2.1 Introduction

The literature surveyed for this study falls in three categories: the first is the category of the levels of learning, the second is the category of design studies and the third is the category of computer-assisted learning (CAL). The study focuses on the way in which first year pre-service technology education teachers' visual analyses of designs as well as their drawings indicate what they have partially learned about aesthetic design constructs through an electronic tutorial. The main research question answered in this study is the following:

What was the role of the tutorial, *Design in Action* (a computer-aided tool), in Kirkpatrick's three levels of learning in a first year design and technology education programme?

The theoretical base set by the literature will be used to answer the research questions in an integrated manner. The categories will now be summarised.

2.1.1 Category 1: Levels of learning

The first category of literature reviewed falls under levels of learning (Kirkpatrick, 1994). It will be discussed in the following order:

- reaction;
- learning;
- behaviour; and
- results.

2.1.2 Category 2: Design studies

The second category of literature surveyed falls under that of design studies. It will be discussed in the following order:

- the concept "design" taken from the definition of the act of designing, as explained by the *RNCS* (Department of Education, 2002);
- drawing and aesthetics in design and technology education programmes, as researched by Garner (Garner *et al.*, 1993) and Davies (Davies, 2000);
- the role of aesthetics and drawing in design activities, as researched by Tversky (1999), Anderson (1998) and Press & Cooper (2002);
- classic works on aesthetics and universal visual language (design principles, design elements and design techniques) by Lauer (1985) and Wong (1993) were consulted to inform about the domain specific constructs of aesthetics;

- supporting evidence of the importance of visual abilities in the design process was found in Garner (1994); Parr (2004); Petrina (n.d.) and Worden (2003) ; and
- drawing as tool for visualising conceptual development (Anderson, 1998; Tversky, 1999).

2.1.3 Category 3: CAL in design and technology education programmes

The literature surveyed for category three falls in the category of computer-assisted learning (CAL) material. It will be discussed in the following sequence:

- learning and teaching support material, as required by the South African Department of Education (Department of Education, 2002);
- CAL and electronic teaching and learning support material, as suggested by Alessi and Trollip (2001) and Hannafin and Peck (1988) and the impact that CAL might have on design and technology education (Atkinson, 1998).

2.2 Discussion of the literature survey

The literature surveyed in order to answer the three research questions derived from the main research question, discussed in chapter 3, will now be discussed according to the different categories summarised above.

2.2.1 Category 1: Levels of learning

Kirkpatrick‘s proposed model for evaluating learning represents a sequence in which instructional programmes can be evaluated (Kirkpatrick, 1994). I used this model (see chapter 1, figure 1.3) as theoretical frame for my research methodology, which is discussed in chapter 3. However, it is important to take cognisance of how Kirkpatrick (1994) defines each of the levels of learning, namely reaction, learning, behaviour and results, in order to understand how I arrived at answering the main research question. In addition to Kirkpatrick (1994), I surveyed a refined way of examining the four levels, as suggested by Alliger *et al.* (1997). The way in which Kirkpatrick (1994) and Alliger (1997) perceive the learning process will now be discussed in an integrated manner.

Kirkpatrick (1994) describes the four levels of learning in his evaluation model (figure 1.3) as representative of a sequence of ways to evaluate instruction and learning support material. Although he acknowledges the importance of each level, Kirkpatrick says, “the process becomes more difficult and time-consuming, but it also provides more valuable information” (Kirkpatrick, 1994, p. 21).

2.2.1.1 Level 1: Reaction

Reaction may be defined as how well learners like instruction and instructional material or parts thereof. In the past, cognitivists explored mental processes from the perspective of cognition rather than affect. However, recent research noted that every sensation gives rise to an affect or emotion (De Villiers, 2002). According to Kirkpatrick (1994) learners' initial reaction to instruction will influence the quality and quantity of learning that takes place. He acknowledges the fact that a positive reaction does not guarantee learning, but argues that a negative reaction certainly reduces its possibility (Kirkpatrick, 1994). A positive reaction would be evident in how much learners "like" instruction. How much they enjoy it; how easy and understandable they find it, will be reflected in affective expressions of general satisfaction (Alliger *et al.*, 1997), which will cultivate a positive attitude towards instructional material. In addition to this, perceived usefulness of instructional material will also contribute to feelings of satisfaction. One way in which learners express their perceptions of its usefulness, is through utility judgements in which they convey their beliefs about the value and usefulness of the instruction, as well as their beliefs about the potential for practical application in related tasks (Alliger *et al.*, 1997).

