

## 5.1 Introduction

In summary I will discuss the salient points of this study pertaining to the findings and the research methodology applied.

### 5.1.1 The findings

The findings of this study revealed that participants demonstrated learning of the design constructs specific to the domain of aesthetics in segments of patterns, families and categories (figure 4.22). These segments were evident in the three levels of learning evaluated for the purpose of this study.

#### 5.1.1.1 Level 1: Reaction

- Participants were in general satisfied with the tutorial. Despite participants' negative reaction about the time it took to open the tutorial from the Internet, they were motivated to work through the tutorial, implying their overall positive feelings about the tutorial. This was an indication of the participants' motivation and positive attitude towards the design tasks in the module. They enjoyed the visual images in the tutorial and also found the tutorial easy to use, which indicated their satisfaction with the programming of the tutorial.
- The semi-structured interviews confirmed what was found in the literature, i.e. despite negative responses to other aspects of the tutorial, participants considered the relevance of the tutorial so important that they would revisit and reuse it (Clark, n.d.) - in the rest of the module as well as for other modules in the design and technology programme.

#### 5.1.1.2 Level 2: Learning

The data gathered from the exercise conducted immediately after the intervention supported the argument that participants demonstrated immediate retention of some of the design principles; that they retained knowledge of design elements to a lesser degree; and showed very little evidence of understanding the use of techniques to realise design principles.

After a period of time students wrote a test requiring of them to do visual analyses of existing designs as well as visualising their understanding of particular aesthetic constructs. The data thus generated indicated varying degrees of ability to distinguish between the constructs of design principles and elements in responses to questions pertaining to visual analysis. Confusion between design principles and elements was apparent. It became evident that some participants did not grasp the intricate interplay between design principles, design elements and techniques in a design. However, some participants' responses after a period of time indicated an emerging increase in sensitivity for detail. This could be seen in their

use of appropriate terminology; detailed references to specific elements and techniques in the design, and insightful explanations of how techniques were used in establishing design principles.

#### *5.1.1.3 Level 3: Transfer*

The findings of this study indicated that participants retained their knowledge obtained in level 2. They were able to differentiate between the various design elements and could draw from their previous experiences in order to develop better conceptual understanding of the constructs specific to the domain of aesthetics in design environments.

The representational drawings in the project indicated that although participants retained knowledge of the design principles and design elements fairly well, they failed to add much visual interest to their designs because of a lack of contrast and anomaly that usually prevent visual boredom on the side of the viewer (Wong, 1993).

#### *5.1.2 Research methodology*

The research methodology decided upon for this study, as well as the qualitative nature of the study had its own inherent advantages and limitations as summarised below. The way these advantages and disadvantages impacted on the findings of this study will later be discussed in more detail.

##### *5.1.2.1 Qualitative nature of the research*

The qualitative nature of the data gathered in this case study, approached from an interpretive perspective, had the advantage of providing me with rich data (Cohen *et al.*, 2000). Being researcher and lecturer at the same time, however, inherently posed the danger of bias. For this reason multiple data gathering instruments had to be implemented to validate the findings.

##### *5.1.2.2 Development research*

The two aims of development research, namely contributing to the improvement of instructional design and to the formulation of theory, were achieved and partially achieved in this research (Van den Akker, 1999). It was possible to contribute to the improvement of the tutorial. However it was not possible to generate theory due to limitations inherent to the Kirkpatrick (1994) model implemented for gathering data. These limitations will later be discussed in detail.

### 5.1.2.3 Kirkpatrick's model for evaluating learning

Kirkpatrick's four level model (Kirkpatrick, 1994) provided me with a structure that simplified the complex task of evaluating the learning that took place. In addition it enabled me to analyse data in a systematic way. However, I found the model over-simplified issues and therefore, I used Alliger's augmented model (Alliger *et al.*, 1997) in addition to Kirkpatrick's model for evaluating learning. The augmented model provided sub-levels for categorising data into more refined categories. However, inherent to the four level model for evaluating learning, however, I experienced three major limitations, namely (1) an over-simplification of learning and (2) only causal linkages between the levels could be inferred and (3) emphasis on the outcomes of learning only and no providing for the processes involved in learning.

## 5.2 Relation of the findings to the literature and theory

Subsequently I will summarise the relation of the main findings of this study with the literature and theory surveyed for this study. The three categories of literature surveyed, CAL, levels of learning and design studies, will be related to the main findings in the study.

