

**Improving my teaching experience with students in Engineering  
Graphics and Design: an Action Inquiry**

**by**

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## DECLARATION

I hereby declare that the work submitted for the Magister Artium in Higher Education Studies in the Faculty of Education, University of the Free State, is the result of my own independent investigation and that I have not previously submitted this work for a qualification at another university or at another faculty at this university. I also hereby cede copyright of this product in favour of the University of the Free State.

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Albert Christoffel Kemp

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Date

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## **List of acronyms and abbreviations**

2D	Two-dimensional
3D	Three-dimensional
ATs	Assessment Tasks
CAD	Computer Aided Design
CAPS	Curriculum and Assessment Policy Statements
CRDD	Curriculum Research and Development Division
DoE	Department of Education
EGD	Engineering Graphics and Design
FET	Further Education and Training

HES	Higher Education Studies
ILOs	Intended Learning Outcomes
LLC	Leadership Learning Community
LO	Learning Outcome
NCS	National Curriculum Statement
SANS	South African National Standards
SOLO	Structured of Observed Learning Outcome
TLAs	Teaching/Learning Activities

## **Abstract**

### **Improving my teaching experience with students in Engineering Graphics and Design: an Action Inquiry**

The purpose of my study was to identify and rate the most effective teaching methods with the help of my students in Engineering Graphics and Design (EGD) which would lead them to a level of higher cognitive thinking. Whilst the students obtained a deeper approach to learning I improved on my own teaching and teaching experiences. To do this, I had to keep the following objectives in mind: to ensure deep learning among my students, to identify teaching methods which could lead to a deep approach of learning, and to rate these teaching methods.

I followed a qualitative research methodology in order to improve my teaching in EGD by means of action research. This could be described as a transformative paradigm, in which I could improve my teaching as well as the cognitive thinking levels of the students. The study may serve as a guide for future implementation not only in EGD but in all educational subjects.

A thorough literature study was done on EGD, teaching methods and the different approaches to learning. I collected data through interviews with lecturers and students, I kept a reflection journal throughout the study and my students reflected on my teaching as well as on the different teaching methods used. After the data collection I analysed the data by sorting and categorising the data in order to identify certain criteria from which I shall draw my conclusions.

Based on the data, my final conclusion is that different teaching methods can be used to improve teaching and to encourage a deeper approach to learning among students. The trustworthiness of my conclusions was maintained by the following criteria: credibility, transferability, dependability and confirmability.

The following stakeholders gained educational advantages from of my study: I, as the researcher, improved on my teaching; the students improved their

grades whilst engaging in higher cognitive activities; and other lecturers and teachers who are positioned in the education field gained a guideline to improve their teaching.

This study is the story of how I reached the stage in my professional development where I can truly say that I have generated my own transformation of educational practice.

## Opsomming

### **Die verbetering van my onderrig ervaring met studente in Ingenieursgrafika en-ontwerp (IGO): 'n Aksie-ondersoek**

Die doel van my studie was om die mees doeltreffende onderrigmetodes met behulp van my IGO-studente te identifiseer en te beoordeel, wat hulle tot 'n hoër vlak van kognitiewe denke sou lei. Terwyl die studente 'n dieper benadering tot leer verkry het, het ek op my eie onderrig en onderrigervaringe verbeter. Om juis dít te bewerkstellig, het ek die volgende doelwitte in gedagte gehou: om te verseker dat diep leer onder my studente plaasvind, om onderrigmetodes te identifiseer wat tot 'n diepe benadering tot leer sou lei en om hierdie onderrigmetodes te beoordeel.

Ek het 'n metodologie van kwalitatiewe navorsing gevolg ten einde my onderrig in IGO deur middel van aksienavorsing te verbeter. Dit kan ook as 'n transformerende paradigma beskryf word waarin ek my onderrig, asook die kognitiewe denkvlakke van die studente, sou verbeter. Die studie kan dien as 'n rigsgaander vir toekomstige implementering, nie net in IGO nie, maar in alle onderwysvakke.

'n Deeglike literatuurstudie is omtrent IGO, onderrigmetodes en die verskillende benaderings tot leer gedoen. Ek het data deur middel van onderhoude met lektore en studente versamel en regdeur die studie dagboek gehou van my indrukke. My studente het ook hul indrukke oor my onderrig gegee, asook die verskillende onderrigmetodes wat gebruik is. Na afloop van die data-insameling het ek die data geanaliseer deur dit te sorteer en te kategoriseer ten einde sekere kriteria te identifiseer na aanleiding waarvan ek my gevolgtrekkings kon maak.

Gegrand op die data, is my finale gevolgtrekking dat die verskillende onderrigmetodes gebruik kan word om onderrig asook 'n dieper benadering tot leer onder studente te verbeter. Die betroubaarheid van my gevolgtrekkings is deur die volgende kriteria gehandhaaf: geloofwaardigheid, oordraagbaarheid, betroubaarheid en bevestiging.

Die volgende belanghebbendes het onderwysvoordele uit my studie verkry: ek, as navorser, het my onderrig verbeter; die studente het hul punte verhoog en terselfdertyd hoër kognitiewe aktiwiteite onderneem; en ander lektore en onderwysers wat hulle in die onderwysveld bevind, het 'n riglyn ontvang om hul onderrig te verbeter.

Hierdie studie sit uiteen hoe ek die stadium in my professionele ontwikkeling bereik het waar ek waarlik kan sê dat ek my eie transformasie van die onderwyspraktyk gegenereer het.

# Chapter 1

## Orientation of my study

### 1.1 Introduction

As a farm boy from the Karoo region of the Eastern Cape, South Africa, I always knew that what I enjoyed most was working with my hands, innovating and creating things that interested me. During my primary school years, I was introduced to a subject called Woodwork. This subject enabled me to communicate on a graphic level by creating simple woodwork drawings. In high school, I continued taking Woodwork as a subject, finding its drawings still relevant though more advanced. I also chose another subject which I felt would add to my repertoire of drawing subjects: Technical Drawing. Throughout my high school years I gained valuable experience in my field of interest, constantly improving upon my ability to communicate by means of graphics. My enthusiasm for this medium grew to such an extent that I decided to enrol for a teaching qualification, specialising in Drawing Science, at the Faculty of Education of the University of the Free State.

After the successful completion of my studies as an educator, I applied for a junior lecturing position in the School of Mathematics, Natural Sciences and Technology Education. This enabled me to live my passion and to share my acquired skills, gained over a period of 14 years, with future educators, who also wish to teach the subject of Engineering Graphics and Design – which by this stage had come to include components of civil, mechanical and electrical drawing (Department of Education (DoE), 2005).

Engineering Graphics and Design (EGD), as a niche area subject within the higher education environment, plays an important role not only in the training of many aspiring educators, but also in enhancing the training of future engineers, architects, technologists, drafters and quantity surveyors, amongst others. EGD therefore assists in responding to the shortage of scarce skill careers in South

Africa, a topic very much in the news recently in newspapers and media reports (Sarie, 2008; Rapport, 2011).

Despite the importance of EGD in my life, as mentioned above, I had never encountered the so-called “deep approach” to learning within this subject, either as a learner or as an undergraduate student. Once I started lecturing in EGD, however, I realised that there was much more to this field than I had previously been taught, and that this challenge needed to be addressed so that I could lead students towards a more fulfilling and useful experience in this course. For the first time I became aware of the true value of quality teaching within EGD regarding cognitive development by means of deep learning (Tagg, 2003; Biggs & Tang, 2009). Deep learning, I realised, could enhance students’ performance to such an extent that they could operate on a higher cognitive level (Entwistle, 2009; Heather, Ketteridge & Marshall, 2009). In Chapter 2 I shall discuss the nature, background and rationale of EGD in more detail. The purpose of this study is therefore to investigate the utilisation of the best possible teaching practices within EGD that will enable me to improve my own teaching of the mentioned subject.

Given this background, it follows that my dissertation would take the form of an action inquiry. According to Huang (2010:95), action researchers are “more autobiographical in their expression”, allowing the use of the first person perspective in presenting information.

## **1.2 Rationale and motivation**

As a novice lecturer, I consider the undertaking of this research to be ground-breaking work, particularly because literature on EGD, and specifically with reference to innovative teaching practices in the subject, is virtually non-existent especially in South Africa. It has been my experience that students often do not find this subject interesting, and that they find some of the drawings particularly challenging to master, while others are initially easy to grasp but difficult to take to the next level. I envisage that the results obtained from this research project will not only contribute to the continued improvement of my own teaching of

EGD but will assist in arousing more interest on the part of my students. Increased levels of interest and motivation should help them understand and apply the subject better, thus leading to a deeper approach to learning.

### **1.3 Theoretical framework**

I shall approach this conceptual qualitative study from a transformative perspective since this paradigm should stop students from simply accessing the curriculum in a one-dimensional manner and should lead them towards a deeper approach. As I do not have any preconceived ideas about the direction my study will take, I shall attempt to understand the way the participants perceive my teaching practices and subject content. I shall then reflect upon their perceptions as well as my own, all within my particular teaching and learning environment in order to improve my teaching so that students may adopt the deep approach to learning.

Direction will however be given to my study by means of my own interaction with my students, reflection, experience, knowledge and understanding of this field. A better understanding of how my students and I can influence social change should further reinforce my belief and epistemological stance by means of my chosen action research design, i.e. action inquiry. This should ultimately lead me to be able to identify which teaching practices contribute to a deep approach of learning, and to be able to indicate correspondence with action research principles.

In order to investigate my own teaching practices, I made use of the constructive alignment model as presented by Biggs (1996) as a theoretical framework (see Chapter 4).

### **1.4 Statement of purpose**

The purpose of my study is to identify and rate the most effective teaching practices in EGD which contribute to a deep approach to learning among my students. These practices will be utilised as possible guidelines for educators not only to obtain maximum results, but also for students to benefit from this

teaching experience by taking them to a deeper level of learning, i.e. to explore, discover and create within EGD. Furthermore I would like to improve my own teaching.

## **1.5 Research questions**

### **1.5.1 Primary research question**

Taking into consideration the needs of EGD students during the facilitation of learning, the study is guided by the following primary question:

- What are the best teaching practices that I can implement to improve my teaching of EGD?

### **1.5.2 Secondary research questions**

In order to fully explore the primary research question through an action inquiry (Norton, 2009), the following secondary questions are addressed:

- What is the nature of EGD and what are the challenges involved in the teaching of this subject?
- How can I adapt my teaching practices to improve student learning?
- How did I adapt my teaching practices?
- How effective have the chosen teaching practices been?
- How can I modify my teaching practices in future?

## **1.6 Clarification of concepts**

Three concepts are presented in this section, intended to clarify the title and aim of my study.

### **1.6.1 Engineering Graphics and Design (EGD)**

Nieman (1976) and the Department of Education (2005) describe EGD as a graphic language used collectively by engineers to comprehend different technical concepts as well as ideas such as the form and size of structures and mechanical objects. The subject integrates the cognitive and manipulative skills needed to design and communicate graphically whilst contributing to learners'

technological literacy by means of problem solving. Personal development of learners is enhanced through their having to reflect on and explore a variety of methods to learn more effectively.

### **1.6.2 Teaching**

Cowan (2006:100) defines teaching as “the purposeful creation of situations from which motivated learners should not be able to escape without learning or developing”. It thus became clear to me that each lesson must be carefully planned so as to encourage students while also presenting the subject matter in a sensible and imaginative way. Students need to be empowered and captivated enough by the subject to trigger life-long interest and a desire for further learning in the subject; they should also be capable of drawing on this knowledge to use in their own classes down the line.

The educator’s job is to create a learning environment that supports the learning activities appropriate to achieving the desired learning outcomes. Therefore it is important to focus on the following components in the teaching system (Biggs & Tang, 2011):

- the curriculum and its intended outcomes,
- the teaching/learning activities used,
- the assessment tasks, and
- grading

These components must be aligned (constructive alignment) with each other (Biggs & Tang, 2011). All are tuned to learning activities addressed in the desired learning outcomes. Capturing the imagination, creativity and attention of the students rests on the different teaching practices utilised (Biggs, 1996; Biggs & Tang, 2011).

A teaching practice consists of the principles and methods used for instruction (Borich, 2007). Examples of teaching practices utilised in EGD entail, among others, group work, problem solving, and question and answer. The choice of an appropriate teaching learning activity depends on the information or skill that

is being taught. This may be influenced by the ability and level of enthusiasm of the students (LeFever, 2004; Petrina, 2007).

### **1.6.3 Deep approach to learning**

When a deep approach to learning is being utilised, the learning activities are characterised by a deep connection to the material (Atherton, 2009). This means that critical thinking and problem-solving skills will inevitably be required, together with application and transformation of knowledge (Tagg, 2003). When a deep approach to learning is adopted, it means that there is a personal commitment to construct meaning thus stimulating high cognitive levels (Marton & Saljo, 1976; Tagg, 2003).

## **1.7 Research methodology**

### **1.7.1 Research design**

I chose an action research design based on Norton's (2009) five action research steps and performed a conceptual qualitative study aligned to Whitehead and McNiff's (2006) planning phase and eight action research questions as a guideline to focus the research. The five action research steps as identified by Norton (2009:70) entail:

Step 1: Identifying the problem

Step 2: Thinking of ways to tackle the problem

Step 3: Doing/ implementing innovative teaching practices

Step 4: Evaluating the actual research findings

Step 5: Modifying my future practice in the teaching of EGD

Whitehead and McNiff's (2006) action research questions entail :

1. What issue am I interested in researching?
2. Why do I want to research this issue?
3. What kind of evidence can I gather to show why I am interested in this issue?

4. What can I do? What will I do?
5. What kind of evidence can I gather to show that I am having an influence?
6. How can I explain this educational influence?
7. How can I ensure that any judgements I might make are reasonably fair and accurate?
8. How will I change my practice with regard to my evaluation?

My answers to these queries will resolve the above-mentioned eight questions of the Whitehead and McNiff (2006) model and will help me in constructing my action plan for implementing the deep approach to learning (see 1.12).

### **1.7.2 Research methodology and methods**

I followed a qualitative research methodology in order to explore and describe how I adapted my teaching of EGD through an action inquiry cycle. I embarked on the transformative paradigm to guide me in improving my own teaching. In doing so I collected information by means of the following methods:

- A conceptual study from literature
- Reflections of my students
- My own reflections
- Informal interviews to explore existing problems.

### **1.7.3 Data collection**

In my studies I attempted to collect data related to the teaching and learning of EGD by means of non-empirical data collection. This I did through an extensive literature review allowing me to obtain theoretical perspectives on the relevance of teaching and learning practices of EGD and also to explore a variety of innovative practices. Data will furthermore be collected by means of:

- obtaining information from participants regarding their experiences and perceptions by means of discussions (focus groups) with students and interviews with lecturers;
- keeping a reflective journal documenting my own experiences during the entire process;

- obtaining theoretical knowledge on the bearing of current and previous teaching and learning practices of EGD;
- gaining information with regard to my own actions and learning by way of the reactions of students to adapted teaching by means of self-reflection on intermittent occurrences;
- collecting written records of actions, reflection and evaluation (Whitehead & McNiff, 2006).

#### **1.7.4 Selection of participants**

In my study I purposefully selected participants according to preselected criteria and characteristics with maximum variation relevant to my particular research question in mind (Killen, 2009; McMillan & Schumacher, 2010). Such homogeneous groups were needed as they provide the following cohesive and relevant perspectives:

- First- to fourth-year students currently registered for EGD modules like Drawing Science and Building Science as well as Subject Didactics of EGD, grouped according to their year of study.
- Former EGD and Technical Drawing lecturers, because of their valuable experience.
- EGD and other similar educators with more than one year's experience since they were also involved in the field of graphic communication and had much to offer and substantiate.

#### **1.7.5 Data analysis**

After gathering all the data applicable to my study, I collected evidence and identified relevant criteria by sorting, categorising and analysing the data in order to identify certain criteria from which conclusions could be drawn (Whitehead & McNiff, 2006). My data analysis had to be appropriate to my research design and approach. Therefore my findings, after I had interpreted my data, had to determine whether different teaching practices might affect the approach to learning followed by my students. I anticipated that my study would

enable me to determine whether the selected teaching practices would give rise to a deeper approach to learning.