2.2.1.2 Level 2: Learning

Kirkpatrick considers learning as change on an intellectual level, namely increasing knowledge, developing or improving skills and changing attitudes (Kirkpatrick, 1994). According to him no change in behaviour will occur without learning. For Kirkpatrick increased knowledge refers to the amount of content learned, i.e. concepts and principles mastered; skills refer to improvement of performance and technique, and attitude refers to how positive a person feels towards the training (Kirkpatrick, 1994). Learning can also refer to which principles, facts, elements and techniques were understood and absorbed by learners (Clementz, 2002).

There are different kinds of learning, e.g. momentary learning and temporary retention of knowledge; relevant, unintended learning, acquisition of inert knowledge serving a purpose only when placed into a context and formal learning (De Villiers, 2002; Price, 1998). Alliger *et al* (1997) refined Kirkpatrick's model by referring to immediate knowledge and knowledge retention. He views immediate retention as the amount of knowledge acquired at the conclusion of an intervention, while knowledge retention is considered as the amount of knowledge retained at some point after the immediate conclusion of the intervention (Alliger *et al.*, 1997).

2.2.1.3 Level 3: Behaviour

Behaviour is regarded as the application of a trained strategy within a different context (De Villiers, 2002) as the result of learning (Kirkpatrick, 1994). True learning (transfer) can be considered to have taken place when knowledge and skills learned in one domain are applied in another situation (Osman & Hannafin, 1992). The implication is thus that change in behaviour is constituted by demonstrated transfer and application of knowledge, skills and attitudes in new situations (Kirkpatrick, 1994). Commenting on Kirkpatrick's third level of evaluation, Clark maintains that "behaviour is the action that is performed, while the final results of the behaviour is the performance" (Clark, n.d.). I was, therefore, actually interested in the consequence of the behaviour, i.e. the performance. Alliger, on the other hand, describes behaviour as "demonstrated on the job performance some time after the conclusion of the training" (Alliger *et al.*, 1997 p.6).

According to Kirkpatrick, behaviour cannot change unless learners' have had the opportunity to demonstrate it. He is also of the opinion that it is impossible to predict when a change in behaviour will occur. Change can take place at any time, ranging from immediately after the intervention to a situation where it may never happen. However, behaviour can only change if transfer of knowledge has taken place (Kirkpatrick, 1994).

2.2.1.4 Level 4: Results

Results refer to the achievement of goals of training in terms of reduced costs, higher quality, increased production and lower rates of employee turnover and absenteeism. This level measures the success of the programme in terms that managers and executives can understand. From a business and organisational point of view, this is the overall reason for a training programme, yet level four results are not typically addressed in an educational institution. Determining results in financial terms is difficult to measure, and is hard to link directly to training (Winfrey, 2002). It was not possible to test "results" as it was not appropriate to this study.

2.2.2 Category 2: Design studies

It is generally accepted in design studies that there are four aspects of design, i.e. function, aesthetics, ergonomics and value (Department of Education, 2002; Garratt, 1996; Press & Cooper, 2002). It is also acknowledged that drawing is a core skill to be mastered in design methodology (Davies, 2000; Garner, 1994). The literature surveyed in this category will thus focus on learning and teaching a universal visual language, the role of aesthetics in design and drawing skills in technology education programmes.

2.2.2.1 The concept "design"

The Department of Education has broken down the act of designing into separate activities, all of which form part of the design phase in the design process suggested in the *RNCS* (Department of Education, 2002):

- understanding the problem;
- writing a design brief;
- generating possible solutions;
- drawing ideas on paper;
- considering several possible solutions;
- applying graphic skills: use of colour, rendering techniques, two-dimensional and three-dimensional drawings, planning, sketching, calculating, modeling;
- managing resources;
- choosing the best solution;
- justifying choices;
- preparing final working drawings; and
- testing, simulating or modelling the solution.

Davies suggests the development of three abilities that can help to empower learners and inform their decision making:

- presenting information in 2-D and 3-D forms;
- selecting symbol systems, language and styles to suit problem contexts and audiences; and
- using the mind and the hand in an integrated way to achieve desired products (Davies, 1996).

The focus of this study will be on drawing and the application of graphic skills and aesthetics, which will be amplified by the discussion of the literature surveyed.

