivered, and you have interactivity, 'potent forces in the lives of children' (Montgomery, 1996, online). Online media is thus dynamic and two-way. This participatory quality makes it particularly compelling (Montgomery, 1996, online), and it is this interaction with information that enables possession and acquisition of information (Wurman, 1989, p. 166).

5.2.6 Literacy

Levels of literacy competency affect information acquisition and processing. The nature of literacy is continually being refined with changing technologies for information and communication, as well as changing environments for their use (Leu, 1997. p. 62). Literacy is not static but a process one has to update as new technologies appear. While networked technologies are responsible for these changing and expanding definitions of literacy, defined and tabulated in Table 2 - 21,

they also provide the means to keep up with the change that will be a part of one's life.

Table 2 - 21 Definitions of literacy

Key word	Definition
Literacy	• Competence with a written language, a script. • Movement between and among communication systems, or transmediation.
Information literacy	• Ability to access, evaluate and use information from a variety of sources.
Digital literacy	• Ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers. • Literacy activities that are delivered, supported, accessed or assessed through computers or other digital means rather than on paper. • Ability to interact with information, using new and a growing number of symbolic elements as well as different structure forms.
Hypermedia literacy	• Involvement of the 'reader' in a hypermedia environment in cognitive reconstruction to suit own requirements and specifications.

(Doyle, 1995; Gilster, 1997; Leland & Harste, 1994; Reinking, n.d.; Topping, 1997)

The forms of literacy defined in Table 2 - 21 indicate a progression from simple literacy of competence with the written word, to hypermedia literacy when users are able to cognitively reconstruct a topic to their own requirements, from being competent with one format to competence with many formats. More so than in a traditional print environment, literacy on the Internet (Leu, 1997, p. 65) and in a digital environment is gained through experience (Berners-Lee, 2000, p. 143) and informal social interactions with peers (McCluskey, 1996, online).

An experienced user in a digital environment

- knows where to find information on a busy screen;
- develops sophisticated navigational strategies to source information in a digital format on the World Wide Web, CD-ROM or computer screen;
- becomes sceptical of digital material;
- evaluates information based on the authority of the uniform resource locator (URL) or compact disk (CD) publishing data;
- is aware of the variety of meanings inherent in the multiple media forms in which messages appear;
- is aware of peer review when material is available in digital format; and

- recognises the basic elements in the language of visual gestures that determine their ability to navigate the non-verbal, non-linear digital environment (Alvarez, 1998, p. 42; Berners-Lee, 2000, p. 143; Leu, 1997, p. 64-65; Rushkoff, 1999, p.52).

Lack of experience in a digital environment results in information anxiety and inhibits information acquisition and processing.

5.2.7 Preferred information sources

The preferred source of information in a digital environment is dependent on the need and type of information required. Of all forms of information exchange, verbal communication is used the most as it is simple, informal, flexible, interactive and private. Paper-based documentation is more commonly used for formal communication. Computerised information is mainly used as an information management tool. There is little evidence that computer-derived information is preferred over traditional written or verbal sources (Zeffane & Cheek, 1995, p. 119).

5.2.8 Computer laboratory ecology

The spatial configuration of a room influences social behaviour and interaction (Jaffee, 2002, online). Classroom ecology influences the way the learners interact with each other.

5.2.9 Confluence of influencing factors

In conclusion, when learners work in a digital environment, information acquisition, processing and presentation are inhibited by technological anxiety and information illiteracy and, at the same time, are both positively and negatively affected by screen dynamics, access speed, multimedia, interactivity, information literacy and lack of technological anxiety.

There are various models that show the amount of remembering which takes place in different situations. The percentages in Table 2 - 22 are similar to those found in many places in the literature indicating the amount of remembering which takes place when a person reads, hears, sees, says and does.

Table 2 - 22 Percentages of remembering based on the activity

Activity	Rosario	Rose	Average
Reading	10%	20%	15%
Hearing	20%	30%	25%
Seeing	30%	40%	35%
Seeing and hearing	50%		50%
Saying	80%	50%	65%
Doing		60%	60%
Saying and doing	90%		90%
Saying, doing, seeing and hearing		90%	90%

(Rosario, n.d.; Rose & Nicholl, 1997)

Table 2 - 22 shows differing percentages of remembering based on the method of information acquisition, processing and presentation with reading being the least effective, and 'saying, doing, seeing and hearing' most effective. In a *multimedia* environment learners 'see' and 'hear', and 'see and hear'. In an *interactive* digital educational environment learners 'say and do' (Rosario, n.d.) Hence, based on the percentages above, working in a hypermedia interactive digital environment contributes to information acquisition, processing and presentation.

The following section will report on the results of a literature review on the acquisition, processing and presentation of information in an *educational* digital environment.