### **1.7.6 Trustworthiness**

In order to convince my readers as well as myself that my study is valid and trustworthy, I had to demonstrate that the findings of my study are worth paying attention to and taking account of. The trustworthiness of my study depends on criteria such as credibility, transferability, dependability and confirmability. Credibility refers to one's confidence in the truth of the data as well as the interpretations thereof while transferability is focused on the extent to which the findings of a given study can be applied to other situations. Dependability emphasises the stability of the data whilst confirmability is focused on a comparable concern to objectivity (Guba & Lincoln, 1985; Babbie & Mouton, 2006; Shenton, 2004). These criteria are discussed Chapter 3.

I based the research on the issue at hand, i.e. teaching EGD. Method triangulation and participant reviews (member checks) were also utilised to enhance trustworthiness of the study (Shenton, 2004). According to Creswell (2008:266) method triangulation is “the process of corroborating evidence from different individuals (e.g., a principal and a student), types of data (e.g., observational field notes and interviews) or methods of data collection (e.g., documents and interviews) in descriptions and themes in qualitative research”. Creswell (2008:266) is of the opinion that participant reviews (member checks) are “a process in which the researcher asks one or more participants in the study to check the accuracy of the account”.

### **1.8 Value of the research**

It is envisaged that this study will provide assistance to the following stakeholders:

- As researcher the study will help me to improve on my own teaching. Consequently it is anticipated that my students will benefit from my teaching.

- Students will benefit from this study when using a deep approach to learning which in turn should improve their grades as they engage in higher-level cognitive activities.
- EGD lecturers and teachers from other institutions will benefit from the study if they apply its findings and recommendations as a guideline to improve their own teaching practices in order to become more effective teachers.

It is therefore envisaged that the above-mentioned stakeholders will be equipped with the best teaching practices regarding the teaching of EGD. As previously mentioned the most valuable aspect of this study for me is to improve my own teaching as an EGD lecturer. Additionally I shall continue to identify best teaching practices which will contribute towards a deep approach to learning. Other educational disciplines could use these guidelines to improve the grades of their students. According to Spady (1994) students can learn and exceed, but not all in the same manner or according to the same time schedule; therefore it could be useful to test my theory of different teaching practices which will affect the approach to learning with students repeatedly because different students will react differently to different teaching practices.

### **1.9 Ethical considerations**

Written informed consent will be obtained from all EGD students involved in the study and the necessary ethical clearance will be obtained from the Ethics Committee of the Faculty of Education, as well as from the relevant Head of School. As the researcher, I accept the responsibility to assure confidentiality during the research process and data collection. Participants had the option of whether or not they would like to participate in the research project and were informed that the collected information would only be utilised and made public with their consent (Mouton, 2001; Strydom, 2005; Whitehead and McNiff, 2006).

I used method triangulation and participant review to ensure trustworthiness of my interpretations of lecturers' and students' perspectives (Shenton, 2004).

## **1.10 Layout of chapters**

This dissertation consists of the following chapters as presented:

### **Chapter 1**

In Chapter 1 I discussed the orientation and background of my study.

### **Chapter 2**

In this chapter I discuss the nature and challenges of EGD as a field of study and factors which influence the teaching of EGD.

### **Chapter 3**

In Chapter 3 I discuss the research design methodology for this study.

### **Chapter 4**

Chapter 4 contains a discussion and motivation of the use of *constructive alignment* as a framework for the possible best teaching practices which I could implement in order to adapt my current teaching practices.

### **Chapter 5**

This chapter is a reflection on how I adapted my teaching practices; a discussion on the effectiveness of the chosen teaching practices in my teaching of EGD is included.

### **Chapter 6**

In this last chapter, I formulate conclusions and propose consequent recommendations regarding how I can continue to modify my teaching practice to improve learning in future. I also identify the possible shortcomings of my study. The conclusions I derive from my study will be aligned with my research questions. The recommendations may serve as a guideline for future implementation of teaching practices in EGD.

### **1.11 Summary**

In Chapter 1, I explained the background to, and provided an orientation of, this qualitative study aimed at determining whether there are different teaching practices that will contribute to a deeper approach to learning among my EGD students, while at the same time improving my own teaching/learning activities. I have identified the research problem, aims and objectives of my study and furthermore indicated the value of my study for the different stakeholders as well as briefly discussed the research methodology. In this chapter I also described the methods of data collection, data analysis and the interpretation of the data. Ethical considerations as well as the trustworthiness of my study were mentioned, and a short outline of the chapters given.

In Chapter 2, I shall consider the nature of EGD and its various challenges as well as the factors that influence the teaching of EGD.

### 1.12 Matrix for the improvement of teaching in EGD

<b>Improving my teaching experience with students in Engineering Graphics and Design: an action inquiry</b>				
<b>Primary question</b>	<b>Lin Norton action research steps</b>	<b>McNiff questions</b>	<b>Chapter layout</b>	<b>Research method</b>
What are the best teaching practices that I can implement to improve my teaching of EGD?	Identification of problem	What issue am I interested in researching? Why do I want to research this issue?	<b>Chapter 1</b> Introduction and Orientation	<b>Problem: Literature</b>
<b>Secondary Questions</b>	<b>Lin Norton Action Research Steps</b>	<b>McNiff Questions</b>	<b>Chapter Layout</b>	<b>Research Method</b>
What is the nature of EGD and what are the challenges involved in the teaching of this subject?	Identification of problem	What issue am I interested in researching? Why do I want to research this issue? What kind of evidence can I gather to show why I am interested in this issue?	<b>Chapter 2</b> The Nature of EGD and the challenges related to teaching this subject	<b>Problem: Literature</b>
How can I adapt my teaching practices to improve student learning?	Thinking of ways to tackle the problem	What can/will I do? What kind of evidence can I gather to show that I am having an influence?	<b>Chapter 3</b> The research design and methodology I followed	<b>Research plan</b>
How can I adapt my teaching practices to improve student learning?	Thinking of ways to tackle the problem	What can/will I do? What kind of evidence can I gather to show that I am having an influence?	<b>Chapter 4</b> CA as a framework for possible best practices in EGD	<b>Literature</b>
How did I adapt my teaching practices?  How effective have the chosen teaching practices been?	Doing it and evaluating the actual research findings	What kind of evidence can I gather to show that I am having an influence? How can I explain the educational influence of my new methods? How can I ensure that any judgements I might make are reasonably fair and accurate?	<b>Chapter 5</b> Implementation plan and research findings	<b>Action inquiry</b>
How can I modify my teaching practices in the future?	Modifying future practice	How will I change my practice with regard to my evaluation?	<b>Chapter 6</b> Conclusions and recommendations	<b>Comprehensive summary and integration</b>

## Chapter 2

### The nature and challenges of teaching Engineering Graphics and Design

Question	Lin Norton action research steps	McNiff questions	Chapter layout	Research method
What is the nature of EGD and what are the challenges involved in the teaching of this subject?	identification of problem	What issue am I interested in researching?  Why do I want to research this issue?  What kind of evidence can I gather to show why I am interested in this issue?	<b>Chapter 2</b> The Nature of EGD and the challenges related to teaching this subject	<b>Problem: Literature</b>

#### 2.1 Introduction

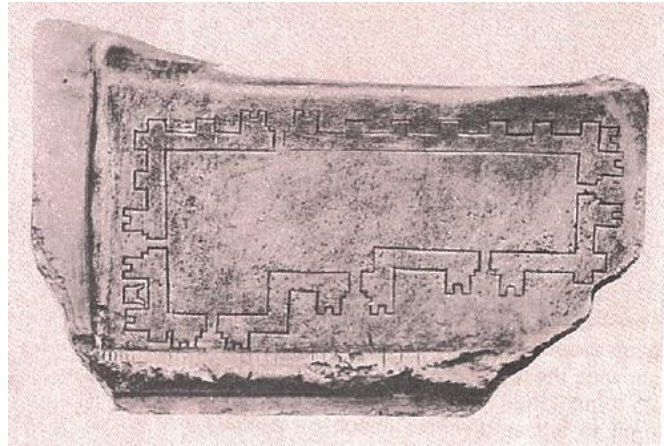
In this chapter I will introduce Engineering Graphics and Design as a subject and will also orientate the reader regarding the origin of EGD, EGD in the 21<sup>st</sup> century, the syllabus of EGD, career links in EGD, my role as educator in EGD and challenges that may influence the teaching of EGD.

#### 2.2 The origin of EGD

From the earliest of times there has been a need for mankind to capture historical events and different experiences on a visual level. On 18 December 1994, a Frenchman named Jean-Marie Chauvet, with his two helpers, discovered a cave in the Ardeche area of France. This cave contained perfectly preserved rock-drawings from an Ice Age approximately 22 000 years ago. The realistic drawings of extinct (in Europe) species of rhinoceros and horse show us the drawing skills of mankind in that era (Fritz, 1995:92-95).

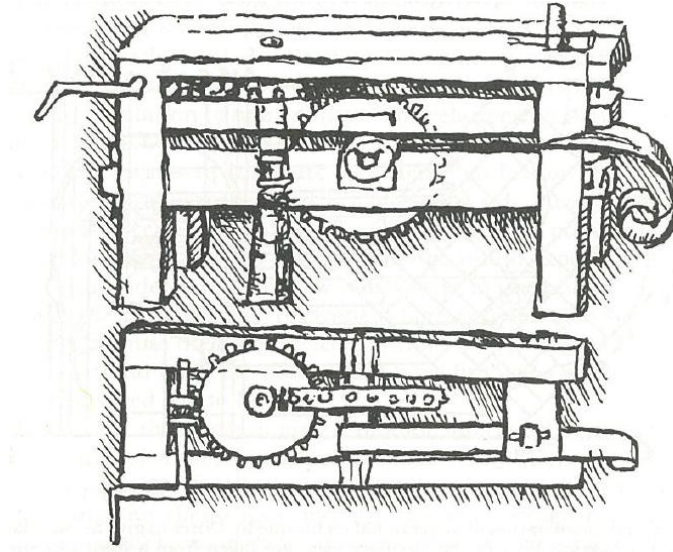
We find the earliest use of drawings for more practical purposes in architecture. Antique Egyptian stoneworkers used papyrus, wood and tablets of rock to draw plans of pyramids and other buildings. The Louvre in France contains one of these plans in the form of a rock tablet with the floor plan of a temple in Ningirsu

(see Fig. 1). The most interesting phenomenon of this floor plan is the provision of scale, which in current terms, puts this tablet in the drawing category of a working drawing in Engineering Graphics and Design (EGD) (French & Svensen, 1966:1-3).



**Fig. 1 A rock tablet with the floor plan of a temple in Ningirsu (French & Svensen, 1966: 3)**

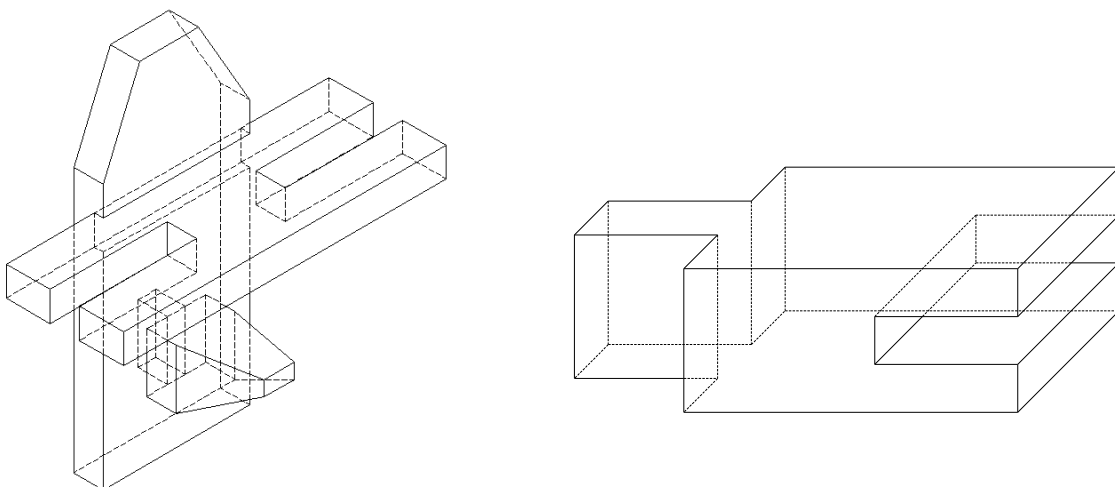
Leonardo da Vinci (1452-1519) did a study on the art of drawing and painting and was quite skilled at creating drawings in three-dimensional views. He not only tried his hand at drawing three-dimensional (3D) views,, but also orthographical views, which include a top view, bottom view, left view and a right view of an object. What is interesting and important is that Da Vinci's orthographic drawings also incorporated an element of 3D drawings (see Fig. 2) (Booker, 1979:46). In Figure 2 we see that Da Vinci moved from a 3D drawing to a more functional orthographic drawing where we can see the front view as well as the top view of the rolling mill for forming lead and copper strips.



**Fig 2. Da Vinci's orthographic drawings with an element of 3D drawings (Booker, 1979: 46)**

Goswell (1995:63) sees 3D drawings as “modelling which allows you to construct your design in three dimensions and visualise it from any position”. Isometric and oblique drawings consequently fall in the category of 3D drawings in EGD.

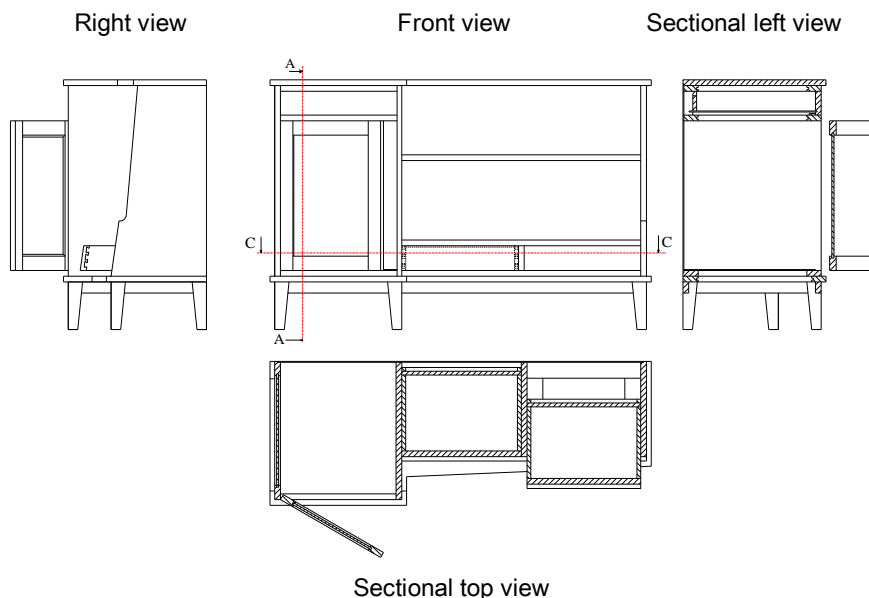
Figure 3 shows an example of a 3D drawing (isometric) and an example of a 3D drawing (oblique) which I drew on Turbo CAD (Computer Aided Design).



**Fig. 3 Isometric and oblique drawings**

Brusic, Kuetemeyer and Fales (2004:162) define an orthographical or two-dimensional drawing (2D) as follows: “One common type of drawing is called a multiview drawing. It shows two or more different views of an object drawn at right angles, or perpendicular, to one another”. Orthographic drawings are sometimes also called “*working drawings*” since they are a very common type of drawing used in manufacturing and construction industries.