2.2.2.2 Aesthetics and drawing in design activities

The notion of drawing as a modelling device and as a tool for expressing aesthetic principles is not a new one (Anderson, 1998). Drawing decisions in design are based on recognised representation and presentation techniques, which have emerged into a standard visual language. It shares visual techniques with art (Tversky, 1999), including the realising of design principles by using design elements through the application of different design techniques as summarised in table 2.1.

Knowledge and understanding of aesthetics form an integral part of product design skills as far as it relates to emphasis on the search for a defined user's preferences through market studies and relating methods. This approach is called "market driven aesthetics" (the intention of making the user buy the product). The philosophy behind this approach is that a product is only considered successful once it is valued as being popular by the buyer (Parr, 2004). In the aesthetic language of products, the transmitter of the message is the product itself (Parr, 2004). Parr argues that product aesthetics is an important means of emphasising functional user preferences – in this way aesthetics can be seen as serving functional product requirements as well (Parr, 2004).

Some suggestions for developing a universal visual language to be included in drawing curricula by design educationalists will subsequently be discussed.

2.2.2.3 Universal visual language

Formal aesthetics deal with perceptual references (composition, proportion, colour, etc.) (Anderson, 1998). Some design researchers regard aesthetics as a language providing the necessary rules for synthesising the basic carriers of meaning (the individual design elements of a product, e.g. line, texture, colour, etc.) (Parr, 2004).

Drawings use a small number of segments or elements in varying combinations to produce a potentially infinite set of different drawings. This allows for "peoples' enormous capacity for recognizing many different patterns" (Tversky, 1999). Studying the segments of sketches give insight into which conceptual modules are operative and how they are schematised (Tversky, 1999). These segments in drawings can naturally be analysed according to:

- design principles;
- design elements;
- techniques; and
- ways of arrangement on the format.

These segments are considered standard visual signs that are considered as communication requirements within a domain of its own, although it shares standard and aesthetic rules or principles with art, achieved through the application of design elements (Press & Cooper, 2002). Drawing tasks towards specific design principles, design elements and technique can provide useful information about the segments (Tversky, 1999) in students' schemas (drawings). Table 2.1 summarises the structure for analysing segments in designers' drawings.

Table 2.1 Standard visual language

Construct	
Design principles	unity, balance, scale, proportion, emphasis, rhythm, illusion of space (Lauer, 1985, Wong, 1993)
Design elements	line, shape, size, texture, illusion of movement, colour, tonal value (Lauer, 1985, Wong, 1993)
Design techniques	repetition, addition, omission, distortion, enlargement, diminution (Tversky, 1999)

Referring to teaching and learning a universal language that is used by designers to apply aesthetic design principles, implies the ability of design and technology students to identify and create formal aesthetic properties of a product.

2.2.2.4 Drawing in design and technology education programmes

The existing research data reported on by the literature indicate that, because of its powerful promotion of cognitive processes when designing, drawing should be included as one of the major components of design education (Garner, 1994). The *RNCS* (Department of Education, 2002) emphasises the importance of drawing as a design skill by the repetitive reference to drawing skills as one of the elements in the various steps of the design process, e.g. in investigating, designing and communicating.

Multiple design researchers and technology educationalists have studied the role of drawing in the design process, as well as its role in developing higher order thinking skills and students' problem-solving abilities. A survey of the literature on the re-evaluation of the role of drawing within design activity through case studies done by Garner (Garner *et al.*, 1993), illuminates the cognitive significance of drawing in the design process in technology education. He distinguishes between different types of drawings used in the development of "designerly thought" and its cognitive value (Garner *et al.*, 1993).

Research undertaken by Atkinson (1998) on primary and secondary technology education learners in the United Kingdom confirms the close links between drawing ability and design skills when done within the boundaries of a project, using a design process model (Atkinson, 1998). Her research findings indicated to me that although the majority of learners in her study did not like drawing, finding it tedious, and those learners who produced the best drawings also generated higher quality conceptual ideas.

Research in design education also indicates the importance of drawing ability in the investigation phase where learners use it as a tool to analyse existing designs and to construct understanding of the structure of objects (Anderson, 1998; Garner, 1994) and to enhance conceptual understanding of a design (Atkinson, 1998).