### 5.2.1 Computer assisted learning (CAL) theories and the findings of the study

Aspects of the findings as described and discussed in chapter 4, for which support could be found in the literature pertaining to CAL, namely theories about CAL in technology education, the suitability of Microsoft PowerPoint™ and tutorials, will be highlighted.

#### 5.2.1.1 CAL in technology education

Atkinson (1998) proclaimed that CAL applied in technology education programmes could stimulate technological activity. In this study, it was evident that the tutorial stimulated the design activity. It required students to engage in investigating<sup>40</sup> existing designs in order to relate them to the constructs in question, which were reflected in participants' responses to all the data generating strategies implemented on level 2 and 3 (see chapter 4).

Atkinson is further of the opinion that CAL could bring design contexts into the classroom (Atkinson, 1998). The tutorial visualised a variety of design contexts reflected in the different product designs described and explained in terms of aesthetics. Evidence of its impact on participants' learning was found in their drawings in the test (Addendum 8) that reflected their learning after a period of time. The similarities between their schemas and the images in the tutorial were significant. The drawings of the participants were also an indication of the

---

<sup>40</sup> Investigating is the first step in the design process, prescribed by the *RNCS* (2002), as one of the technological processes in technological activity.

potential value of the computer for stimulating graphics and modelling activities (Atkinson, 1998).

In chapters 1 and 2 I explained that the purpose of the tutorial was to instruct and reveal information. Atkinson also describes instruction and revelation of information as one of the functions of computer assisted learning in design and technology contexts (Atkinson, 1998). Participants' utility judgements in the questionnaire indicated that they perceived the tutorial as useful to learning aesthetics (Addendum 2), implying that they perceived it as a useful source of information and instruction.

Atkinson (1998) indicated that computer assisted learning support material should be self-paced and self-accessed, and function as a tool to facilitate learning at the point of need in order to be effective as educational tool. The tutorial was not completely self-paced. Some participants indicated their frustration with its lack of sufficient navigational options in the questionnaire, which lengthened the time it took to work through it. Participants could access the tutorial through the Internet. In the questionnaire some participants indicated frustration at the slowness of opening the tutorial from the Internet whilst others expressed their satisfaction with the ease of access. One of the aspects raised in the questionnaire (Addendum 1) and Interview (addendum 3) indicated that learners would like to have help at the point of need while working on the tutorial. This reaction suggested to me that the effectiveness of the tutorial could be improved by including interactivity.

#### *5.2.1.2 Suitability of Microsoft PowerPoint™ as platform*

The advantages and disadvantages of Microsoft PowerPoint™ have been described for a long time. Participants of this study expressed their satisfaction with the ease of use of the tutorial in the questionnaire (Addendum 2). Montgomery (2004) promotes the use of Microsoft PowerPoint™ in educational contexts because of the advantages of linearity that contributes to the ease of use.

The ability of Microsoft PowerPoint™ to be programmed in an interactive tool also has pedagogical advantages (Alessi & Trollip, 2001). The tutorial has one branch linking to a website on the Internet. When questioned on the usefulness of this link, participants indicated in the semi-structured interview (Addendum 3) that they did not have time to follow the link, but would like to examine it during a separate session. The implication is that the branching will only be useful when the tutorial is divided into separate sections in order to limit the amount of time or if it is completely self-paced.

Critics of Microsoft PowerPoint™ warn of the dangers of this platform being boring to viewers. Participants' responses to the questionnaire indicated that they enjoyed the tutorial and experienced the graphics and examples as exciting and relevant. No indication of boredom could be found in their reactions to the tutorial.

#### 5.2.1.3 Tutorials

Literature indicated many different types of learning that is supported by tutorials, e.g. immediate retention, learning after a period of time and transfer of knowledge in new situations (De Villiers, 2002; Kirkpatrick, 1994). Much evidence of these types of learning was demonstrated in the various data generating strategies described in chapter 4. As was suggested earlier, evidence of inferred causal linkages between intervening with the tutorial could be found in the drawings in the test (see figures 4.1 – 4.15).

Tutorials have also been described as instrumental to learning strategies of individuals in which a particular set of skills are organised and used in order to learn its content or accomplish tasks (Schumaker *et al.*, 1984). The findings presented in chapter 4 did not portray evidence of the ways in which participants actually organised the content of the tutorial; due to the focus on the outcomes of the intervention and not on the process of learning.