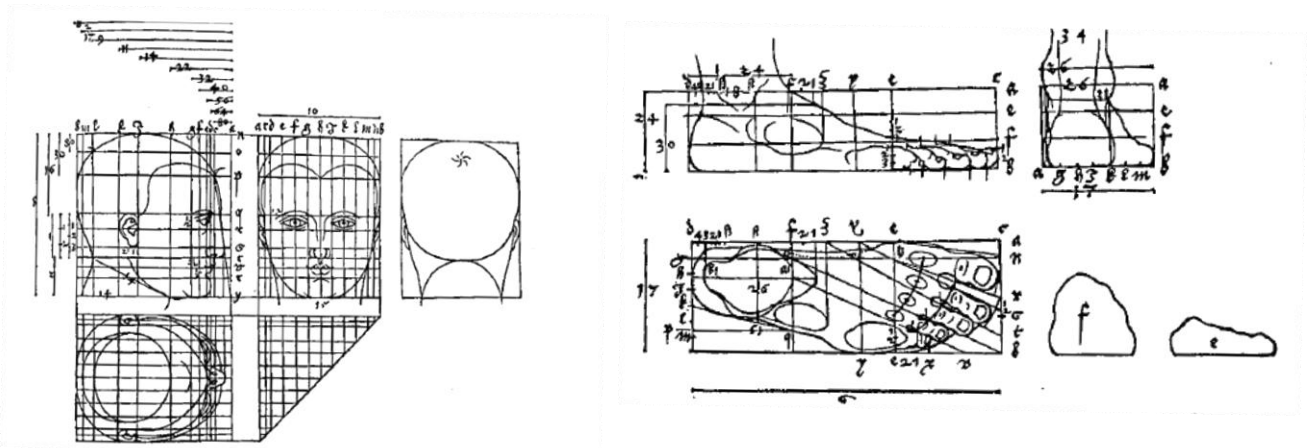
Figure 4 shows an example of an orthographical drawing with the following multi-views: front view, sectional top view, sectional left view and a right view as drawn by myself on Turbo CAD.



**Fig. 4 Sectional multi-view drawing**

During the time of the early Renaissance in Europe, Albrecht Durer (1471-1525) published a book which contains drawings of the human body drawn according to orthographic principles. The drawing of the human head (see Fig. 5) was done according to the principles of third orthographic projection, while the drawing of the human foot (see Fig.5) was done according to the principles of first angle orthographic projection. A possible flaw in Durer’s drawings was that

he used full scale measurements to complete the drawings, and the drawings were therefore large and not easily manoeuvrable (Booker, 1979:43).



**Fig. 5 Orthographic drawings of a head and foot (Booker, 1979: 43)**

Gaspard Monge was born in 1746 in the town of Beaune in France. Monge had a talent for science and mathematics and was therefore sent to the military school in Mezieres. On account of his education in physics he was unable to attend the draughting course at the military but fortunately for him an officer of the engineers recognised his talent and so the commandant appointed him as one of the student draughtsmen in the design office. Monge realised that the methods used in the designing room were very time consuming and quickly became frustrated. The technique they employed at the time entailed the creation of the top view and then using formulas to identify the depth and angles of the rest of the views. He identified the need for a simple technique to use only geometrical methods to complete a drawing. His novel methods quickly made him very unpopular among the other draughtsmen since Monge finished his drawings much faster than the rest of them. The commandant had to investigate Monge's methods because of the other draughtsmen's complaints but soon realised that his methods were better and faster to use. Monge's insights in the designing room made him one of the greatest contributors to descriptive geometry (Booker, 1979:86).

### **2.3 EGD in the 21<sup>st</sup> century, especially in South Africa**

In section 2.2 the origin of the subject EGD was explained. In this section I shall explain how this subject originated in South Africa. I interviewed Mr J.H. Pienaar on 16 March 2010 because of his 47 years of experience in the graphical communication field. It emerged that graphical communication has gone by many names over the years. Graphical interpretation was first introduced in the Free State in 1963. It was then called Technical Drawing. Later the subject name changed to Technical Drawings and eventually in 2005 it changed to Engineering Graphics and Design.

Technical drawing is an all-embracing term for the graphical language that is used universally by engineers to understand different technical concepts and ideas, such as the form and size of structures and mechanical objects (Nieman, 1976:7). The Department of Education (DoE) (2005:9) defines EGD as follows: “Engineering Graphics and Design integrates the cognitive and manipulative skills that are used to design and communicate graphically. The subject combines lines and symbols to render services and design processes and systems that contribute to economic growth and enhanced quality of life”.

At the heart of both definitions we find the theme of communicating on a graphical level. Consequently we know we can use drawings as a means of almost universal communication, and that without saying a (possibly confusing) word we can communicate a lot of crucial information. In years gone by drafters used drawing boards, T-squares, triangles, compasses and pencils to communicate on a graphical level. Nowadays the mechanics of the drawing task have largely been accelerated and automated through the use of computer aided design (CAD) systems.

CAD is an important part of EGD in the schools according to the DoE (2007:2), which states that “The subject deals with the drawing language, developments, projections, first-angle and third-angle orthographic projection drawings of single objects, assembling drawings and detail drawings, freehand sketches, isometric drawing, oblique drawings, computer environment for scale production

drawings using a CAD programme, printing CAD scale production drawings and management of files”.

Engineering Graphics and Design (EGD), as a niche area within the higher education environment, plays an important role in the training of many aspiring educators and also persons following other careers (see 2.4). Imagine an EGD course that challenges educators to meet a number of objectives within EGD. Spady (as quoted by Killen, 2009:51) states: “All students can learn and succeed, but not all in the same time or in the same way”. Furthermore Gardner (as quoted by Giles, Pitre & Womack, 2003:1) states: “Intelligence encompasses the ability to create and solve problems, create products or provide services that are valued within a culture or society”. Spady and Gardner are of the opinion that the individual’s type of intelligence will play a role in how they learn, succeed and understand things. I totally disagree with the statement and believe that if one accommodates every student’s learning style and combines this with effective teaching and learning, students will succeed. EGD gives me the opportunity to do just that.

## **2.4 Career links**

Considering global career development and opportunities I must ask the following question: *why do students study EGD on secondary and tertiary level?* I would have to answer as follows: Whilst you are in the further education and training (FET) phase you have to decide which subjects you need to do in order to follow a particular career or profession. The DoE (2005, 2010) suggests that Engineering Graphics and Design provides the following knowledge and possibilities in relation to career directions, although not necessarily limited to these:

- application of the principles of Mathematics, Physical Sciences, Computer Applications Technology and Life Sciences to manufacturing, engineering and technology problem solving;
- conceptual design, synthesis and graphics;
- conceptual knowledge, understanding and application of materials and processes in manufacturing and in the built environment;

- civil, electrical and mechanical engineering fields;
- oral and written communication, using appropriate language, structure, style and graphical support;
- application of codes of practice (standards and conventions) and legislation;
- incorporation of indigenous knowledge systems and global knowledge systems; and
- consideration of a range of technological solutions, particularly those that are sustainable and not detrimental to human health, well-being or the environment.

The above-mentioned aspects would be useful in a wide range of careers, as suggested by Engelbrecht (2006): EGD educator, architect, civil engineer, mechanical engineer, electrical engineer, technologist, CAD draughter and quantity surveyor, for example. To understand the importance of EGD in these careers it is necessary to provide an idea of what is involved in different careers, so as to link EGD to those careers.

According to the Curriculum Research and Development Division (CRDD) of the Republic of Ghana (2010) the *EGD educator* must lead EGD students: to obtain the required knowledge (cognitive), skills (psychomotor) and attitudes (affective) for further education and training (FET); to acquire critical thinking skills for solving social, economic, environmental and technological problems; to acquire definite approaches towards the safe use of drawing instruments, equipment and material; and to acquire positive attitudes and required competence in the application of EGD for productive work.

Wallach (1971) and Deckler, Graupner and Henning (2008) portray the *architect* as a person who is trained in the planning, designing and oversight of the construction of buildings.

Bertoline, Wiebe, Hartman and Ross (2011:3) describe *engineers* as “creative people who use technical means to solve problems. They design products, systems, devices and structures to improve our living conditions. Although problem solutions begin with thoughts or images in the mind of the designer, presentation devices and computer graphics hardware and software are powerful tools for communicating those images to other”.

Furthermore Bertoline, Wiebe, Hartman and Ross (2011:3) describe the *technologist* as follows: “Technologists work with engineers and are concerned with the practical aspects of engineering in planning and production. Technologists must be able to communicate quickly and accurately using graphics, by sketching design problems and solutions, analysing design solutions and specifying productions procedures”.

According to Brusica, Fales and Kuetemeyer (2004) the *CAD draughtsman* does freehand sketches in advance because these sketches are done quickly and they assist in creating accurate technical work drawings on the computer via CAD software like Turbo CAD, Auto CAD and Ally CAD.

Earle (1983) describes the *quantity surveyor* as someone who is accountable for the administration of resources, manpower, finances and materials necessary for construction projects. These projects may vary from erecting of multi-storey buildings to the movement of concrete and earth.

Informal sketches can be done by anyone but one needs a background in draughting, CAD, civil, electrical or mechanical engineering and mathematics to do formal sketches (work drawings) and computerised drawings. Furthermore to ensure accurate and precise communication of engineered design specifications according to the South African National Standards (SANS) you have to be trained according to the SANS for building practice (SANS 10143) and engineering drawing (SANS 10111-1), and fortunately, EGD offers this.

## **2.5 Syllabus/Content of EGD**

As an educator in any subject, I would need some guidelines to assist me in the presentation of my subject. According to the Department of Education there are a few things to consider in the process of educating my students. The National Curriculum Statement (NCS) Grades 10-12 for EGD (2005) emphasises the importance of the following two factors: definition and purpose.

### **2.5.1 Definition**

To have a true understanding of the nature of EGD, I had to search for different formal statements of EGD to define the subject. I was able to find the following definitions:

“Technical drawing is a medium necessary for the smooth functioning of a modern industrial, technological society” (Yarwood, 1994:vii).

“The graphical form is ideal for quickly conveying complex ideas in an unambiguous manner. Anyone attempting to write a complete description of an engineering component will realize the difficulties of producing a concise and unambiguous description and will readily agree the truth in the saying that ‘a simple picture is worth a thousand words’ (Davies & Yarwood, 1986:1).

“Engineering Graphics and Design integrates the cognitive and manipulative skills that are used to design and communicate graphically. The subject combinations lines and symbols to render services and design processes and systems that contribute to economic growth and enhanced quality of life” (DoE, 2005:9).

Taking these three definitions into consideration, I am enabled to state that EGD drawing is an effective means of communicating technical ideas and problem solutions. Therefore I can say that EGD is actually graphical communication using engineering drawings and models as a clear, exact language with unambiguous rules that must be mastered if one is to be successful in Engineering Graphics and Design.

### **2.5.2 Purpose of EGD**

According to Bloom and his colleagues, as quoted in Killen (2009:81), it is common practice for educators to group learning outcomes into three domains which I consider as important factors in the purpose of learning EGD. These domains are:

- the cognitive domain, concerned with mental processes;
- the psychomotor domain, concerned with the control of body movements and physical actions; and
- the affective domain, concerned with feelings, attitudes and values.

According to Bloom's taxonomy, the purpose of learning is to enhance the students' cognitive, affective and psychomotor skills (Bloom, 1956; Killen, 2009). Therefore I came to the conclusion that it is necessary for EGD to strive to accommodate all three of the above-mentioned domains.

The DoE (2005:9-10) describes the purpose of EGD as subject matter in the following manner: "EGD contributes to students' technological literacy by giving them opportunities". Organised according the different domains of Bloom, I have identified some of these opportunities as follows:

Cognitive domain:

- Apply the design process to solve civil, electrical and mechanical problems analytically and graphically.
- Students have to understand concepts and knowledge used in EGD and use them sensibly and purposefully in the areas of civil, electrical and mechanical technology.
- Students must be able to develop and apply specific drawing skills related to EGD on the drawing board.
- Identify and solve design problems while making responsible decisions using critical and creative thinking when applied to civil, electrical and mechanical drawings.

Psychomotor domain:

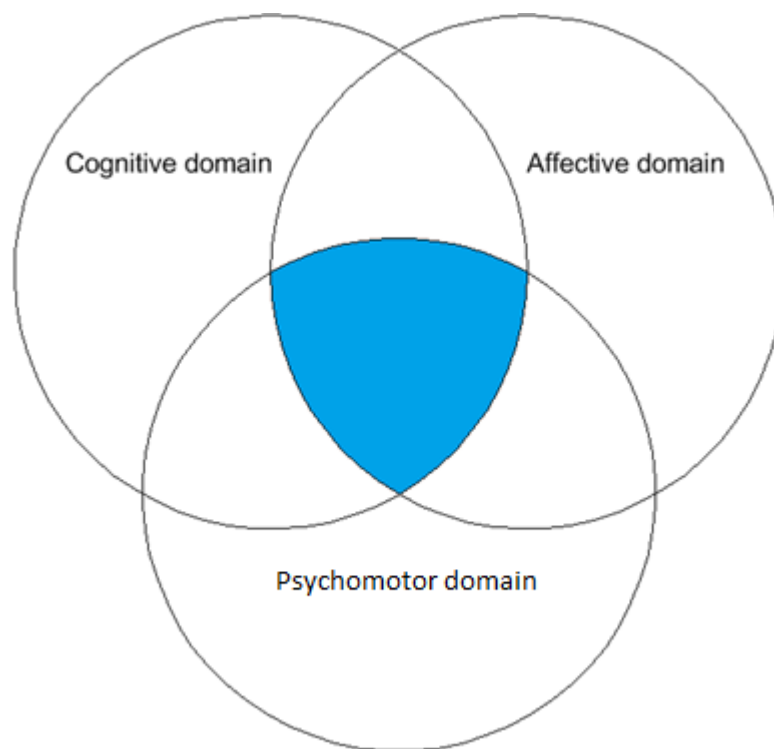
- Collect, analyse, organise and critically evaluate information when producing drawings.
- Communicate effectively using visual, mathematical, scientific and graphical and/or language skills in oral and/or written modes as applied to EGD.
- Freehand, instrument and computer aided drafting.
- Students must have the necessary psychomotor skills to create and apply theoretical knowledge in the drawing process.

Affective domain:

- Students must appreciate the interaction between people's values, attitudes, society, environment, human rights and technology.
- Work effectively with others as a member of a team, group, organisation or community.
- Use science and technology effectively and critically, showing responsibility to the environment and to the health of others when using and producing drawings related to Engineering Graphics and Design and providing services.
- Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.
- Participating as responsible citizens in the life of local, national and global communities.
- Being culturally and aesthetically sensitive across a range of social contexts.

Therefore I would say that the purpose of teaching and learning EGD is applied thoroughly because all three domains of Bloom are indeed utilised in the completion of the syllabus. According to Williams and Williams (1996) there is an interrelationship between the three domains. Unfortunately there are still

educators who try to separate Bloom's domains, and it remains important for educators to understand that the domains don't occur in isolation but must preferably work together to configure one unit (see Fig. 6 as drawn by myself on Turbo CAD). Hence all three domains must be stimulated equally for a student to achieve the outcomes at the end of the module. To ensure that a deep approach to learning is accommodated in EGD, all three domains of Bloom must be present throughout my teaching in EGD.



**Fig. 6 Bloom's domains**

The above example illustrates the interrelationship between the domains in EGD. EGD students must have good small muscle coordination to make the necessary sophisticated hand movements with the drawing tools (psychomotor), they must know the different movements needed to create a drawing (cognitive) and must also want to perform and repeat these movements enough so that proficiency can develop through practice (affective).

## 2.6 My role as educator in EGD

According to the Policy Handbook for Educators (ELRC, 2003) and the NCS (DoE, 2005:5) for EGD, there are seven roles as an educator that I should follow in my profession. The seven roles are: learning mediator; interpreter and designer of learning programmes and materials; leader administrator and manager; scholar, researcher and lifelong learner; community, citizen and pastoral role; assessor; and learning area/subject/discipline/phase specialist. According to the Policy Handbook, (ELRC, 2003) the seven roles can be explained as follows:

**Learning mediator:** In this role, the educator mediates learning in such a way that he/she is sympathetic to the diverse needs of students, including those with learning difficulties.

**Interpreter and designer of learning programmes and materials:** The educator in this role will be familiar with the learning programmes to such an extent that he/she will be able to interpret, adapt and design new learning programmes.

**Leader administrator and manager:** Here the educator makes suitable decisions with reference to managing learning in the EGD classroom and carrying out administrative classroom duties, as well as taking part in making democratic educational decisions.