2.2.2.5 Drawing as a cognitive tool

Drawing is, however, more than an expression of aesthetics. Literature indicates that it is known that there is a close link between drawing and designing, and the demands for clarification and development of the role of drawing within design have long been voiced, but rarely met (Garner, 1988). Davies has reported on some research on the role of drawing in design by investigating the real world of product designers. He found that designing requires "the formulation of images in the mind's eye which implies a capacity for mental modeling" (Davies, 1996, p.3). According to Davies reacting to design problems implies thinking about and modeling ideas in order to develop understanding of the range of solutions that might be available (Davies, 1996). Possible solutions can be managed in ways that are relevant to the growth and development of ideas. Imaging means that a universal language or symbol system is used to communicate and convince others of the worth of the solution to the problem.

Drawings are regarded by researchers in the field of visual literacy, as a cognitive tool that can reveal thought and conceptual understanding (Tversky, 1999).
Studies by Anderson (1998) on first year novice designers suggest that exercise and the process of drawing development enhance visual understanding through experiences that further broaden the visual library of shapes, details and potential applications. Arnheim (1954) confirms the importance of visual experiences: "These experiences play a significant role in how we see, recognise, and understand objects. New images come into contact with memory traces of shapes from past experiences that are similar" (Arnheim, 1954 , p.141).

Many design researchers have discussed the role of visualisation in design. Worden says:

> *Visualisation can be part of doing research through the process of designing, where it is then central to methods of generating ideas, or is part of a design process of iteration and reflection. The process of visualisation can be diagrammatically represented or communicated through the production of an artefact that is interpreted through the act of viewing. Drawing is integral to this as are other forms of technical visualisation* (Worden, 2003, p.2).

Many design researchers have also described the act of visualisation. It can be said that in acts of imagining or giving form, visualisation means to make visible, especially to the mind, things not visible to the eye (Worden, 2003).

Anderson's (1998) study on first year novice designers indicated that as a skill, drawing construction helps the student to mentally focus, simplify the structure of visual information and to enhance clarity and understanding.

It appears that there is no clear division between drawing strategies aimed at exploring problems, manipulating information and visualising responses. The implication of this statement by Garner (1993) is that it is difficult for researchers to establish accurate and concrete proof of exactly what takes place during investigating and designing (presenting possible solutions). In addition to the extremely complicated set of cognitive processes interrelated when drawing for design purposes, Garner (1993) reports on skilled designers being able to produce drawings that have multiple functions and, more importantly, functions that apparently take place simultaneously. It is, therefore, possible that a designer can produce a drawing that may have been made to externalise a private and incomplete idea, which at the same time can function as the communication of form, detail, scale, shape, colour, etc. The same drawing may also facilitate evaluation and at the same time provoke further generation of ideas (Garner *et al*., 1993).

In order to achieve conceptual understanding, the student has to be skilled in observation, analytical thinking and critical thinking, applying knowledge and skills (Davies, 1996). Anderson indicates that design drawing represents conceptual understanding of a design problem, which clarifies an idea sufficiently so as to offer specific intent (Anderson, 1998). This implies that the learner demonstrates his or her understanding of the conceptual relations between the problem and possible solutions through drawings.

2.2.3 Category 3: CAL in design and technology education

In order to answer research questions 1 and 2, the third category of literature surveyed focused on the development of learning support material for the purpose of design and technology education purposes, with specific focus on the use of computer-based interventions in technology education programmes.

In this section I surveyed literature clarifying the following:

- introduction to CAL in educational programmes;
- CAL in teaching and learning design and technology in general; and
- CAL in teaching and learning specific knowledge and skills in design and technology education.

The policy document, *Teacher's Guide for the Development of Learning Programmes for Technology,* states the following:

> *Learning and Teaching Support Materials have a very important role to play in the learning of Technology. They provide the medium through which teaching and learning happens at school…Among other things, they provide opportunities for learners …to:*
>
> - *Develop skills, knowledge, values and attitudes as underpinned by Learning Outcomes and their corresponding Assessment Standards in the Technology Learning Area Statement.*
> - *Do research in various areas of Technology*.
>
> and
>
> *Learning and Teaching Support Materials in Technology include …*
> *Reference Materials – i.e. textbooks, encyclopaedias, electronic reference media* (Department of Education, 2004, p.51).

The theoretical underpinnings for evaluating and selecting learning and teaching support materials were founded on the policy document, *Teacher's Guide for the Development of Learning Programmes for Technology*, (Department of Education, 2004):

- learner centeredness;
- cooperative learning;
- appropriateness of learner activities to learners' cognitive development;
- contextualisation of activities;

- assessment guidelines; and
- affordability.