#### 5.2.2 Levels of learning

The relation between the literature as the basis of the evaluation of the three levels of learning in this study, reaction, learning and behaviour, from Kirkpatrick's model of evaluating learning (Kirkpatrick, 1994), and the findings of this research will subsequently be summarised.

##### 5.2.2.1 Level 1: Reaction

One of Kirkpatrick's theories is that the initial reaction to instruction will influence quality and quantity of learning. He acknowledges that a positive reaction does not guarantee learning, but argues that a negative reaction reduces learning (Kirkpatrick, 1994). Schumaker (1984) also proclaims that tutorials should be presented in such a way that learners are motivated and enjoy what they are doing in order for learning to be effective. Participants' responses to the questionnaire (Addendum 1) and interviews (Addendum 3) in this research indicated that they were positive towards the tutorial which motivated them sufficiently to work through the tutorial for at least four hours (level 1) and to complete the exercise (Addendum 6) on level 2 at the end. However, no evidence could be found of the causal linkage between the positive reaction and the quality and quantity of learning.

Alliger (1997) explained that participants express feelings of satisfaction by indicating how much they like interventions in the form of affective comments. Participants also indicate their perceived usefulness of the interventions through utility judgements. Affective responses to and utility judgments in the responses to the questionnaire (Addendum 2) provided much useful information pertaining to participants' likes and dislikes of aspects of the tutorial.

#### *5.2.2.2 Level 2: Learning*

Kirkpatrick describes learning as a change taking place on an intellectual level (1994). Clementz (2002) interprets an increase in knowledge as the amount of content learned and concepts and principles mastered. Skills are seen as the improvement of performance and technique. The findings of this research presented in chapter 4 indicated an increase in knowledge of constructs as well as the skills demonstrated on level 2 in the visual analyses, as well as the drawings of the participants in the sub-level of immediate retention, through the exercise and test. On level 2 the following changes on the intellectual level was evident in participants' drawings in the test, after a period of time, indicating the following:

- Some participants' schemas were very similar to the images in the relevant slides in the tutorial, which indicated "memory traces of shapes from past experiences" (Arnheim, 1954, p.5).
- Participants, whose drawings resembled the examples in the tutorial, did not necessarily have better conceptual understanding of the constructs tested than those whose drawings showed no resemblance.
- Schemas not resembling the examples in the tutorial closely, but that realised the design principle in question by using other design elements, techniques and arrangements on the format, demonstrated intent as well as conceptual understanding.

#### *5.2.2.3 Level 3: Behaviour*

Kirkpatrick (1994) describes evaluation of behaviour as evaluation of the transfer of knowledge, skills and attitudes from one situation to another. Evidence of the transfer of knowledge and skills in the domain of aesthetics acquired through intervening with the tutorial and retained and sustained on level 2 was transferred to new situations in level 3. Participants' behaviour was demonstrated in the projects and end-of-year examination discussed in chapter 4. The change in behaviour was evident in the following segments of patterns that emerged (see figure 4.22):

- Participants revealed the design principles and elements clearly, indicating transfer of

knowledge regarding principles and elements. This transfer of knowledge was sustained after a period of time during the examinations.

- Some participants improved significantly in transferring their knowledge of design techniques from the first assessment on level 3 to the second assessment (figure 4.20), while some participants who already performed well in the first assessment, did not improve much (figure 4.18 and 4.21).
- Some participants' drawing skills have developed such that they could represent their ideas well (figure 4.20) while others still had not achieved the necessary change in behaviour in this respect (figure 4.19).
- Most participants did not achieve creating visual interest well in the first assessment on level 3, namely the projects. However, in the second assessment in the examination, I found significant evidence of development in the drawings of some participants, which not only enabled them to represent their ideas better, but also enabled them to include visual interest better (figure 4.20).

Kirkpatrick (1994) is of the opinion that it is impossible to predict when change in behaviour will take place. Predicting when change takes place focuses the attention on the process of learning and not on the outcome, which contradicts the inherent focus of Kirkpatrick's model, namely the outcomes of interventions (Bates, 2004). It was evident in this study that when evaluating the levels of learning, it does not allow for studying the process but only the outcomes (performance) of the participants, which I consider as one of the limitations of the study.

In this section it has been shown how the findings of this study correlated with Kirkpatrick's (1994) theory of evaluating the levels of learning and which areas in his theory were not substantiated by evidence in the findings. I will subsequently highlight evidence of correlations between the findings of the study and that of theories about design studies pertaining to aesthetics.