**Scholar, researcher and lifelong learner:** The educator should be intrinsically motivated to achieve on-going personal, academic, occupational and professional growth through reflective teaching, study and research (action research) in the EGD learning area. The educator must furthermore be up to date with all the latest developments in EGD.

**Community, citizen and pastoral role:** The educator will encourage democratic values and endorse a crucial, dedicated, ethical and supportive attitude in terms of developing a sense of respect and responsibility in relation to students and fellow educators.

**Assessor:** Here the educator must realise that assessment is a crucial part of teaching and learning. The educator should know the purpose, methods, types and the effects of assessment. The educator must continuously provide feedback to the students.

**Learning area/subject/discipline/phase specialist:** In this role, the educator must be personally grounded in the knowledge, skills, values, principles, methods and procedures relevant to EGD.

The seven roles mentioned above are intended to be a description of what it means to be a competent and effective educator. This is not a checklist to assess oneself against to measure if one is competent, but rather seven guidelines that a person may follow which may assist him/her to become a competent educator. Whilst I am reflecting on my own teaching and identifying teaching practices which will enhance a deep approach to learning, I must still use these guidelines in order to be a competent educator.

## **2.7 Challenges which may influence the quality teaching of EGD**

According to Killen (2009) there are two different challenges which may constrain the teaching of EGD: the constraints created by the administrative system and the constraints you create yourself. Whether dealing with the constraints caused by me or the constraints of the “system”, I must develop alternatives to deal with any constraints which may hinder my teaching in EGD.

Killen (2009) describes various system constraints. Among these would be too much administrative work, which leads to more time being allocated to administrative work and not enough time allocated to teaching. There is a shortage of recognisable resources and updated reference books (handbooks, workbooks etc.) in teaching in general and in EGD especially. There are also several other constraints that I have come to recognise during my short teaching career and that I would also like to add. Students often do not find the subject particularly interesting and classify it as a bit boring. They also complain about how difficult some of the drawings are and that they cannot grasp the crux of the drawings. They are able to do the elementary drawings

(surface approach), but when they need to move to the next level, or to advanced drawings (deep approach), they struggle. My own experiences have led me to understand that the reason for this problem is that although EGD is usually an exact subject, it can also often be an abstract subject. Consequently an educator should not simply hit the drawing board and ask students to copy the work as they will remain at the shallow end of learning thus ways must be found to access the deep approach to learning. Another challenge is to ensure that there is a balance between the three domains of Bloom as all three domains must be stimulated equally for students to achieve the outcome.

At this point the following question arises: are the above-mentioned “system” constraints really “system” constraints or my own constraints? As an effective teacher I must rely on my own creativity to overcome or deal with these challenges.

As an expert in my subject I should know which work in the syllabus is more important. I should be able to identify and focus on the more important principles of EGD and make sure that the students understand these principles rather than focusing on work that is not as important and even irrelevant in achieving the outcomes by the end of the semester. According to Ayers, Sawyer and Dunham (2004) it is better for the students to understand the basic underlying principles of their specific learning area than to have a shallow understanding (surface approach to learning) of a large amount of content. Therefore as an educator I should be able to determine to a large extent how much time goes into administrative work and how much time goes into teaching.

As a creative teacher I may not use the shortage of recognisable resources as an excuse not to teach effectively. I must be prepared to visit the library, surf the Internet, talk with other educators in my field and collect and develop resources to teach EGD. According to Mysliwiec, Shibley and Dunbar (2004) your local newspaper, regardless of your subject, will have ideas and information to use as a resource in teaching. For example in EGD I may use a newspaper article that describes the structural collapse of a bridge and then ask

the students to apply their theoretical knowledge to design a new, stronger bridge.

To address the challenge of lack of interest in the subject, I can make use of different teaching practices which are mentioned in Chapter 4, to arouse and retain their interest during the session. These teaching practices will help the educator to facilitate this exact subject in different ways, and the students will understand, remember and enjoy EGD better. I am also using the different teaching practices to move the students from a low cognitive thinking level (surface approach to learning) to a higher cognitive level of thinking by means of deep learning which will assist them to do the elementary drawings and then to move to the next level of advanced drawings without undue struggle.

## **2.8 Summary**

In this chapter I explained the subject EGD and I familiarised the reader with the foundation, syllabus, career links, my role as educator and the challenges which may influence teaching in EGD. These challenges play an integral role in teaching the subject and emphasise the problem at hand, in other words, how I can approach the subject to make it more palatable to students. If, as an educator, I don't know the syllabus of EGD, I cannot expect the students to understand and know what is expected of them. The career links are important, because I as an educator must lead the students in the right direction to choose a career which they most likely will follow for the rest of their lives. I see this as a very important role of an educator. If I compare the history of graphic communication with the situation at present, one thing is clear: we use drawings to communicate on a graphic level. Different drawings are done in EGD which will ultimately lead students to a higher cognitive level of thinking – if the subject is taught correctly.

In the next chapter I will present a literature study on the research design and methodology I followed.

## Chapter 3

### The research design and methodology

Question	Lin Norton action research steps	McNiff questions	Chapter layout	Research method
How can I adapt my teaching practices to improve student learning?	Thinking of ways to tackle the problem	What can/will I do? What kind of evidence can I gather to show that I am having an influence?	<b>Chapter 3</b> The Research Design and Methodology	<b>Research plan</b>

#### 3.1 Introduction

In this chapter I shall attempt to expand upon the research design and methodology that I introduced briefly in Chapter 1. In order to clearly understand why, how and what I intend to do in my study I have to discuss my research design and methodology to outline the different qualitative approaches I followed. My path of research and study started taking an unexpected and drastic yet welcome turn in November 2009 when I accompanied a colleague to a seminar presented by Prof. Jack Whitehead. In his seminar Whitehead introduced action research. Action research entails the improvement of one's practice by means of specific approaches and constantly asking questions of and about oneself and the educational environment, thus leading one to constantly improve one's knowledge and education (Whitehead, 2009). My attendance proved opportune months later when I decided to embark upon studies for a Master's degree and I started formulating various questions in my mind regarding my study as well as the classes I taught.

At this time the desire to improve my teaching and my knowledge thereof led me away from the traditional way of research, where I would normally have written up my research in the third person ("the researcher decided"). Instead, I use a more personalised style of writing where I use the first person perspective ("I decided"), which I felt afforded a more personal point of view that is less formally academic and reads more easily than a traditional dissertation. My

continual reflection and process of self-improvement as well as my desire to improve my teaching of EGD, led me to realise how useful action research could be to me, since I can only improve upon my teaching if I implement improvements which in turn are dependent on my level of honest self-reflection. Action research also entails that the process of researching is a self-reflective process on how to improve my teaching in EGD (Whitehead, 1993; Whitehead, 2009).

De Vos, Strydom, Fouche, Poggenpoel, Schurink and Schurink (2001) describe the research design as a blueprint according to which a study will be implemented. It also entails the planning and the structuring of the study. Thus in this chapter I outline the methodology that I used for my study in order to address the following: Teaching students in Engineering Graphics and Design: an action inquiry. Furthermore I address my research questions and indicate the caution with which I approached issues such as ethical considerations and trustworthiness, sampling, data collection and the data analysis of my study.

### **3.2 Research problem and research questions**

As mentioned before, I had never experienced or implemented a deep approach to learning within the subject EGD, either as a school learner or later as an undergraduate student,. Whether it was because of a lack of interest on my part or that of the educators (which is not the relevant issue), the important factor is that a problem was identified and I am busy addressing this problem. I truly understood the importance of the deep and surface approaches to learning once I had done the teaching and learning course (HOS518) in higher education at the University of the Free State. After this course, whilst teaching, I realised that in the past drawings had mostly been copied, which means that one had to take an already existing figure and then simply draw it in exactly the same way. To me this is a typical example of where no meaning was constructed and a drawing was merely reproduced. Never were the questions raised or answered of where all of this fits into the picture, or why there is a need to understand drawings. I now know that it is important to lead the students to a higher cognitive level whilst doing drawings. The question which

sprang to mind was, how was I going to do this? I do know that I had to use my teaching to help the students to achieve that higher cognitive thinking level. I furthermore realised that I was right when I said that I had never experienced a deep approach to learning.

To substantiate what I expected, I discussed the EGD students' marks with the previous lecturer, after I had taken a look at the mark sheets of the previous 5 years and seen the evidence that only a minority of students ever achieved more than 70 percent for the subject. This led me to the conclusion that the majority of the class only used a surface approach to learning, and that their aim was simply to pass the subject. The question now raised was, how could I change this? The purpose of my study is therefore the following: to determine the best teaching practices that I can implement to improve my teaching of EGD and which will contribute to a deep approach to learning among my students. These will be utilised as possible guidelines for educators not only to obtain maximum results, but also for students to benefit from this teaching experience which would take them to a deeper level of learning to explore, discover, interpret and create within EGD (Bloom, 1956; Anderson & Krathwohl, 2001) . Furthermore I want to improve my own teaching and teaching experiences. The following research questions derived from the above mentioned research problem:

- What are the nature and challenges in the teaching of EGD?
- How can I adapt my teaching practices to improve student learning?
- How did I adapt my teaching practices?
- How effective have the chosen teaching practices been?
- How can I modify my teaching practices in the future?

### **3.3 Research aims and objectives**

The study was aimed at increasing a deep approach to learning among students whilst using different teaching/learning activities in EGD, and at the same time I wanted to improve my own teaching of EGD. Furthermore I will encourage the implementation of these teaching/learning activities by designing

a framework that may serve as a possible guideline for future implementation of the mentioned teaching practices, to improve on a deep approach to learning. My research objectives were the following:

- To investigate the nature of teaching and the challenges involved in teaching EGD by means of a literature study.
- To investigate EGD as a constructive aligned module by means of a literature study.
- To facilitate a qualitative focus group, the members of which will reflect on the use of teaching practices in EGD. This could lead to a deep approach to learning.
- To propose a framework for the implementation of teaching practices, which will enhance a deep approach to learning among students.

### **3.4 Research design and methodology**

I will now illustrate the research design and methodology I have engaged with in my study by means of a schematic representation (see Fig. 7).

#### **3.4.1 Qualitative research design, methodology and methods**

As a young researcher in this new age of information I wanted to find a method of research and presentation where a more personalised approach could be followed. In doing so, I wanted to improve my teaching in EGD. First I had to identify a method which would do just that.

There are different methods of research which can be divided into two categories, namely quantitative or qualitative methods. In my study I will make use of qualitative research which is defined by Key (1997:1) as “a generic term for investigative methodologies described as ethnographic, naturalistic, anthropological, field, or participant observer research. It emphasizes the importance of looking at variables in the natural setting in which they are found. Interaction between variables is important. Detailed data is gathered through open ended questions that provide direct quotations. The interviewer is an integral part of the investigation”. Qualitative research differs from quantitative

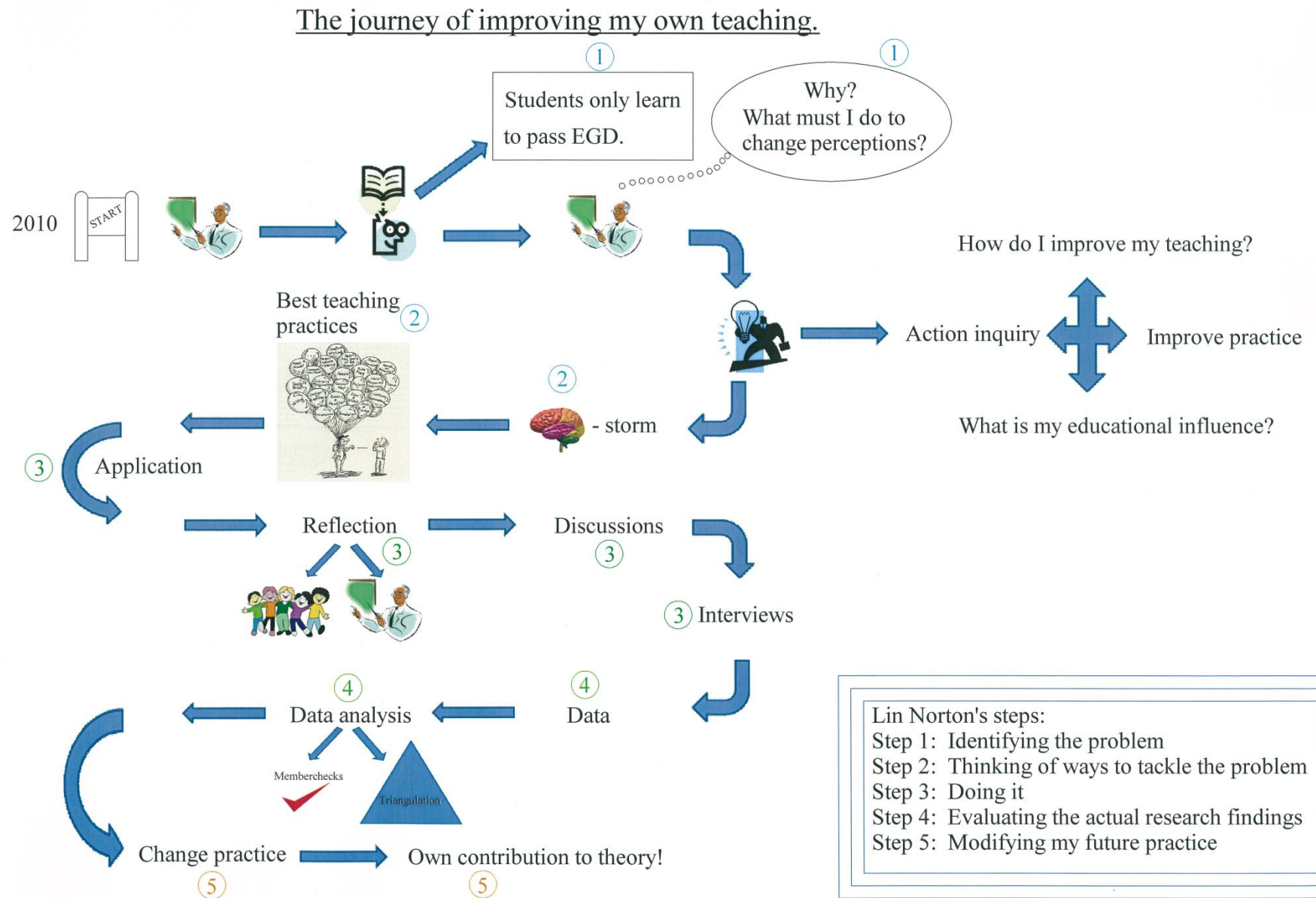
research, in which the researcher attempts to gather data by objective methods to provide information about relations, comparisons and predictions, and attempts to remove the investigator from the investigation.

Once I established the difference between quantitative and qualitative research, I could set about choosing the research method that best applied to my study. Since it was my aim to improve my teaching practices in Engineering Graphics and Design, I looked at the natural setting of EGD which is the classroom. Taking all aspects into consideration, I chose qualitative research (see 3.4.1.1) as a starting point for my study.

The following characteristics of qualitative research are applicable to my study and emphasise why I chose to work in the field of qualitative research.

Qualitative research investigates what, how and why things happen the way they happen and makes use of various methods to acquire knowledge of how participants construct their social world. Furthermore, qualitative research gives a clear and detailed explanation of actions and also gives interpretations of the actions. It emphasises the process/cycle of the study and not just the outcome of the study. Qualitative research has a vast variety of combinations and techniques with which to collect data. It allows for reports to be more flexible and less structured than quantitative research reports (Babbie & Mouton, 2001; Henning, Van Rensburg & Smit, 2004; McMillan & Schumacher, 2010).

After identifying the qualitative research design, I had to discuss the theoretical framework of my study. Mertens (1998) and McNiff (2002) identify ontology, epistemology and methodology as key aspects in educational research which support the ***theoretical grounding*** of my study.