5.3 Interacting with information in an educational digital environment

In an educational environment learners are expected to acquire information, process it and present the results. In a digital environment information acquired is usually of a digital nature, and the method of presentation would involve a digital input. The information is processed as it is acquired *and* presented. The following will discuss how the digital environment influences the interaction with information in an *educational* environment.

5.3.1 Cognitive aspects

The study of cognition can be subdivided into problem solving, error, skill acquisition, reasoning and memory (Dix, 1998, p. 36). Information is cognitively processed in an educational digital environment and in the creation of or working with hypermedia and multimedia projects as tabulated in Table 2 - 23 based on the divisions of problem solving, error, skills, reasoning and memory from Dix (1998, p. 36).

Table 2 - 23 Cognitive information processing in an educational digital environment

Process	Activity
Problem solving	• Working in a technology enriched learning environment, *Evaluation* of information measured against Bloom's Cognitive Taxonomy was found to be significantly higher, and *Analysis* and *Synthesis* of information were found to be generally higher. • Creativity by learners exploring the unknown, taking individual initiative to find solutions, was also exhibited.
Error	• Acceptance of error and resolving of errors is part of work in a digital environment where errors can be quickly resolved.
Skills	• Skills gained in the technical field are continually challenged, the limits being pushed with the available software. It is not clear if technical skills learned, using for example the computer, are transferred to fields such as the video or mobile phone, but it is presumed they are. • Learners use skills of previewing, skimming, checking and rereading while browsing online. It has not been established through a literature review whether learners transfer those skills to their reading of paper-based material. • In the creation of multimedia projects learners use project management, research, organisation and representation, presentation and reflection skills.
Reasoning	• Reasoning skills are used while working with multimedia, to transform an object from one sign system and recast it in terms of the content and expression of another sign system, or transmediation. • Intertwining of many perspectives from multiple media sources to create new meaningful forms requires many forms of reasoning. • Authentic language is used as part of the reasoning process, in collaboration with peers.
Memory	• Sensory (graphic, auditory, kinetic) features of digital environment can assist short-term memory. • Sensory overload can overwhelm, depending on the level of media literacy. • Organisation or structure of digital environment assists in long-term memory.

(Carver *et al*, 1992; Coiro, 2000; Hopson, 1998; Leland & Harste, 1994; Shenk, 1997)

Table 2 - 23 summarised and tabulated cognitive information processing in an educational digital information environment based on the divisions of Dix (1998, p. 36).

5.3.2 Affective aspects

The educational digital information environment influences the processing of information by means of motivation and by developing a spirit of community as discussed in Table 2 - 24.

Table 2 - 24 Affective information processing in an educational digital environment

Process	Activity
Motivation	• Extrinsic motivation in improved information processing, i.e. learning and better marks. • Intrinsic motivation in more enjoyable information processing, i.e. teaching and learning. • Unceasing effort, perseverance, a sense of empowerment, confidence, excitement and on-task engagement.
Spirit of community	• Collaboration or cooperation and group ownership of work. • Conventional communication patterns transformed; learners teach and learn from each other. • More honesty, less fear, less shyness and less aggressive domination of peer-to-peer discussion.

(Bump, 1999; Clifford, Friesen & Jacobsen, 1998; Coiro, 2000; Hopson, 1998; Tuman, 1992; Wishart & Blease, 1999)

The motivational aspects of working in a digital information environment are noted as well as the positive spirit of community in Table 2 - 24.

5.3.3 Physical aspects

The educational digital environment influences the physical activities of learners, tabulated in Table 2 - 25, as the learner clicks, scrolls, surfs, communicates, downloads, examines, jumps, loses sight of time, moves, redoes, talks and focuses on the computer while working in a digital information environment.

The activities described in Table 2 - 25 indicate how learners physically process information in a digital information environment, information processing activities unique to a digital information environment.

Table 2 - 25 Physical information processing in an educational digital environment

Process	Activity
Click, scroll, surf	Continually active, clicks the mouse, surfs web sites, scrolls up and down, always moving.
Communicate	Communicates with other learners showing and sharing work.
Download	Downloads large amounts of information always looking for more facts.
Examine	Examines animated images, sound, video clips and images before reading text.
Jump	Jumps from hyperlink to hyperlink, never satisfied with what is available.
Lose sight of time	Not able to plan use of time, work always handed in late, always under pressure, always trying to do better.
Move	Moves quickly onto the next graphic or screen, looking for the elusive piece of information, not processing what is there.
Redo	Redoes multimedia projects, never satisfied with what has been created.
Talk	Discusses information, thereby processing information.
Focus on	Looks at computer monitor and interacts with fellow learners.

(Africa, 2001; Yeo *et al*, 1998)

5.4 Perspectives on the interaction

In the preceding section the formats of information found in a digital environment and then how that environment influences the interaction with information were discussed. The discussion ended by indicating how a digital environment influences information processing in an educational digital environment.