### 5.2.3 Design studies

Correlations and anomalies between the findings of this study and the main points in the literature surveyed, referring to drawing as a cognitive tool, will now be discussed.

#### 5.2.3.1 *Drawing as a cognitive tool*

Garner's (1994) report on studies of the role of drawing in design and technology education programmes revealed drawing as a powerful promotion of the cognitive process in design and technology programmes. Drawing also played an important role in developing higher

order thinking skills. Analysing levels 2 and 3 of learning in this study revealed that participants' drawings involved the following cognitive activities that correlated with Garner's theory of the role of drawing in technology classrooms in cognitive development of learners:

- retention of knowledge (indicated on level 2);
- application of knowledge (indicated on level 2 and 3);
- analytical abilities including decision making, evaluating abilities and critical abilities (indicated on level 3); and the
- transfer of knowledge (indicated on level 3).

Atkinson (1998) found in her research done on novice designers in technology classrooms that those learners who produced the best drawings, also generated higher quality of conceptual ideas. I found evidence correlating to Atkinson's (1998) theory in the drawings of the participants in this study. Participants 9 and 21, who produced better drawings (figures 4.20 and 4.21) than participant 14 on level 3 (figure 4.19), also managed to generate higher quality of visual interest in their designs.

Arnheim's theory that new images come into contact with memory traces of shapes from past experiences that are similar (Arnheim, 1954), was confirmed by the findings of this study. The close resemblance of participants' schemas of design principles, elements and techniques with those of the images in the tutorial, indicated how traces of shapes and other elements seen in these images influenced participants' new drawings (figures 4.1 – 4.15).

Tversky's notion of drawing as a cognitive tool that can reveal thought and conceptual understanding by using standard segments and elements in numerous different combinations (Tversky, 1999), supported the above theories. The drawings of the participants (figures 4.16 – 4.21) in this study revealed evidence of how they applied their newly acquired knowledge of visualising their ideas for lamp designs on level 3.

It has also been shown that exercises and the process of drawing development enhanced visual understanding that broadened the "visual library" of design elements, techniques, details and potential applications (Anderson, 1998). The outcome of this study, indicating that the improvement in the quality of the drawings of some participants in the examination (level 3), correlated with Anderson's theory, namely that repeated drawing exercise and experience led to more detailed drawings. Some participants' drawings revealed a marked increase in attention to detail by applying a variety of elements (figure 4.20) not applied in drawings in the project (figure 4.16) or earlier drawings in the test (figures 4.1 and 4.7). It



was found that it was this increased attention to detail that improved the visual interest of the participant's designs (see chapter 4).

In addition the data generated by questions in the exercise and in the test (level 2), indicated that repetitive exposure to the activity of visual analysis improved from vagueness to specifics and recognition of detail (see figure 4.22). The findings reported on in chapter 4 also indicated that the tutorial served as stimulus to recognising and identifying constructs applicable to designs in the exercise with questions pertaining to visual analysis. This led to participants' understanding of concepts in aesthetics, which correlates with what Davies (2000) found in activities pertaining to the improvement of observation skills, namely that in order to achieve conceptual understanding, students have to be skilled in observation. Analytical thinking and the application of knowledge and skills in subsequent drawings can improve observations skills (Davies, 2000).

In the subsequent section, I will highlight the role the research methodology played in answering the research questions.

### **5.3 The research methodology and its impact on the study**

In order to establish the role of the research methodology selected for this study, in answering the research questions, the nature of the study and the aims of the study will be related to the findings of the research.

#### **5.3.1 The nature of the study**

The qualitative nature of this case study suited the chosen research methodology well. The inherent flexibility of qualitative research allowed me to adapt the sample size, the pace and the scope of the research to the research process according to changes in circumstances. The number of participants, who initially indicated their availability till the end of the research, kept on changing until the end of the examination, when only three students were in fact available to take part. The pace at which the class' project developed was different for different students, due to events such as a lack of commitment by some students to complete in time, forgetfulness and illness. These events complicated the control of the pace at which the research was conducted.

The qualitative nature of the research data enabled me to make rich and thick descriptions in order to portray the complexities involved in the learning of the aesthetic domain-specific constructs accurately. The multiple strategies implemented for evaluating the different levels of learning contributed to the richness of the data, while at the same time served as tool for

crystallisation of the findings. In addition it allowed me to blend descriptions of the learning context with the analysis thereof and highlighted specific events that were relevant to the case.