It is within this broad theoretical field of developing learning support material that the focus of this study falls on the development of electronic reference media to support the development of design skills, knowledge, values and attitudes and to do research in various areas of technology.

2.2.3.1 A strategy for teaching and learning drawing in technology education

Academics and practitioners in the Western World have considered theories of learning and instruction in order to develop effective learning, particularly since the 1960s. Instructional theory studies methods of facilitating human learning and development to "help people learn better" (De Villiers, 2002). Instructional and learning theories are concerned with formal learning. Basic instruction is predisposed to the pragmatic simplification of phenomena and associated isolation of aspects of a domain. Methods of communicating information are proposed to help learners apply knowledge, to integrate learning and to transfer it to complex domains (De Villiers, 2002).

Evaluating learning support material (contextually integrated learning support material) as category of instructional material can be complicated as it may lead to discussions without clear isolation of courseware components. Studying the educational and pedagogical value of any support material can, therefore, not be done without considering the whole context in which it is implemented. The question to ask is "under which conditions is the learning support material valuable"? The type of technology (media), the type of student and the particular conditions (learning environment) involved, as well as the dynamic interrelations between all these factors, have to be considered when evaluating learning support material (Poole, 2001).

Alessi and Trollip maintain:

> *If we were to chart out all the instructional topics, the wide variety of learners, and the many instructional situations, we would sometimes find an advantage for books, sometimes teachers, sometimes film or video, sometimes peer-tutoring, sometimes hands-on field experience, sometimes listening to an audiotape, and sometimes computers. Not surprisingly, across these many studies, which utilized a variety of topics, learners, and*

situations, little or no overall effect was found in favour of a single medium (Alessi & Trollip, 2001, p.10).

Alessi and Trollip continue:

> *To take advantage of the computer's particular capabilities and not to waste them, our first rule for correctly using or developing instruction to be delivered via computer is to do so in situations where the computer is likely to be beneficial* (Alessi & Trollip, 2001, p.10).

According to Poole the question which needs to be asked and answered when assessing (computer) technology's impact in education, is "what added value does technology bring to the classroom?" (Poole, 2001). The implication of the above statements is that critical evaluation of the appropriateness of learning support material and the suitability of the medium in which it is implemented, should be made.

In order to critically evaluate the suitability of computer assisted learning support, its usability and effectiveness should be tested. Usability testing is described as "a dynamic process that can be used throughout the process of developing interactive multimedia software" (Lee, 1999b, p2). The purpose of usability testing is to find problems and make recommendations to improve the utility of a product during its design and development. For developing effective interactive multimedia software, dimensions of usability testing were classified into the general categories of learnability; performance effectiveness; flexibility; error tolerance and system integrity; and user satisfaction. In the process of usability testing, evaluation experts consider the nature of users and tasks, tradeoffs supported by the iterative design paradigm, and real world constraints to effectively evaluate and improve interactive multimedia software. According to Lee (1999b) software should be simple to use, simple to understand, yet still powerful enough for the task.

Numerous studies have shown that interactive video, CD-ROM storybooks, computer-based drill and practice and tutorials can be powerful instructional tools. Computer-based tutorials are described as programs providing "some information or clarifies certain concepts in addition to providing the student with practice exercises" (Soe *et al.*, 2000). The implication is then that the computer can begin to take over actual instructional functions, adapted to the student's individual level of accomplishment.

Alessi and Trollip (2001) have identified the purpose of computer-based tutorials as the presentation of information to learners and the guidance through the initial use of the content. A tutorial (or self-study guide), therefore, comprises the following attributes:

- it presents factual information and model skills;
- it guides learners through the initial use of information;
- information is queued according to learner's abilities;
- it motivates the learner; and
- the locus of control should be with the learner (Alessi & Trollip, 2001).

There are two types of structures for computer-based tutorials, namely linear tutorials and branched tutorials. This is the simplest type of programming in tutorials. The tutorial progresses from one topic or concept to the next, presenting information and asking questions. Although this structure is commonly used, it does not take full advantage of the capabilities of computer-based instruction as it does not adapt to individual learners' needs (Alessi & Trollip, 2001).