**Fig. 7 Schematic of my research design and methodology**

According to Mertens (1998:6), Guba and Lincoln (1994) and Neuman (2000) **ontology** raises the following question: “*What is the nature of reality?*” In my study the nature of reality is transformative since I am change-oriented of nature. As the lecturer and researcher I am part of the EGD environment where the research was done. I wanted to change my practice in such a way that I could change and so that a deep approach to learning would be enhanced among my EGD students. Since I was part of the study, it would not have been possible to separate myself from the students’ environment; therefore I also adopted a participatory approach in my study (Creswell, 2003; Mertens, 2005).

Furthermore the above-mentioned authors build upon **epistemology** by means of the following question: “What is the nature of knowledge and the relationship between the knower and the would-be knower?” The principle of epistemology entails how the students understand the knowledge, what is known to them and how the knowledge becomes known by them. I as the researcher and educator will play an important role in assisting the students to obtain and understand knowledge about EGD, teaching/learning activities and the different teaching approaches. I as the researcher also construct my own knowledge whilst reflecting on my teaching practice. Therefore I am obliged to say that the transformative ontology of my study is going to influence the epistemology of my study.

**Methodology** refers to the following question: “How can the knower go about obtaining the desired knowledge and understanding?” (Mertens, 1998:6; Guba & Lincoln, 1994; Neuman, 2000). The research methodology I followed was influenced by the ontology and epistemology (Mackenzie & Knipe, 2006). It refers to “how things are done”. My experiences as an educator, the interaction with my students and the process of reflecting in EGD assisted me to understand the research design and methodology I followed. To clarify what I did in my study I will explain it in the following sections (see 3.4.1.1 to 3.4.1.3) of this chapter. In summary, the ontology, epistemology and methodology influence the research of my study in a real life situation and accumulate knowledge based on my personal values, experiences and interaction with the

participants. The task at hand was to obtain new knowledge which would improve my understanding of teaching EGD and to empower the students with knowledge to use higher cognitive levels of thinking whilst using a deep approach to learning to excel in EGD (McNiff, 2002).

#### **3.4.1.1 Why action inquiry as methodology?**

According to Niewenhuis in Maree (2009) there are six types of qualitative research design: conceptual studies, historical studies, action research, case study research, ethnography and grounded theory .

During the process of investigating the above-mentioned research designs, action inquiry underpinned by action research as a design caught my eye. According to Tripp (2003), action inquiry is an umbrella term for the deliberate use of any kind of action research plan, act, description or review cycle for inquiry in a field of practice. Reflective practice, diagnostic practice, action learning, action research and researched action are all various kinds of action inquiry.

The reader may ask why I chose action research and my answer will be to quote the following:

“Action research is a term which refers to a practical way of looking at your own work to check that it is as you like it to be” (McNiff, 2002:5).

“Action research is a process in which participants examine their own educational practice systematically and carefully, using the techniques of research” (Ferrance, 2000:1).

“Action research is the process of using research principles to provide information that educational professionals use to improve aspects of day-to-day practice” (Abrahams as quoted in McMillan & Schumacher, 2010:444).

Once I took these three definitions of action research into consideration it seemed evident to me that I should use this method of research as it is

grounded in actual classroom experience. Furthermore Cohen, Manion and Morrison (2009) acknowledge that action research may be utilised in a variety of areas:

- Teaching/learning activities
- Learning strategies
- Evaluative procedures (Evaluating my own teaching)
- Attitude and values
- Continuing professional development of educators
- Management and control
- Administration

In my particular study I identified and used three of the above-mentioned areas of action research. These entail the following:

- Teaching/learning activities: I am substituting traditional teaching/learning activities and teaching practices by discovering new methods and practices which may lead to a deep approach to learning.
- Attitudes and values: I wanted to inspire a more positive attitude on the part of students towards their work and, in a way, I wanted to modify the students' value systems with regard to some aspects of life. The value I intend for them to acquire is internal motivation to succeed (using a deep approach to learning to excel in EGD).
- Continuing professional development of educators: I will attempt to improve on my own teaching practices, develop new methods of learning and improve my overall teaching of EGD.

McNiff (2002:8) states that “the methodology of action research means that you have to evaluate what you are doing. You need to check constantly that what you are doing really is working. Are you really influencing your situation or are you fooling yourself?” During my study I reflected upon my teaching to evaluate what I was doing and checked constantly to identify whether this self-evaluation was having an influence on my teaching and on my students. Thus it is fair to say that the action research methodology which I followed in my study was

appropriate (McNiff, 2002; Henning, Van Rensburg, & Smit, 2004; Whitehead, 2009).

#### **3.4.1.2 The transformational nature of action research in my study**

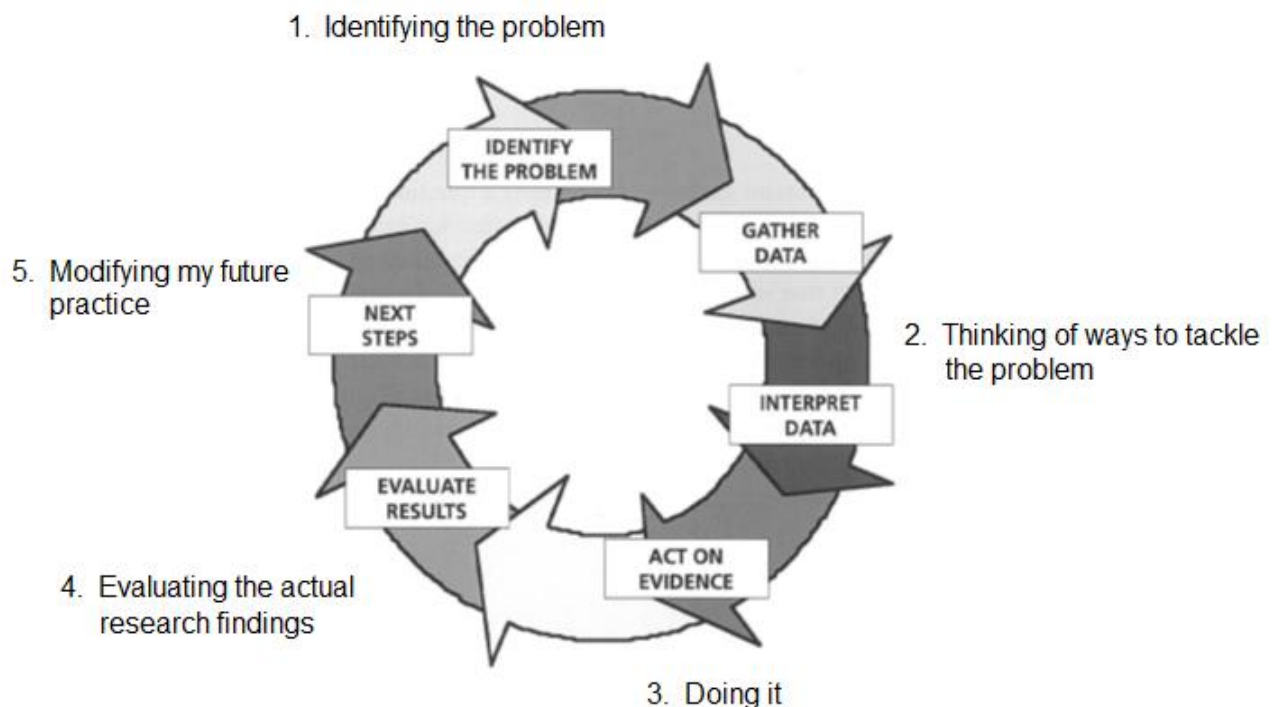
Not too long ago I would have found the notion of this research design preposterous and would not have considered it to be authentic research. The reason for this is that I was trained according to a positivist research paradigm during my undergraduate years as a student where everything had to be scientifically proven: if not, it was considered false. According to Miller (in Neuman, 2000:65) “positivism is the most common philosophical outlook on science”. However, whilst doing research for my Honours degree, I came to the conclusion that there are other paradigms which had a different appeal, and which I found attractive.

Bassey (1990:13) defines research paradigms as: “a network of coherent ideas about the nature of the world and the functions of researchers which are adhered to by a group of researchers, conditions the patterns of their thinking and underpins their research actions”.

The paradigm I chose which suited best for my study was the transformative paradigm. Kemmis (2001:92) defines the transformative paradigm as an “action aimed at transforming situations to overcome felt dissatisfactions, alienation, ideological distortion, and the injustice of oppression and domination”. With this definition in mind, why then did I choose a transformative paradigm for my study? If I, as the educator, only use lecturing as a teaching/learning activity, there is only one-way communication and I am dominating the class with my own beliefs. Whilst only using teaching/learning activities which enhance a surface approach to learning, I alienated the students in not helping them to use a deep approach to learning which in turn, could help them to perform better in the subject EGD (Mackenzie & Knipe, 2006).

### 3.4.1.3 Research design

The focus of my research question was to improve my own teaching of EGD. Eames (in Twomey, 1997:26) stated that it is important “to evaluate and improve my practice in a methodological and rigorous manner”. In the case of my study, evaluation to improve on my teaching assumed that I will observe and reflect on my own teaching. My action reflection cycle, integrated with Lin Norton’s (2009:70) five steps (see Fig. 8 according to Ferrance, 2000:9), indicated the course that my research cycle would take.



**Fig. 8 Action research cycle**

The steps I took to put my action research cycle into practice were:

- I identified an area where I saw a weakness in my practice. In this case I identified that there was a lack of deep learning among my students in EGD.
- I applied my mind to the issue of finding solutions to this problem, and came up with the following: I would use alternative teaching practices to develop and improve a deep approach to learning among my students.

- I evaluated and reflected on my teaching practices throughout my study and collected data to validate what I was trying to prove.
- I gathered data throughout my action reflection cycle in collaboration with my students in order to enhance a deep approach to learning.
- I analysed my data and modified my practice based on the evidence in my evaluations.

(McNiff, 2002; Tomal, 2005; Whitehead, 2009; McMillan & Schumacher, 2010)

I chose an action research design informed by Lin Norton's (2009) five action research steps and performed a conceptual qualitative study aligned with Whitehead and McNiff's planning phase and eight action research questions (Whitehead & McNiff, 2006:12). The five action research steps as identified by Lin Norton (2009:70) are:

Step 1: **I**dentifying the problem

Step 2: **T**hinking of ways to tackle the problem

Step 3: **D**oing it

Step 4: **E**valuating the actual research findings

Step 5: **M**odifying my future practice

According to Norton (2009:70) the **ITDEM** model is a "useful way of thinking about the process of doing a feasible pedagogical action research study". The issue I identified as a problem (see 5.2.2, 5.2.3) was primarily the lack of deep learning amongst my students. Secondly I needed a way of improving my own teaching of EGD. There might have been many ways of tackling this problem. I made use of my students to brainstorm (see Fig. 7) and identified teaching/learning activities which might assist in solving the problem. Between my students and myself, we came up with various teaching/learning activities which might promote deep learning and improve my teaching of EGD. Then the preparation to facilitate my classes by using these teaching/learning activities

began (see 5.2.4.2). Whilst implementing these methods I started to improve on my own teaching. After the “doing” step was finished the students and I evaluated the teaching/learning activities from best to worst (see 5.2.2.4.18). Lastly I started modifying my future practice by implementing the teaching/learning activities we rated best.

I then combined these five steps with Whitehead and McNiff’s action plan using the following eight questions as an additional guideline to direct my implementation of Norton’s five action research steps as previously shown (see 1.7.1 and 1.12):

1. What issue am I interested in researching?
2. Why do I want to research this issue?
3. What kind of evidence can I gather to show why I am interested in this issue?
4. What can I do? What will I do?
5. What kind of evidence can I gather to show that I am having an influence?
6. How can I explain this educational influence?
7. How can I ensure that any judgements I might make are reasonably fair and accurate?
8. How will I change my practice with regard to my evaluation?

My answers to these questions, together with Norton’s steps, will assist in helping me to construct my action plan for implementing the deep approach to learning.

### **3.4.2 Target population and sampling**

In choosing an action research methodology, I included all my participants in the research as equal in status and worth. I also included myself as an active participant in my own research (Kemmis & McTaggart, 1988; Creswell, 2008). I selected my participants according to predetermined criteria relevant to my particular research question (Killen, 2009:79). I identified two types of sampling which were relevant to my research: convenience and purposive sampling

(Leedy & Ormrod, 2005). Cohen, Manion and Morrison (2011: 155) define convenience sampling as “choosing the nearest individuals to serve as respondents and continuing that process until the required sample size has been obtained or those who happen to be available and accessible at the time”. In the study my own students, previous EGD lecturers and educators were the nearest individuals who happened to be available and accessible at the time. According to Cohen, Manion and Morrison (2011:156) purposive sampling is where I as the researcher “hand-pick the cases to be included in the sample on the basis of their judgement of their typically or possession of the particular characteristics being sought”. My critical friends whom I used in the study I chose because of their specific knowledge of my subject as well as their years of experience. Homogenous groups were needed for the following perspectives:

- My own students (43) currently registered and grouped according to their year of study (convenience sampling).
- Three previous EGD and Technical Drawing lecturers (convenience sampling).
- EGD and similar educators (4) with experience of one year at least (convenience sampling).
- Three educators which acted as critical friends (purposive sampling).

### **3.4.3 Data collection**

In line with my chosen action research methodology, I began to monitor my practice and gather data about what I was doing and whether I was influencing my practice in enhancing a deep approach to learning among my students. Through observation, conversations and the reflections of my students, I noted the teaching/learning activities which encouraged a deep approach to learning as well as those that did not. I also noted those teaching/learning activities that the students enjoyed most.

I gathered data over a course of one year during my research. The data was about my own teaching, since I was the focus of my study, and I carefully

monitored whatever I was doing (own journal) in relation to the students I was working with. I also monitored what they were doing in response to my work with them using reflection sheets and my own reflection and journal.

I used the following data collection methods:

- I obtained Information from the student and lecturer participants regarding their experiences and perceptions by means of discussions (focus groups).
- I kept an own reflection journal, documenting my own experiences. during the entire process.
- I obtained reflection sheets from my students.
- I obtained theoretical knowledge on the bearing of current and previous teaching and learning practices for EGD.
- I gained information with regard to my own actions and learning as well as the reactions of students to adapted teaching by means of self-reflection on continuous episodes.
- I collected written records of action, reflection and evaluation (Whitehead & McNiff, 2006:64, 68).
- I studied relevant literature.
- I obtained feedback from all the research participants.
- I obtained Department of Education policy documents.
- I obtained EGD curriculum and policy documents (Engineering Graphics and Design National Curriculum Statement Grades 10 to 12).

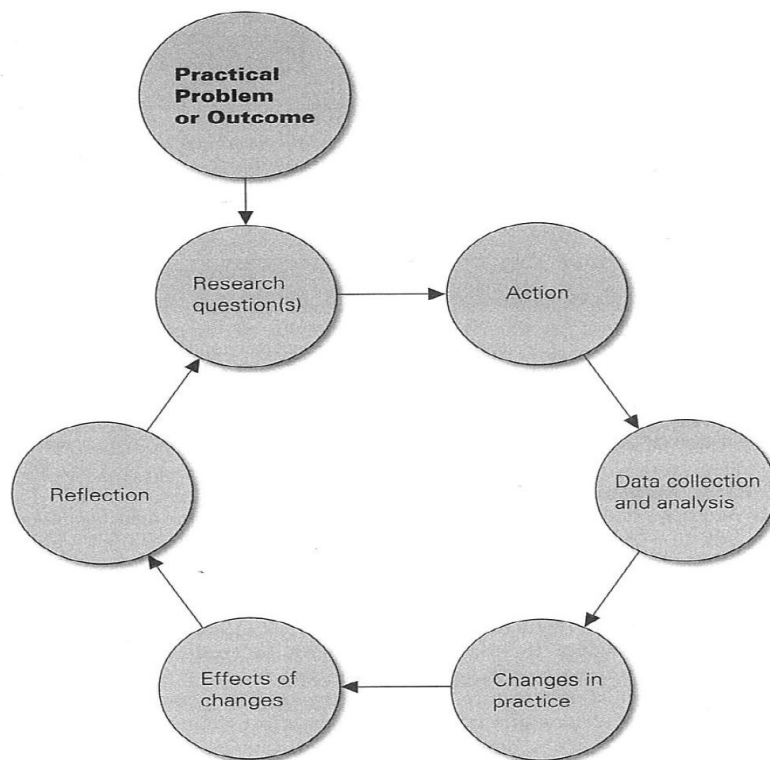
In my journal I recorded the progress of the research, what was done and what I intended to do during each session, as well as my thoughts and reflections on my teaching of EGD. Throughout my data gathering I was able to monitor and document my cycles of planning, observing and reflecting (McNiff, 2002; Tomal, 2005; Leedy & Ormrod, 2005; Cohen, Manion & Morrison, 2009).