This study falls in the category of social responsible development research, implementing evaluation strategies to gather and interpret data.

### 5.3.2 The aims of social responsible development research

The study had two aims, namely interpretive and development. Interpretive goals portray how education works by describing and interpreting phenomena related to teaching, learning, performance, etc. (Reeves, 2000). In this the interpretive aims were met by:

- portraying which aspects of the constructs specific to the domain of aesthetics were learned (see table 5.1); and
- establishing the role of the tutorial in learning aesthetic constructs (see table 5.2).

Development goals refer to the dual objectives of (1) developing creative approaches to solving human teaching, learning and performance problems, and (2) constructing a body of design principles<sup>41</sup> that can guide future development efforts (Reeves, 2000).

Table 5.1 summarises the interpretation of the data in this study, meeting the interpretive goal of the approach to this study.

**Table 5.1 Interpretation of the data**

Information sought	Information found and interpreted
Level 1 • Did the participants consider the training relevant? • What was the perceived practicality and potential for applying the knowledge and learning? • Was it worth their while?	Participants indicated that they <b>perceived</b> the tutorial as <b>useful</b> due to its <ul style="list-style-type: none"> <li>• relevance to the module;</li> <li>• usefulness to other modules; and</li> <li>• practical applicability.</li> </ul> I learned from the responses to the questionnaire and semi-structured interviews that participants perceived the tutorial as useful, and, therefore, considered their time well spent.

<sup>41</sup> "Design principles" here refers to principles pertaining to the design of instruction and instructional material (Van den Akker, 1999) and not to the construct of aesthetic design principles.

Information sought	Information found and interpreted
<p>Level 2:</p> <ul style="list-style-type: none"> <li>• What did participants learn about the design principles?</li> <li>• What did they learn about the design elements?</li> <li>• What techniques could they identify and relate to the principles and elements?</li> </ul> <p>Level 3:</p> <ul style="list-style-type: none"> <li>• How well did the drawings reveal the design elements and techniques used to realise design principles?</li> <li>• Was there sufficient clarity?</li> <li>• How well did it represent the idea?</li> <li>• Was there sufficient visual interest created through variety?</li> </ul>	<p>Participants' responses to the <b>visual analysis</b> questions in the test indicated the following pertaining to their retention of knowledge after a period of time:</p> <ul style="list-style-type: none"> <li>• they could not differentiate well between design principles and elements;</li> <li>• they could identify most design elements;</li> <li>• the design principle "balance" was not yet understood yet;</li> <li>• there was an emerging increase in sensitivity to detail;</li> <li>• some understanding of the purposeful use of techniques to create specific principles was emerging; and</li> <li>• they could transfer some knowledge from 2-D designs to 3-D objects.</li> </ul> <p>Participants' responses to the <b>drawing</b> questions in the test indicated the following pertaining to their retention of knowledge after a period of time:</p> <ul style="list-style-type: none"> <li>• all the participants knew the design principles;</li> <li>• not everyone recalled the design element "visual texture";</li> <li>• in most cases participants recalled a specific design in the tutorial illustrating the particular design principle/element in question.</li> </ul> <p>The conclusion to research question 3 was:</p> <ul style="list-style-type: none"> <li>• All participants managed to reveal the design principles and elements with sufficient clarity, indicating that transfer of knowledge regarding principles and elements has taken place sufficiently in order to change participant's behaviour. This change in behaviour was sustained after a period of time during the examinations.</li> </ul> <p>Some participants improved significantly in transferring their knowledge of design techniques from the first assessment on level 3 to the second assessment, while some participants who already performed well in the first assessment, did not improve much.</p> <ul style="list-style-type: none"> <li>• Some participants could represent their ideas well while some still had not achieved the necessary drawing skills.</li> <li>• Most participants did not achieve creating visual interest well in the first assessment on level 3. However, in the second assessment significant improvement in the transfer of this skill was evident in the drawings of some participants.</li> </ul>

The interpretive aim of the study was to describe and interpret the extent to which the tutorial under discussion contributed to students' learning of the constructs of aesthetics in a technological context. The information gathered for this purpose was used to indicate the adequacy of the tutorial in achieving the learning outcomes of the module (see chapter 3). The outcome of the module relevant to this study was to demonstrate knowledge, transfer and application of aesthetics, namely design principles, elements and techniques, as well as the extent to which achievement was established and validated by this study. These are summarised in table 5. 3

Table 5.2 summarises the role of the tutorial in the realisation of the module's outcomes.