6 Synthesis and profile of a South African Further Education and Training learner in an educational digital environment

Chapter 2 commenced by defining and discussing a digital environment. The dynamics between modern South African society and FET learners were discussed with reference to the way in which the interaction of FET learners with information is influenced. This was followed with a discussion of how learners process information in an educational digital environment.

Based on the preceding literature review, a profile of a South African FET learner in a digital environment was created and then used in the field as a basis for the creation of a fuller profile. To facilitate the development of the profile, the South African FET learner's behaviours or activities when interacting with information in an educational digital environment is divided into three different perspectives, i.e.

cognitive, affective and physical. Tables 2 - 26, 2 - 27 and 2 - 28 synthesise material discussed in preceding sections and tables and attempts to create the profile based on the literature review.

Table 2 - 26 below describes the way in which learners interact with information from a cognitive perspective based on the literature examining how they acquire, recall, process and plan, and present information. The table references in Tables 2 - 26, 2 - 27 and 2 - 28 are not directly correlated to the specifically behaviour or activity, but to the behaviours or activities as a whole in each perspective.

Table 2 - 26 Cognitive profile of a South African FET learner interacting with information in a digital environment based on the literature review

Cognitive perspective	Cognitive behaviour or activity	Table reference
Acquiring information	• Able to source material in digital environment with sophisticated search strategies • Absorbs material quickly as individual learner is accommodated • Critical of content of resource material • Prefers acquiring information from graphic images as opposed to text • Knows where to find information on a screen	Table 2 - 12 Table 2 - 18 Table 2 - 19 Table 2 - 20
Recalling information	• Recall of screen-based material is difficult • Short term memory assisted by sensory features of digital environment • Recalls text on screen in chunks and not with the bigger picture • Is literate in non-verbal environment • Long term memory is assisted by organisation of digital environment	Table 2 - 15 Table 2 - 18 Table 2 - 23
Processing / planning information	• Plans the creation of digital projects • Builds mental models of the learning material • Uses higher-level thinking skills • Visually processes a number of programs at once	Table 2 - 18 Table 2 - 19 Table 2 - 23 Table 2 - 24
Presenting information	• Cognitive processing of screen-based material is superficial • Is able to communicate understanding of the subject matter in multiple formats • Develops own symbols and abbreviations for communicating • Transfer of learning to other contexts takes place • Uses authentic language in developing digital projects which assists information processing	Table 2 - 15 Table 2 - 18 Table 2 - 19 Table 2 - 23

The preceding table tabulated behaviours or activities that illustrate how learners interact with information from a cognitive perspective. Table 2 - 27 tabulates

behaviours or activities from the literature when a learner interacts with information from an affective perspective looking at motivation, the influence of peers, management of time and their mental state.

Table 2 - 27 Affective profile of a South African FET learner interacting with information in a digital environment based on the literature review

Affective perspective	Affective behaviour or activity	Table reference
Motivation	• Intrinsically motivated • Extrinsically motivated	Table 2 - 12 Table 2 - 18 Table 2 - 19 Table 2 - 24
Influence of peers	• Learns in a positive social environment • Critical of own digital creations, i.e. wants to correct and redo, to impress peers • Learns with group ownership • Wants the independence to find / create own learning resources	Table 2 - 12 Table 2 - 20 Table 2 - 24
Management of time	• Wants useful, relevant information • Wants fast access to information resources	Table 2 - 12 Table 2 - 19 Table 2 - 20
Mental state	• Does not suffer from computer anxiety • Willing to try a number of options and accept error • Adventurous, creative, ready to explore the digital unknown	Table 2 - 12 Table 2 - 17 Table 2 - 23

Behaviours or activities with reference to motivation, the influence of peers, management of time and the learner's mental state are tabulated in Table 2 - 27. The following table tabulates how learners physically interact with information when they acquire and process information in a digital environment based on the literature.

Table 2 - 28 Physical profile of a South African FET learner interacting with information in a digital environment based on the literature review

Physical perspective	Physical behaviour or activity	Table reference
Acquiring information	• Looks for required data using digital features • Moves continually onto a new feature in the digital environment, continuing the flow state • Reads certain areas of the screen first in preference to others • Reads text in a digital environment relatively slowly • Skims and rereads certain portions of the screen	Table 2 - 18 Table 2 - 15 Table 2 - 23
Processing information	• Works / learns actively doing things • Works / learns in a group with talking • Works with partner, shares ideas and copies work	Table 2 - 12 Table 2 - 25

Table 2 - 28 lists activities found when learners interact with information in a digital environment based on the literature. The three preceding tables summarise the findings in the literature of how South African FET learners interact with information in a digitally enabled environment.

7 Summary

Chapter 2 developed a profile of a South African FET learner in a digital information environment based on the literature review. The profile described how learners interact with information from cognitive, affective and physical perspectives as they acquire, recall, process and present information motivated, influenced by peers, management of time and their mental state. This profile will be used as a basis for the case studies. The methodology used in the research is discussed in Chapter 3.