### 3.4.4 Reporting the data

The data I collected are reported on in Chapter 5 by means of detailed descriptions of the participants' reflections. During the analysis of the data, relevant data were identified from the various reflection sheets. Thereafter the relevant data were compared and interpreted.

### 3.4.5 Data analysis and interpretation

According to McMillan and Schumacher (2010) I as action researcher should use my results, initial data collection and analysis to change my practice. Subsequently this analysed data would produce new research questions which would then be followed by new data collection and analysis procedures for further studies. Thus I should follow a cyclical process (see Fig. 9) . Therefore I may state that my data analysis tends to be an on-going and non-linear process which implies that my data analysis and interpretation are interconnected and not merely a number of successive steps (Seidel, 1998).



**Fig. 9 The on-going cycle of research (McMillan & Schumacher, 2010: 450)**

An important factor in the data analysis was that it had to be appropriate to my research design and approach. Thus my findings after my data analysis and interpretation had to conclude that alternative teaching practices in EGD would enhance a deep approach to learning among my students. During the analysis of the data I had to prepare the data, code the data, establish themes within the data, structure my analysed data and afterwards interpret the data to make conclusions about the effect of the alternative teaching on my students' learning (Niewenhuis in Maree, 2009).

I structured the evidence by identifying relevant criteria, sorting, categorising, interpreting and analysing data before drawing conclusions (Creswell, 2008; Whitehead & McNiff, 2006).

### **3.5 Trustworthiness of the research**

The trustworthiness of any given study is largely determined by its validity and reliability and so I therefore paid particular attention to these aspects. Killen states that "Validity is often considered as the extent to which a test (or test item) measures what it is intended to measure" (2009:332). In turn Trochim ventured to say that validity is "the best available approximation to the truth of a given proposition, inference, or conclusion" (2006: 1). To me this meant that my research had to be tested against the idea that it was governed, determined and measured only by relevant data. Therefore my sources, techniques and conclusions were considered with great care and critical precision.

Trochim (2006:1) considers reliability as dealing with "the quality of measurement. In its everyday sense, reliability is the 'consistency' or 'repeatability' of your measures". Killen (2009:322) expands on this by saying that reliability is "the degree to which test scores are free from errors of measurement". Accordingly I can state that reliability deals with the consistency and steadfastness of my research and that my research can only be considered valid and reliable if it would convey the same results under the same circumstances if repeated. If I can achieve the same results then I know my research is reliable. According to Leedy and Ormrod (2005), Creswell (1998),

Guba and Lincoln(1985) suggest that the term validity should not be used in qualitative research but that one should rather make use of the following to ensure the trustworthiness of a study: credibility, transferability, dependability and confirmability.

Thus in order to convince readers as well as myself that my research is valid and trustworthy, I must prove that the findings of my study are worth paying attention to and are worth taking account of.

Credibility refers to one's confidence in the truth of the data as well as the interpretations thereof. Participant reviews (member checks) and triangulation may be used to substantiate the truth of the data. I therefore made use of both of these methods to enhance the credibility of my study. Transferability is focused on the extent to which the findings of a study can be applied to other situations in comparison with other studies done with an action inquiry approach, thus I had to read other action inquiry reports in education. Dependability refers to the stability of the research data, and confirmability focuses on a comparable concern with objectivity. My judgments were minimised and truthful and not just figments of my imagination. To confirm the confirmability of my study I made use of critical friends who read my findings as well as the participant reviews (Guba & Lincoln, 1985; Mertens, 1998; Shenton, 2004; Babbie & Mouton, 2006).

Furthermore I based my research on the issue at stake, i.e. teaching EGD. Method triangulation and participant reviews were used to give trustworthiness to the study (Shenton, 2004). According to Shenton (2004), Leedy, Ormrod (2005) and Creswell (2008), I could use the following strategies to support the trustworthiness of my study:

- Extensive time in the field: Leedy and Ormrod (2005:100) describe the extensive time in the field as follows: "The researcher may spend several months, perhaps even a year or more, studying a particular phenomenon, forming tentative hypotheses, and continually looking for evidence that either supports or disconfirms those hypotheses". In my

study I spent one year in the field (EGD class) searching for evidence. This prolonged engagement substantiates the credibility and dependability of my research.

- Feedback from others: According to Leedy and Ormrod (2005:100), here the researcher “seeks the opinion of colleagues in the field to determine whether they agree or disagree that the researcher has made appropriate interpretations and drawn valid conclusions from the data”. I used interviews as well as critical readers to get feedback from fellow EGD educators in order to verify the credibility, dependability and reliability of my study.
- Respondent validation/member checks: Creswell (2008:267) describes member checks as follows: this is “a process in which the researcher asks one or more participants in the study to check the accuracy of the account”. I took the conclusions that I made, back to the participants and asked them whether they agreed with those conclusions. These participant reviews substantiate the credibility, dependability and reliability of the study.
- Triangulation: According to Creswell (2008:266), method triangulation “is the process of corroborating evidence from different individuals (e.g., a principal and a student), types of data (e.g., observational field notes and interviews), or methods of data collection (e.g., documents and interviews) in descriptions and themes in qualitative research”. Triangulation supports the credibility of the study.

I therefore used a wide variety of approaches to support the trustworthiness of my study. The most important factor relating to the trustworthiness of my study was that I was part of the study and I reflected on what I had done as well as on what the students had done. I was involved in the study with the participants

from the beginning to the end of my study, therefore I was a participant observer.

### **3.6 My role as researcher in the process**

My role as researcher in the study entailed the following activities:

- Carrying out of a literature study on the orientation of the study, on the nature of EGD and the challenges involved in teaching the subject, and constructive alignment as a possible best practice for teaching EGD
- Facilitating of the EGD sessions
- The collection of data
- Examining interviews and students reflections
- Data analysis and interpretation of the data
- I was involved in the study the whole time from the beginning to end with the participants therefore I can be seen as a participant observer (Creswell, 2008:177).

### **3.7 Ethical considerations**

Written informed consent was obtained from all EGD students involved (Appendix 2). In addition the necessary ethical clearance was obtained from the Faculty of Education's Ethics Committee (Appendix 3) and the relevant Head of School (Appendix 4). I as the researcher accept the responsibility to ensure confidentiality during the research process and data collection. Participants had a choice regarding whether or not they were prepared to participate and were informed that collected information would only be utilised with their permission (Mertens, 1998; Mouton, 2001; Strydom, 2005; Whitehead & McNiff, 2006).

Various ethical principles need to be considered when attempting a research project such as this. The participants must be informed about the research taking place as well as about their involvement in the research. They also need to agree to the set terms of the research as laid out by the researcher; thus, they need to be aware of and agree to the following guidelines:

Prior to becoming part of the research the student will be notified of:

- the aims, methods, possible benefits and any conceivable hazards
- their right to refrain from taking part as well as their right to cease participation at any given time
- the classified nature of their feedback
- no student will unknowingly become part of research unless they are given the above mentioned information and agree to without duress as well as agreeing to actual their participation
- anonymity is agreed upon and any identifying information will be destroyed once the research is concluded unless otherwise agreed upon

(Mertens, 1998; Leedy & Ormrod, 2005; McMillian & Schumacher, 2010)

Students agreed to the above mentioned principles that are aimed at protecting the privacy and dignity of everyone involved and who, during the research, might be requested to provide personal information or potentially commercially valuable information about themselves or their work.

### **3.8 Summary**

In order to conduct and justify my research, an account of the research design and methodology used in the study needed to be provided. As mentioned previously, I used an action inquiry underpinned by action research. The aim of this chapter was to justify the use of the action research methodology and to explain how I implemented this methodology in order to answer my research questions. Since my ideal is to improve my students learning and also my own teaching practices, my study was conducted with a qualitative and transformative paradigm in mind.

In the next chapter I shall focus on a literature overview of constructive alignment (CA) as a possible best practice for teaching Engineering Graphics and Design.

## Chapter 4

### Constructive alignment as a framework for possible best practices in EGD

Questions	Lin Norton action research steps	McNiff questions	Chapter layout	Research method
How can I adapt my teaching practices to improve student learning?	Thinking of ways to tackle the problem	What can/will I do? What kind of evidence can I gather to show that I am having an influence?	<b>Chapter 4</b> CA as a framework for possible best practices in EGD	<b>Literature</b>

#### 4.1 Introduction

In this chapter I shall discuss the approaches to learning and the four components of a constructive aligned model developed by John Biggs (1996) which will help educators to lead students to a higher cognitive level of thinking and will also improve a deep approach to learning among students (Biggs, 1996; Biggs & Tang, 2011). Constructive alignment involves working with the following components in course design and delivery:

- Intended learning outcomes (ILOs)
- Teaching/learning activities (TLAs)
- Assessments tasks (ATs)
- Grading

ILOs are statements which guide the students to know what is expected of them to succeed in a module. ILOs include action verbs which describe observable actions the student has to perform. The TLAs are the teaching/learning activities, formulated with the same verbs which lead students to achieve the outcomes of the course as well as the enhancement of higher cognitive thinking

in EGD. ATs (assessment tasks) and more specifically assessment standards are items which address each ILO which initially will guide students to the outcomes of the course because with the ATs the students know what is expected of them. Lastly the grading component is where the students' work is assessed against a criterion to identify if the students achieved the outcomes of the course (Biggs & Tang, 2011).

In their critique against constructive alignment, Jervis and Jervis (2005) claim that constructive alignment does not attempt to invalidate the value of it as a way to organise teaching and learning, but rather it does simply points out the constraints that are forced upon the educator when they choose to align ILOs, TLAs, ATs and grading. These constraints lead to students being trapped within the boundaries of the module and thus the absence of being the free to construct their own acquired learning.

Despite this critique, I am convinced that constructive alignment will assist in improving teaching and learning in EGD. Without constructive alignment students will still use a surface approach to learning, which I don't need in EGD.

The above-mentioned components of constructive alignment may lead students from a surface and strategic approach to a deep approach to learning. It is now important to discuss these approaches to understand how they influence the learning process (Krause, 2005; Biggs, 1999).

## **4.2 Learning approaches**

### **4.2.1 Introduction**

According to Carrol (1963, as quoted in Kramer 1999:1), "all learners could achieve, given sufficient time". Spady (1994) also believes that all students can learn, succeed and achieve the outcomes, although not necessarily in the same time or way. As educators we know this; we only have to be reminded of it every now and then. Some students simply learn faster than others do, yet one must remember there are different approaches to learning which affect the

learning and understanding process (Nightingale & O'Neil, 1994; Brandt, 1998; Ahlberg, 2003).

#### **4.2.2 Surface, deep and strategic approaches to learning**

Two of the important approaches to consider in the context of higher education are the surface and deep approaches (Marton & Saljo, 1976) to learning. There is, however, another approach known as the strategic approach to learning (Ramsden, 1981).

The surface approach is defined as follows by Biggs and Tang (2009:22): "The surface approach arises from an intention to get the task out of the way with minimum trouble, while appearing to meet course requirements". Houghton portrays this as "Accepting new facts and ideas uncritically and attempting to store them as isolated, unconnected, items" (2004:1). Killen portrays the surface approach as follows: "A surface approach is concerned primarily with avoiding failure" (2009:4). In short, the student who follows this approach only has passing the subject in mind.

According to Biggs and Tang (2009:24) a deep approach can be defined as follows: "The deep approach arises from a felt need to engage the task appropriately and meaningfully, so the student tries to use the most appropriate cognitive activities for handling it". Houghton (2004:1) on the other hand describes it as: "Examining new facts and ideas critically, and tying them into existing cognitive structures and making numerous links between ideas". Killen describes the deep approach as follows: "A deep approach is deliberately intending to gain personal understanding" (2009:3). The student who follows this approach is therefore internally motivated to succeed and excel in the subject and not only wants to pass the subject, but wants to understand it and pass it well.

The strategic or achieving approach can be summarised as a very well-organised form involving both the surface approach and deep approach, in which the motivation is to get good marks (Kember & Gow, 1994; Entwistle, 2000). Spencer (2003:2) furthermore suggests that this approach is “characterised by the students’ intention to excel in assessed work with the focus on effective organisation, time management and self-regulation in study”. The student who follows this approach follows it because of the need for achievement.

During this study I shall only focus on the surface and deep approaches to learning. The students who use the deep approach need hardly any teaching because these students are already motivated and want to excel in class. The students who use the surface approach on the other hand, don’t necessarily worry about the quality of their work, as long as they pass the subject (Marton & Saljo, 1976; Entwistle, 1981; Ramsden, 2003; Tagg, 2003; Cano, 2007; Draper, 2009). One of the biggest tasks for me as educator is to get the students to use a deep approach rather than a surface approach when learning, since this delivers a more meaningful educational experience.

#### **4.2.3 The importance of reflection on teaching**

Killen states that: “In our everyday lives when we use terms like reflection or reflective thinking we usually mean that we are looking back at something and thinking about what happened and why it happened” (2009:93). It remains important for educators to reflect on what they have been teaching the learners and what approach the students followed to achieve the outcome, as this process leads to continuous effective teaching. I have to reflect continuously on my teaching to identify which learning approach students follow and to identify new methods to enhance a deep approach of learning among my students. This suits my action inquiry where I also reflect on the whole teaching process.

#### **4.2.4 Adopting a surface approach**

There are various reasons why students follow a surface approach to learning. Some students are more involved in extracurricular activities than in their educational pursuits; some are time-challenged as they have too much to do; others have a negative perspective on education, and of course there are those who struggle with the content (Entwistle & Tait, 1990; Tagg, 2003; Biggs & Tang, 2011).

In EGD specifically, several of these reasons (see 5.2.4.1) could encourage a surface approach. The ever-busy campus life includes all sorts of functions from rag and formals to sport and theatre, all of which can easily distract a student. Apart from formal lecture contact time, work covered during EGD classes must be practised and studied in a student's own time. Add to this various other educational, extracurricular and personal demands and students are sometimes left with little time to spare. If a student is not particularly interested in either drawing or by extension computers, it is easy to see why he/she will lack interest and have a negative approach to the subject. For various reasons, some students simply struggle with subject content; thus a superficial learning experience is engendered and consequently the student sticks to the surface approach.

Even when all these factors have been considered and addressed by the educator, there still remains a risk that a student can remain trapped in the surface approach to learning. This possibility is confirmed by Biggs and Tang (2009:24) when they state that: "Even under the best teaching some students will still maintain a surface approach". Consequently I must be ever-vigilant in regard to the possibility that a student may remain fixed in the surface approach and I must continually strive to develop their methodology.

#### **4.2.5 Adopting the deep approach**

There are many times when students follow the easier surface approach while the educator is aiming for the deep approach. This has long-term negative effects for the student's education as surface learning leads to a lack of foundation for future learning. This idea is supported by Biggs and Tang (2009:25) when they state that an educator should be "teaching by building on what students already know".

In EGD there are several reasons (see 5.2.4.1) which could encourage the deep approach. When using snap modes in TurboCAD (Computer Aided Design, a subsection of EGD), for instance, one is initially dealing with the purely theoretical knowledge of snap modes. This will simply remain theoretical knowledge however if the student does not make the time and effort to apply his/her knowledge of the function in a practical sense. This is a clear example of the surface approach: the superficial knowledge cannot yet be applied in a practical sense, which would be the (preferable) deep approach and would include insight. When dealing with 2D orthographic drawings, students are still dealing with the surface approach as they have not yet moved to the more advanced isometric and oblique 3D drawings. These drawings are followed by even more advanced drawings like solid modelling where every part is drawn separately in 3D and then assembled in one single drawing. At this point students start with parametric designs where knowledge is amalgamated to manipulate already existing drawings by way of various short cuts.