**Table 5.2 Role of the tutorial in the realisation of the module's outcomes**

<b>Research question 1:</b> What are the implications of the participants' reaction to the tutorial with regard to the possible improvement thereof?	
<b>Outcome of the module</b>	<b>Cognitive and affective activities indicating the outcomes</b>
use contextually integrated learning support material that <ul style="list-style-type: none"> <li>• is instrumental in learning</li> <li>• students perceive as useful</li> <li>• create a positive attitude in students regarding the learning support material and the module</li> </ul>	<ul style="list-style-type: none"> <li>• affective reactions in response to the questionnaire indicating participants' general satisfaction with the tutorial</li> <li>• utility judgements in response to the questionnaire indicating the perceived usefulness of the tutorial are instrumental to participants' learning of the constructs</li> </ul>
<b>Role of the tutorial established</b> Evidence of similarities between explanatory text in the tutorial and that in the responses of participants in the exercise and the test pertaining to visual analysis, indicated a direct link between the content of the tutorial and what was learned	
<b>Research question 2:</b> What are the implications of the participants' retention of knowledge with regard to the possible improvement of the tutorial?	
<b>Outcome of the module</b>	<b>Cognitive activities indicating the outcomes</b>
<ul style="list-style-type: none"> <li>• investigating existing designs; analysing existing designs</li> <li>• drawing ideas on paper</li> <li>• applying graphic skills: using colour, rendering techniques and three-dimensional drawings;</li> <li>• choosing the best solution</li> </ul>	<ul style="list-style-type: none"> <li>• <b>visual analysis</b> in the exercise and in the test</li> <li>• indicating immediate retention and learning after a period of time</li> <li>• <b>drawing</b> in the test indicating learning after a period of time</li> </ul>
<b>Role of the tutorial established</b> Schemas in the test indicated easily discernable similarities between existing designs in the tutorial and participants' schemas. Similarities in participants' final representational drawings in the project and development drawings in the examination were not so easily discernable. However, the evidence of learning transferred to the project and examination confirmed Arnheim's (1954) theory that new images come into contact with memory traces of shapes from past experiences that are similar and, therefore, I inferred that the intervention with the tutorial had an ongoing effect on participants' learning on level 2 and on 3 summarised below.	
<b>Research question 3:</b> What are the implications of the participants' behaviour/transfer with regard to the possible improvement of the tutorial?	
<b>Outcome of the module</b>	<b>Cognitive activities indicating the outcomes</b>
<ul style="list-style-type: none"> <li>• drawing ideas on paper</li> <li>• applying graphic skills: using colour, rendering techniques and three-dimensional drawings;</li> <li>• choosing the best solution<sup>42</sup> preparing final representational drawings</li> </ul>	<ul style="list-style-type: none"> <li>• representational drawings in the project indicating change in behaviour (transfer of learning)</li> <li>• development drawings the examination indicated sustained change in behaviour</li> </ul>

The development goals of this study, namely

- developing creative approaches to solving human teaching, learning and performance problems; and
- generating, articulating and testing design principles (Van den Akker, 1999)

<sup>42</sup> Representational drawings in the project were the outcome of a process of choosing the best solution and did not indicate the choosing process.

were partially met. The first goal namely was met by creating a set of suggestions of how to improve the tutorial. Table 5.3 summarises the suggestions. The second goal was not met, due to the limitations inherent to qualitative research, as discussed in 5.4.1.