2.2.3.2 The use of CAL in technology education

The integration of educational software designed for integration in the domain of technology education, has recently been emerging worldwide. Computer Aided Learning (CAL) in technology education programmes as tool to facilitate learning is seen as particularly attractive as a means of stimulating technological activity providing learning at a point of need, and to bring design contexts into the classroom (Hodgson, 1994). The potential value of the computer in a number of specific categories of activities relating to design and technology, namely graphics, modelling, manufacture, control and information use is currently being investigated by researchers in the field (Hodgson, 1994).

According to Atkinson (1998), CAL systems typically simulate activities, instruct or reveal information – usually with a specific educational purpose in mind. The pedagogical advantages of CAL have all been well researched (Alexander, 1995; Atkinson, 1998; Ford, 1999; Lee, 1999a). Benefits have been reported in terms of individualised learning that can be self-paced, self-accessed, asynchronised, synchronised or in real time modes, provide non-sequential based delivery and include positive motivation interactive features.

Hodgson (1994) identifies examples of support that CAL, specifically in design and technology, may provide:

- bringing real design situations and contexts into the classroom;
- simulation of technological activity and so moving more rapidly and effectively towards a design outcome; and
- information or instruction at the point of need.

2.2.3.3 Suitability of Microsoft PowerPoint™ as platform for a tutorial

Some authors regard Microsoft PowerPoint™ as a suitable platform for tutorials because of its capacity to be programmed in a linear way as well as to branch. This versatility can, therefore, be utilised to suit the particular needs of the learners (Montgomery & Wiley, 2004). Microsoft PowerPoint™ has traditionally been used as an educational tool for live presentations supporting presenters' spoken message. It has been criticised harshly by audiences, students and researchers for a number of reasons (Rozaitis, 2004). Some critics claim that Microsoft PowerPoint™ lends itself to abuse to the extent that it in fact leads to less effective rather than more effective communication. Taylor recorded a student commenting on a lecturer using Microsoft PowerPoint™ as saying: "It can take away from the teaching. If the notes are in paragraph form, I can't focus on what's important, and I don't pay attention to the lecture" (Rozaitis, 2004; Taylor, 2003).

Microsoft PowerPoint™ has also been criticised for causing boredom of audiences to the extent of "death by PowerPoint" caused by its simplified linearity, lack of interactivity, bulleted telegraphic text repeated by the presenter, the tendency to present facts through misleading graphs and irritating animations and presenters focusing on visual effects contributing nothing to the quality of the content (Norman & Spohrer, 1996). However, Microsoft PowerPoint™ has several advantages that make it particularly suitable for conveying the dynamics of visual material because of its capacity to deliver high quality graphic representations as well as advanced branching programming possibilities (Weiser 2003). It is the branching ability that makes it particularly suitable for the purpose of a self-study guide, namely interactive asynchronous use, self-paced, undirected individual and independent learning.

2.2.3.4 Tutorials

There are different kinds of learning, e.g. momentary learning and temporary retention of knowledge; relevant, unintended learning; acquisition of inert knowledge serving no purpose until placed into a context; and formal learning (De Villiers, 2002). A learning strategy is an individual's approach to complete a task. More specifically, a learning strategy is an individual's way of organizing and using a particular set of skills in order to learn content or accomplish other tasks more effectively and efficiently in school as well as in non-academic settings (Schumaker *et al.*, 1984).

In order to make effective use of an electronic self-study guide, the software must allow for the individual needs of the learners. It should be presented and programmed in such a way that learners are motivated, enjoy what they are doing and learn effectively. The efficient instructions should be clear to allow for undirected use. The focus should be on learners constructing own knowledge and understanding of the domain specific content (Schumaker *et al.*, 1984).

2.3 Overview of the literature relating to the theoretical underpinnings of this study

Experts in the field of design and technology education indicated that one of the most effective strategies in teaching and learning technological literacy and conceptual understanding is through the design process. The design process is also regarded as a strategy for solving problems in a systematic and non-threatening way. It was also found that there are many models of the design process, both linear and iterative in nature. The focus area of the literature surveyed was on the role of visualisation through drawing in the design process and the extent to which computer-based educational software designed towards the understanding of aesthetic design principles enhanced the design abilities of design and technology education students. Several usability studies of educational software were found, but the focus in this study is on the simplicity of use, simplicity of understanding and its power to accomplish the set learning outcomes.

In this chapter, a survey of the literature, definitions of key concepts and an integrated discussion of the literature were given. In the following chapter, the design and methodology followed during the fieldwork and the motivation for selecting the qualitative research method will be documented.