This progressive path of development, from orthographic to isometric to oblique drawings to solid modelling to parametric design, clearly delineates the path from surface approach to deeper approach. This deepening of the learning experience illustrates why it is necessary for students to engage in the deeper approach from the start as they will not otherwise be able to achieve the necessary outcomes towards the end (Marton & Saljo, 1976; Tagg, 2003; Biggs & Tang, 2009).

### **4.3 Constructive alignment of EGD**

Constructive alignment arose from a study done by John Biggs (Biggs & Tang, 2009) using the authentic assessments and assessment portfolios of the students in a part-time B.Ed. programme. The students were teachers during the day and because of their experience in teaching he wanted them to compile portfolios of how they had improved their own teaching. By the end of the course he had not realised what he had implemented. It was an example of outcome-based education (OBE) which he later called Constructive Alignment (Biggs & Tang, 2009). As mentioned before, constructive alignment involves the alignment of the following components: ILOs, TLAs, ATs and grading. I shall now explain this, and also explain how I use the components in EGD to improve a deep approach to learning.

#### **4.3.1 Intended learning outcomes**

According to the Department of Education's (DoE's) National Curriculum Statement (NCS) (2005:7) Grades 10-12 in Engineering Graphics and Design (EGD), a learning outcome "is a statement of an intended result of learning and teaching. It describes skills, knowledge, values and attitudes that learners should acquire by the end of the Further Education and Training band". According to Biggs and Tang (2009:55), ILOs "are statements written from students' perspective, indicating the level of understanding and performance they are expected to achieve as a result of engaging in the teaching and learning experience". Therefore it is important for students to know and clearly understand the learning outcomes to achieve the ILOs at the end of the EGD course. These mentioned concepts are addressed and grounded in EGD lesson plans which are carefully planned with chosen activities leading to their constructive alignment. Biggs and Tang (2009, 2011) furthermore identify the structure of observed learning outcome (SOLO) taxonomy as well as Bloom's taxonomy as useful tools to select verbs which will lead students' performance to grow in complexity. Using these verbs will lead students to a higher cognitive thinking level which will enhance a deep approach to learning.

#### 4.3.1.1 Intended learning outcomes for EGD

To understand the ILOs of EGD I need to explain the learning outcomes in my subject. The DoE (2005:9-10) describes the purpose of EGD as a subject in terms of the following ILOs:

Learning outcome one: *“The student is able to demonstrate an awareness and understanding of the interrelationship between Engineering Graphics and Design, society and the environment”*.

- Within this learning outcome (LO) it is expected of students to understand the impact of EGD on natural resources, cultural values, socio-economic development and the indigenous knowledge systems of our different cultures in South Africa. This LO also enhances an awareness about safety, fairness and equal access to employment, services and further studies (DoE, 2005; DOE, 2011).

Learning outcome two: *“The student is able to understand and apply the design process”*.

- For this LO, EGD students must be able to solve civil, electrical and mechanical design problems on a graphical and analytical level whilst using the design process mentioned in 5.2.2.4.9.

Learning outcome three: *“The student is able to demonstrate knowledge and understanding of the principles and concepts of graphic communications within the contexts of Civil, Electrical and Mechanical Technologies”*.

- This LO will lead students to investigate the various codes of practice compiled in the South African National Standards (SANS) for building practice (SANS 10143) and engineering drawing (SANS 10111-1). Furthermore the theories related to CAD and the methods of projections in the contexts of civil, electrical and mechanical technologies must also be investigated.

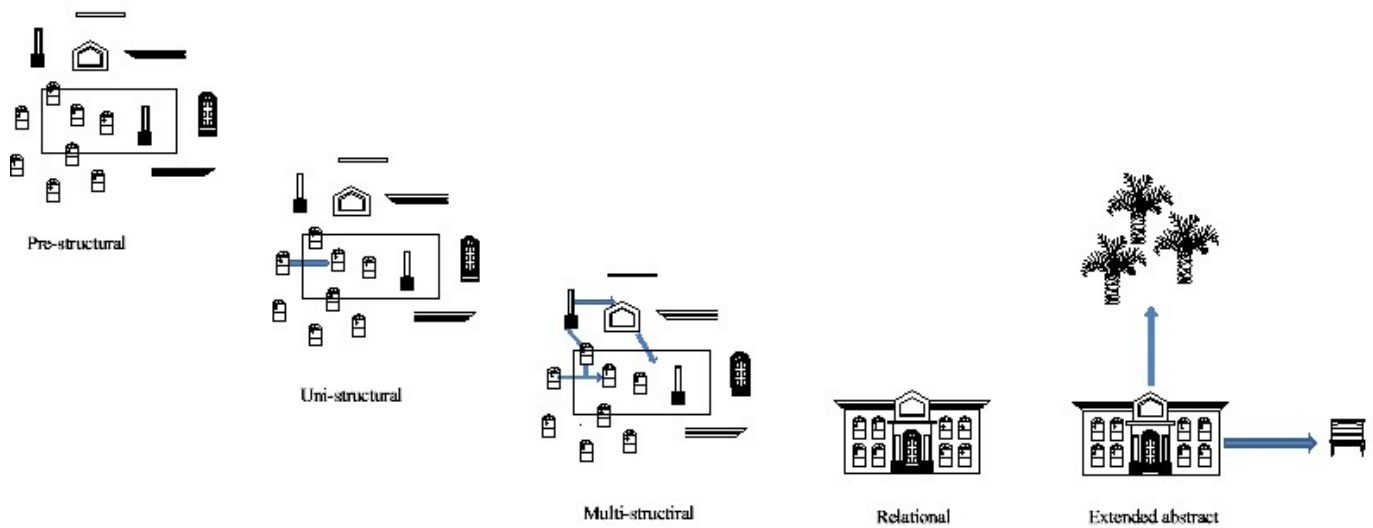
Learning outcome four: *“The student is able to demonstrate the application of engineering graphical skills and techniques across a range of disciplines effectively and responsibly”*.

- Throughout this LO, the EGD students must be able to apply cognitive and manipulative skills to create different drawings. These explicit skills, which are associated with creating freehand, instrument and CAD drawings, should be utilised during the development of drawing techniques (DoE, 2005; DoE, 2011). This LO clearly supports a deep approach to learning. The reason why I make this assumption is that whilst students are doing the drawings they have to use higher cognitive thinking skills to apply the theory in practice and they have to understand the different verbs (SOLO taxonomy or Bloom’s taxonomy) which will lead them to a deep approach to learning.

It is important to align my teaching sessions with the above-mentioned learning outcomes to ensure that the students know what is expected of them to complete the course at the end of the semester. If the students know what is important and understand the ILOs, they can apply the relevant knowledge and skills to achieve the required outcomes. Hence I have to communicate these verbs clearly to my students for them to understand what is expected of them. Next I will discuss the SOLO and Bloom’s taxonomies and identify the verbs which will be relevant to EGD.

#### **4.3.1.2 SOLO taxonomy**

The structure of observed learning outcome (SOLO) taxonomy describes the level of increasing complexity in the students’ understanding of a module (EGD) (see Fig.10). According to Atherton (2011) and Biggs & Tang (2011) the different levels are as follows:



**Fig. 10 Schematic representation of the SOLO taxonomy**

**Pre-structural:** Here students acquire pieces of information of EGD which have no structure and will make no sense to them. The pre-structural level will be used in the beginning of the EGD module, where the students learn all the different types of drawings (orthographic, oblique, isometric, perspective) but they don't know how it all fits together.

**Uni-structural:** Relevant connections are made, but the significance of these connections is not clearly understood by the students. The students may realise that there is a connection between the different drawings that they are doing but they cannot connect all the dots at this moment.

**Multi-structural:** More relevant connections are made, but still the students don't link all of these connections together. They don't see all the drawings as a whole yet, and they still think of them as independent of one another.

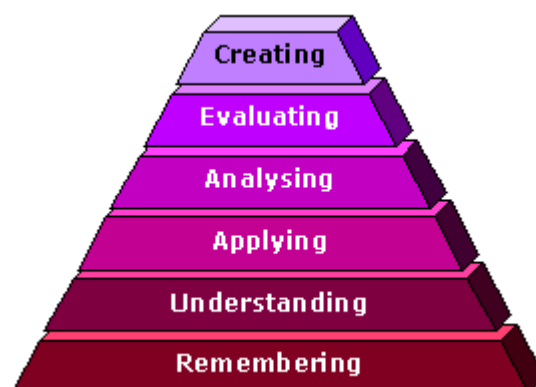
**Relational:** During this level students are now able to appreciate the significance of all the drawings in EGD in relation to the whole. Students now

connect orthographic, isometric, oblique and perspective drawings with each other.

Extended abstract: Atherton (2011:1) describes the extended abstract level as being reached when “the student is making connections not only within the given subject area, but also beyond it” and when they are “able to generalise and transfer the principles and ideas underlying the specific instance” (Atherton, 2011:1). In EGD students now understand EGD as a whole: they make connections with other subjects like mathematics where geometry is used, and civil technology where civil orthographic drawings are used, and so forth. Therefore it is important for students to reach the extended abstract level according to the SOLO taxonomy by the end of EGD.

#### **4.3.1.3 Bloom’s taxonomy**

According to Atherton (2011:1), “Bloom recognised six levels within the cognitive domain, from the simple recall or recognition of facts, at the lowest level, through increasingly more complex and abstract mental levels, to the highest order which is classified as evaluation”. However, Anderson and Krathwohl (2001) made some minor modifications within this domain and they changed the nouns to verbs (Atherton, 2011). Verb examples that represent intellectual activity on each level are listed in Figure 11.



**Fig. 11 Bloom’s revised taxonomy**

In EGD the following levels are used: remembering, understanding, applying, analysing, evaluating and creating.

1. *Remember* the methods to produce relevant drawings in EGD. According to O'Neil and Murphy (2010) the following action verbs are related to the remembering level: list, describe, tabulate and use appropriately.
2. *Understand* the techniques to produce EGD drawings. According to O'Neil and Murphy (2010) the following action verbs could be appropriately used: summarise, interpret, predict and execute.
3. *Apply* the principles of single and multi-view projections to produce EGD drawings. According to Killen (2009:83) the following action verbs could be used: classify, experiment, calculate and construct.
4. *Analyse* different drawings and create a new drawing from the analysis. According to O'Neil and Murphy (2010) the following action verbs are important: order, explain, differentiate and achieve.
5. *Evaluate* different EGD drawings according to a specific criterion. According to O'Neil and Murphy (2010) the following action verbs can be used: rank, assess, conclude and action.
6. *Create* the theory related to computer hardware and complex functions of CAD software in EGD. According to O'Neil and Murphy (2010) the following action verbs could be used in this case: combine, plan, compose and actualise.

These levels are interchangeably interacted with at different points of operation of EGD, thus ultimately engaging with all these different levels of cognitive mental processes using a deep approach to learning. This leaves students with a more well-rounded and grounded learning experience. Students need to be familiar with these verbs as they will indicate specifically what they need to know and achieve in order to reach the required outcomes. This familiarisation process happens naturally during the course of the development of the subject as students engage with the different types of drawings.

### 4.3.2 Teaching/learning activities (TLAs)

According to Biggs and Tang (2009, 2011), when the educator thinks about changing and designing new teaching/learning activities, they are implementing constructive alignment. I must change the way I have always thought about teaching and change the way I taught previously. In order to change my teaching habit of only using lecturing as a teaching/learning activity, I had to identify new TLAs that would enhance deep learning.

#### 4.3.2.1 Background

As an educator I have found that there is always more to do and I must always strive to find ways of doing my teaching better. Therefore it is important to ask myself the following questions:

- Where am I now in terms of my learning and teaching practice?  
Before 2010 I mainly made use of lecturing as a teaching/learning activity to facilitate my classes. I only wanted the students to pass EGD, it didn't matter what their grades were (surface approach to learning).
- What is my motivation behind integrating active learning and teaching/learning activities?  
After I did the HOS518 course offered by the School of Higher Education Studies (HES), I realised that I needed to change my practice to help students to use a deep approach to learning instead of a surface approach to learning. Therefore I needed TLAs which could help me to do just that.
- How can I build on my existing practice?  
Whilst identifying different TLAs and implementing them in my classes, I build on my own teaching practice and improve on the lecturing method that I used before. Furthermore I reflect on my teaching to improve on what I do in class.
- What do I hope to achieve?  
In the end I hope to achieve the following: identify different teaching/learning activities that will improve a deep approach to learning

among my students in EGD; reflect on my own teaching to improve my own educator skills.

If I take in consideration what the Northern Ireland Curriculum (2007:4) tabulates for the role of a teacher, I can clearly see that I need to change my practice from using only lecturing to alternative teaching/learning activities to assist me in changing my teaching to improve a deep approach to learning. I would only add surface and deep learning to their table (see Table 1):

**Table 1      Role of a teacher**

From:	To:
Teacher-centred classroom	Learner-centred classroom
Product-centred classroom	Process-centred learning
Teacher as transmitter of knowledge	Teacher as an organiser of knowledge
Teacher as a doer for children	Teacher as an enabler, facilitating pupils in learning
Subject-specific focus	Holistic learning focus
<b><i>Surface learning</i></b>	<b><i>Deep learning</i></b>

(Northern Ireland Curriculum, 2007:4)

The reason for me adding surface and deep learning is because of my own experiences of lecturing as a teaching/learning activity. When I was a school learner, as well as a student and a young lecturer, I realised that you cannot motivate a student to achieve in a subject if you only give them the work and tell them to learn. I have to use a variety of TLAs to cater for the different learning styles of students, which will assist me in helping them to be internally motivated to succeed in my subject. Therefore I will use different TLAs to assist me and my students to excel in EGD.

### **4.3.2.2 Which teaching/learning activities did I use?**

My students and I made use of brainstorming and identified teaching TLAs, which I would later apply in the facilitating of my classes. Brainstorming is a process for generating multiple ideas in which a decision is suspended until a maximum number of ideas have been generated. Following the generation of ideas, options are analysed and then the best solution is chosen (De Bono, 1985; Avenant, 1990; Malawi Institute of Education, 2004; Killen, 2009). Here are the eight different TLAs that we chose: group work; lecturing; letter to a friend; problem solving; question and answer; role-play; storytelling and video analysis, discussion and application.

In the next section I shall define each teaching/learning activity and also state the advantages and disadvantages of the teaching/learning activities according to the literature.

#### **4.3.2.2.1 Group work**

Denton defines *group work* in Banks (1994:145) as follows: “a generic term which relates to any situation where two or more people work together. This could be passively, by sharing a resource but working independently, or actively where there is collaboration”.

#### **Advantages**

- Allows active participation of all students
- Students often more comfortable in small groups
- Stimulates peer group learning
- Promotes development of critical thinking skills
- Can reach group consensus
- Promotes higher levels because of application, synthesis, evaluation versus simple memorisation

#### **Disadvantages**

- Students may get side-tracked and start social conversations

- May be frustrating for students when they are at significantly different levels of knowledge and skills
- Can be time-consuming
- Relies on student preparation and willingness to participate
- Cannot ensure full participation among students
- Educator needs special skills to facilitate, debrief and summarise what was done in group work

(Banks, 1994; Avenant, 1990; Borich, 1996; Jacobsen, Eggen & Kauchak, 1999; Biggs & Tang, 2009; Killen, 2009)

Group work as a teaching/learning activity would not be my first choice . The reason for this is that I would rather do my own work and know it is done properly than have to rely on others. I know that some of my students feel the same way about group work. The reason why I would use this method, however, is because it enhances peer teaching among the students, and students sometimes understand difficult terms better if someone can explain it in their own “language”.

#### **4.3.2.2 Lecturing**

According to Biggs and Tang (2009) *lecturing* is an oral presentation intended to present information or teach people about a particular subject. Typically, an instructor will stand before a class and present information for the students to learn. Usually, very little exchange occurs between the instructor and the students during a lecture.