**Table 5.3 Useful solutions for improving the tutorial suggested by the data**

<b>What to keep</b>	<b>What to change</b>
<ul style="list-style-type: none"> <li>• The way it works.</li> <li>• Asynchronicity.</li> <li>• Examples in colour.</li> <li>• Organisation of material.</li> <li>• Understandable language.</li> <li>• Good layout.</li> <li>• Practicality.</li> </ul>	<ul style="list-style-type: none"> <li>• Enlarge pictures.</li> <li>• Find a quicker way to open from the Internet – alternatively provide tutorial on CD.</li> <li>• Add interactivity providing help with the exercise.</li> <li>• Make distinction between design principles and design elements clearer by changing the titles or adding screens.</li> </ul>
<b>What to keep</b>	<b>What to change</b>
<ul style="list-style-type: none"> <li>• Usefulness for other modules.</li> <li>• Ease of use.</li> <li>• Accessibility.</li> <li>• Visual appeal of graphics used.</li> </ul>	<ul style="list-style-type: none"> <li>• Deliver the tutorial earlier in the year in the module on graphic design.</li> <li>• Check protocol thoroughly for inconsistency of font sizes.</li> <li>• Re-programme allowing users to exit the tutorial sooner.</li> <li>• Shorten the tutorial by providing material in separate sections.</li> <li>• Include a menu with navigation buttons.</li> <li>• Add more examples, on which the differentiation between the design elements is clearly indicated.</li> </ul>

Table 5.4 indicated that this study provided me with suggestions useful for a variety of improvements of the tutorial, thus complying with the purpose of social responsible research (Van den Akker, 1999), namely to improve instructional design practice, development and the evaluation thereof (Van den Akker, 1999). In addition, the concern in social responsible research with the practical uses of the research findings and with understanding “how” instructional technology improves education was partially fulfilled in this study. In chapter 4 the visual similarities between designs in the tutorial and the drawings of some participants were shown and reported on. It can thus be said that the “power of the image” (Van den Akker, 1999) brought by the electronic medium contributed directly to learning. This retention of visual material was in later stages of the research transferred to new design contexts.

From the conclusions and recommendations of this study, I developed the following theory pertaining to the design and evaluation of electronic tutorials for the domain of aesthetics.

**General principles formulated:** visual and verbal reference to the constructs and segments of the constructs should be done explicitly and repeatedly in tutorials. Ways to reinforce students' verbal referencing could include interactive activities as part of the tutorial in order to provide help to users whenever it may be needed.

Demonstration of change in behaviour (transfer of knowledge about constructs) in level 2 should not be interpreted as permanent change occurring early in the learning process unless sustained change in level 3 is also evident.

#### 5.4 Limitations of the study

Limitations of this study, as emerging from the research findings, are discussed by referring to the disadvantages of the type of research implemented, the researcher's effect and the difficulties experienced in the research.

##### 5.4.1 Disadvantages of qualitative research

The disadvantage of this study can be ascribed to its qualitative nature, which limited this research's ability to lead to generalisation (Van den Akker, 1999). Readers need to be encouraged to make their own attempts at exploring the potential transfer of the findings of this research to theoretical propositions in relation to their own context (Van den Akker, 1999).

##### 5.4.2 Researcher's effect

In addition to its failure to generalize, I experienced my integral involvement (researcher effect) in this case study problematic due to the potential bias stemming from being the researcher as well as lecturer (Miles & Huberman, 1984). The potential dangers that had to be acknowledged were the following:

- my presence in the computer laboratory could change the participants' behaviour, e.g. being more nervous and, therefore, not performing as well as they should;
- my becoming personally involved with participants;
- my own artistic biases influencing objective analysis and conclusions;
- my competence as novice researcher pertaining to content analysis and visual analyser of aesthetics; and
- participant's inability to express themselves clearly and, therefore, the danger of misinterpreting reactions could be included in the final write-up.

#### 5.4.3 Difficulties in the research

I experienced the evaluation of learning and transfer in this study to be more difficult and time consuming than the measurement of reactions, which is confirmed by Kirkpatrick (Kirkpatrick, 1994). The reasons for this are closely linked to (1) the complexity of the criterion set for the activities of visual analysis and drawing and (2) the compound way in which constructs appropriate to the domain can manifest in designs (Tversky, 1999), explained in section 4.7.3. Another difficulty was discerning whether drawings were evidence of memory traces (Arnheim, 1954) or whether intent and conceptual understanding were also imbedded (Tversky, 1999).

#### 5.4.4 Future research

I encountered many unanswered questions pertaining to the process of learning that need to be examined through other means than allowed by the Kirkpatrick model (Kirkpatrick, 1994). The reason for this is the focus of the model on outcomes of instructions only and not on the process of learning:

- What are the reasons for the retention of some design principles being better than others?
- What are the reasons for some design principles being identified easier than others?
- What is the effect of the change in the behaviour and sustained performance of students peaking early in the module, but not improving on level 3?
- What are the reasons for the participants' difficulties in distinguishing between concepts of design principles and elements?
- To what extent do correlations exist between performance in visual analysis and the visualising of aesthetic constructs in drawings?