#### **Advantages**

- Presents factual material in direct, logical manner
- Large groups of students can be accommodated at one time
- Is useful for covering underlying concepts and principles in EGD
- The lecturing method is particularly suitable for introducing a subject
- It is direct and straight to the point, and it may save a lot of time
- It stimulates thinking for open discussion

## Disadvantages

- Experts are not always good teachers
- Communication is one-way
- Learning is difficult to measure
- May lead to student overload as it is common for educators to include too much information in too short a time frame
- May lead to boredom and have limited effectiveness in teaching anything other than knowledge
- Provides little opportunity for students' independent thinking  
(Avenant, 1990; Borich, 1996; Malawi Institute of Education, 2004; Killen, 2009; Biggs & Tang, 2009)

This would be the easiest teaching/learning activity to use as an educator because it is direct and straight to the point. Using this method, which is basically one-way communication on the part of the educator, the students almost never have a say in the learning process and there is no student activity. It is better to combine lecturing with other teaching/learning activities to enhance student involvement which will lead the students to understand the work better and to use a deep approach.

### 4.3.2.2.3 Letter to a friend

According to Prosser and Trigwell (1990) a *letter to a friend* is written by a student to a real or imaginary friend, describing the relevant course and reflecting on the unit. This will provide useful feedback to the educator on aspects of the course.

In this form of assessment, the student is asked to compose a letter to a friend who is thinking of enrolling in the subject. The student describes his or her experiences in the course. When the students chose this TLA they were not aware of the initial usage of this activity. We then changed it to an activity combined with another one, for example lecturing, where the theory was done by means of lecturing and at the end of the theory the students would write a

letter to a friend, identifying whether the students had reached the intended learning outcome.

There are no specific advantages or disadvantages in this approach as a teaching/learning activity at this moment; however, I will combine advantages and disadvantages according to my own reflection and the reflection of the students in terms of this 'teaching/learning activity' in Chapter 5 (5.2.2.4.6).

#### **4.3.2.2.4 Problem solving**

*Problem solving* is a strategy for “posing significant, contextualized, real-world situations, and providing resources, guidance, and instruction to learners as they develop content knowledge and problem-solving skills” (Mayo, Donnelly, Nash & Schwartz, 1993:227).

##### **Advantages**

- Develops analytic and problem solving skills
- Allows for exploration of solutions for complex situations
- Allows students to apply new knowledge and intellectual skills
- Students may remember the work for longer
- The students become more able to develop their individual abilities
- Students may identify with the real life situations and understand them better

##### **Disadvantages**

- Students may not see the relevance to own situation
- Insufficient information may lead to inappropriate results
- Students may not have the necessary knowledge and skills to solve the problem
- Unless students believe they are capable of solving the problem they may be reluctant to engage with it
- Unless the students see that the problem is relevant they may see it as work simply intended to keep them busy

- Successful problem-solving lessons require a lot of preparation on the part of the educator

(Mayo, Donnelly, Nash & Schwartz, 1993; Borich, 1996; Marshall, 2003; Schwarz & Kluth, 2007; Killen, 2009)

This TLA enhances a deep approach to learning from the beginning to the end during the teaching and learning process. To use this method correctly, students must first identify the problem which is given to them. They then have to generate possible solutions to the problem, after which they must select the best solution and apply this solution to the problem. After applying this solution, they have to evaluate whether this solution was the best one for the problem. If not the student may repeat the process again after evaluation. In my opinion, this method is one of the most meaningful TLAs of teaching because the students' higher cognitive levels of thinking are stimulated to find solutions to the problems.

#### **4.3.2.2.5 Question and answer**

Avenant (1990) explains *question and answer* as engaging students in a question-and-answer dialogue to guide students to new insights. The usual 'one-way' flow of information from instructor to students is transformed into a more interactive process.

#### **Advantages**

- May be used to test the student on what was taught previously in order to identify what student has learned
- High level questions may promote deeper thought and critical thinking, if questions are asked that require students to apply, analyse, and evaluate
- Divergent questions can be used to test students on different levels of understanding of previous work
- Different questioning techniques can be used to lead students to a specific understanding
- Use questioning to stimulate students to pursue knowledge on their own

- Misunderstandings can be discovered more easily and can be corrected whilst doing the questioning

### **Disadvantages**

- Ineffective application of this method may lead to boredom and frustration among students
- Educators may use ambiguous questions and confuse students in answering the questions
- Some educators may use questioning as punishment
- Some educators may supply the correct answer to the students before the students have had time to think about the answer to the question
- Not all subject matter lends itself to the application of this method. If the students don't have the necessary background knowledge of the subject they cannot answer and be led to new insights
- Students may feel afraid to give an incorrect answer  
(Avenant, 1990; Brown & Wragg, 1993; Jacobsen, Eggen & Kauchak, 1999; Borich, 2003; Killen, 2009)

I like this method since I can, by means of such questioning, identify which students understand the work and which of them do not. However as a former student I also know that I didn't like it when the educator made use of this method to see whether we understood what had been taught previously. As an educator now, I realise that I can identify students who need help, and I can also lead them towards a deep approach to learning by using questioning on a higher cognitive level. For example, instead of asking a student to name the components of the design process, I could rather ask the student to describe how he/she would use the design process to solve a problem.

#### **4.3.2.2.6 Role-play**

Petrina defines *role-play* as "Learners take on the role of another person or character to see what it would be like to be that person or character. Thus, a

student could play the role of an imaginary student no one likes or a news reporter” (Petrina, 2007:99).

### **Advantages**

- Actively involves the students and enhances communication
- Adds variety, reality, and specificity to the learning experience
- Provides an opportunity for students to assume the role of another person and hence appreciate another point of view
- Provides opportunities to practise problem-solving and verbal expression skills
- Provides the educator with immediate feedback of what the students understand and the ability to apply the concepts
- Improves the probability of transferring of learning from the classroom to the real world

### **Disadvantages**

- Students may be self-conscious and may feel threatened which could lead to resistance
- Depends heavily on students’ imagination and willingness to participate
- Can be unpredictable in terms of the intended outcomes
- Relies on student identifying with the role played
- There is a possibility of this becoming a form of entertainment which may hinder the learning process
- Can be time-consuming  
(Jones & Palmer, 1998; Davies, 2002; Phillips, 2005; Petrina, 2007; Woodhouse, 2007)

I enjoy this method of teaching, since I can see how students interpret real life situations and how they react to them. Higher cognitive levels of thinking are used during this method because students have to think on their feet to respond to each other’s statements in order to solve a relevant problem which has been given to them. All of the students are involved during role play since there are

the main characters who play the parts and also the audience who must evaluate what the main characters are doing.

#### **4.3.2.2.7 Storytelling**

Lefever (2004) clarifies *storytelling* by stating that educators at times try to bring about in-context viewing by means of stories: the educator tries to present the facts in such a way that the students' imaginations are captured and they are able to identify with the characters.

#### **Advantages**

- Storytelling may make the lesson more interesting and may grab and retain students' attention
- Develops the imagination of students which will help with higher cognitive thinking
- Helps the students to bridge textual knowledge and everyday life
- Increases the virtues and values of students; real life stories improve values such as valour, bravery, patriotism etc. which could create lasting impressions on the minds of students
- Creates a pleasant class atmosphere and students can visualise and become involved in the story
- Students learn whilst listening to the story without knowing that they are learning.

#### **Disadvantages**

- Not all lessons can be taught by means of storytelling
- May be a lengthy method of teaching
- Not all educators are born story tellers and could bore the students
- Sometimes the story may be remembered but the goal intended vanish into oblivion

- If the story doesn't hold the students' attention the students won't gain anything from this method
- Students may make deductions which are not in accordance with what they are supposed to learn

(Avenant, 1990; Mattingly, 1991; Lefever, 2004; Grobstein, 2006; Hunter & Hunter, 2006)

I would not say that I am a born story teller but I have realised that students find this method of teaching interesting. After the storytelling the students have to identify the aim of the story which in most of the cases is a problem which must be solved. A higher cognitive thinking level is achieved because the student must identify the problem, generate a solution, apply the solution, evaluate the solution and perhaps repeat the cycle if they are not satisfied with the solution to the problem.

#### **4.3.2.2.8 Video analysis, discussion and application**

Poskiene (n.d, p.2 of 4) describes *video analysis, discussion and application* as "a method which leads a student and educator to a deeper negotiation and case analysis. The main advantage of this method is that the student's creativity and inventiveness are disclosed".

#### **Advantages**

- Entertaining way of teaching content and raising issues
- Retains students' attention
- Stimulates discussion which will furthermore enrich students' knowledge, skills and attitudes
- Can portray realistic situations
- Can be used when real experiences are not readily available or could endanger students
- Discussion and application will lead the students to higher cognitive thinking

## **Disadvantages**

- Effective only if educator prepares questions and a discussion after the show
- Students may have different interpretations which are not in harmony with what they were supposed to learn from this method
- Students may be afraid to discuss what they have seen because they are afraid of doing it wrongly and others might laugh at them
- Requires more preparation time for the educator
- Requires media which certain schools may not possess
- If the outcomes are not clearly stated student may not know what is expected of them to gain from this teaching/learning activity  
(Greenfield, 1984; Brookfield & Preskill, 1999; Lance & Kitchin, 2007; Brecht & Ogilby, 2008; Poskiene, n.d.)

In my opinion this is the most effective method of teaching to improve higher cognitive levels of thinking among students. Students have to watch the video, then they must discuss what happened in the video and lastly they have to apply this new knowledge to create a relevant drawing. Furthermore this method brings a real life situation into the classroom, where student will also use problem solving to identify solutions to solve the problem.

### **4.3.2.3 Teaching/learning activities that might encourage the deep approach**

There are several things that educators can do to inspire the deep approach method in their students. When an educator has a personal interest in his/her subject, he or she will inexorably continue to develop the knowledge, understanding and methodology of the subject. This will allow him/her to instil a greater confidence in his/her learners and will lead them toward a greater passion for and understanding of the subject, thus inevitably guiding them towards deep approach learning. Another challenging aspect the educator faces is that of sufficient time. Having enough time is important in order to

properly convey any and all relevant knowledge and key concepts. Students must be allowed the necessary time to absorb and master the knowledge and concepts, and not simply be rushed through them without any real understanding. Educators must strive to use assessment criteria that do not simply check knowledge or facts, but require critical thought and ideas to be used together. These learning criteria should be known to the learner in order for them to be able to judge if they are in possession of the relevant knowledge, skills and attitudes, and also if they are able to apply them (DoE, 2005; DoE, 2011).

To reach the levels of the deep approach an educator must be able to lead learners to link the latest knowledge, skills and attitudes to previously acquired knowledge, skills and attitudes, thus activating their background knowledge and establishing a more meaningful and lasting learning experience. During this process learners should be allowed to make mistakes without being penalised as penalisation discourages future learning and exploring while making mistakes is a natural part of the learning curve. While negative criticism and penalisation should be avoided, effort and success should be rewarded. This extrinsic motivation should in time lead to intrinsic motivation as the learner experiences a sense of accomplishment and wishes to repeat and expand on this feeling (Entwistle, 1990; Ramsden, 1992; Kember & Gow, 1994; Biggs, 1999; Tagg, 2003; Floyd, Harrington & Santiago, 2009).

In the EGD class I, as the educator, must be very well versed in the subject as this will help me to stay ahead of my class and not to be intellectually cornered out of ignorance by my inquisitive students. When students see the educator as ignorant and without the necessary in-depth knowledge themselves, they will not be motivated or able to use the deep approach: the relevant knowledge and skills will simply not be available and the educator will be in no position to instil confidence or knowledge in their students. When there is only limited time in one's schedule and very little time to cover even the most basic concepts of EGD, it is unrealistic to expect the students to follow a deep approach to

learning as they will only engage in the surface approach when learning the basics. Consequently one should organise one's time so that one is able to engage the subject and its content on a deeper cognitive level and not simply stick to the basics so that students will connect to the deeper approach and know more about the subject and its various applications.

In most classrooms the aim is to avoid negative criticism and engage in positive reinforcement, but in the case of EGD this is not always possible. Both drawing and computer functions have an absolute right and an absolute wrong with very few in-betweens. This leaves little room for interpretation and consequently avoiding criticism, as mistakes are blatant and must be addressed. Students will however have a very clear idea of what is expected of them and will be able to develop to this point and deliver the required work with the necessary skills, which will allow them to deepen their educational experience. In order for students to successfully engage in EGD they need to have a background in drawing as well as basic computer skills as the subject itself simply teaches them to create drawings using computer graphics. This means that the educator will have to access a fair amount of background knowledge and skills as progress is made through EGD and the educational process (DoE, 2005; DoE, 2011).

Even though EGD may seem to be a subject of absolutes, students are given enough time on their own to do drawings, make mistakes and develop their skills. This happens during lesson times as they practise the work explained to them at the start of the lesson, as well as when they do drawings for homework. All this allows for students to experience EGD from a superficial to a profound level and to engage fruitfully in the educational experience.

The ideal in education will always remain the deep approach to learning but this ideal will remain a continuous process. The educator should remain vigilant in terms of the students' learning process, development and feedback, and also to how he/she, as the educator, can influence and manage this process. This

entails continual reflection and adjustment to remain informed as to where the students are on the learning curve and what they can do to improve. All this is basic to the educators' trade, and it assists in guiding learners from the surface approach and understanding to a deeper approach and application (Entwistle, 1988; Ramsden, 1992; Kember & Gow, 1994; Biggs, 1999; Tagg, 2003; Floyd, Harrington & Santiago, 2009).

The various teaching/learning activities used were thus discussed in 4.2, and the reflection on the teaching/learning activities will be done in Chapter 5 (see 5.2.2.4).

### **4.3.3 Assessment tasks (ATs)**

According to McMillan assessment can be defined as “the collection, evaluation, and use of information to help educators make decisions that improve student learning” (McMillan, 2007:8). Furthermore the DoE defines assessment as “...a process of collecting and interpreting evidence in order to determine the learner's progress in learning and to make a judgment about a learner's performance” (DoE, 2005:39). Van der Horst and McDonald define assessment as “...a strategy for measuring knowledge, behaviour or performance, values and attitudes. It is a data-gathering strategy. The measurement or data you gain from assessment helps you to evaluate” (1997:170).

I think it is safe to say that assessment is the gathering of information about a student's learning to estimate and indicate if the student has achieved the necessary outcomes to succeed and proceed in EGD. To understand assessment even better, the following questions spring to mind: why do I assess? (purpose); how do I assess?; which methods do I use to assess?; what types of assessments do I use?

#### **4.3.3.1 Why do I assess?**

There are various reasons for educators to assess students. These reasons include, amongst others, the monitoring of students' progress; providing

feedback to students about their progress; identifying learning problems; improving student performance; motivating students; seeing if students will achieve the outcomes at the end of the module and determining performance achieved by students (McMillan, 2007; DoE, 2005).

Therefore I can say that if assessment indicates a lack of progress amongst the students, I should change my teaching and learning plans accordingly.

#### **4.3.3.2 How do I assess?**

Assessment can be done in number of ways including administering tests (written or oral), holding quizzes, grading homework, noting students' reactions to questions and comments, assigning projects, using digital artefacts, observations and questionnaires (Avenant, 1990; Jacobsen, Eggen & Kauchak, 1999; Petrina, 2007).

Assessment may be used to identify whether the students use a surface or a deep approach to learning. If students only make use of the surface approach they will only pass the tests and won't be motivated to excel – which will happen if they use the deep approach to learning. Therefore, by assessing their work and tests, I can identify which students use which approach of learning.

#### **4.3.3.3 Which forms of assessment do I use?**

Using different forms of assessment may ease the workload of the educator in EGD. In the case of big classes and where time management is of the utmost importance, I would advise the educator to use different forms of assessment. The assessment methods that are most important in EGD are educator assessment, self-assessment and peer assessment (DoE, 2005).

Educator assessment: The educator is still the most important role player in assessment and is not replaceable. Therefore, as the educator, I must be up to date with the latest assessment standards, assessment methods and types of assessment because assessment plays an important role in students achieving the outcomes. Whilst doing the assessment on my own, I can reflect on my own teaching and see if the students did understand the work and whether they

are ready to move on to a higher cognitive level in their drawings. This assessment method is used in formal and informal tests, examinations, assignments, projects, quizzes and questionnaires.

Reasons for using educator assessment:

- Educators identify learning problems with students and attend to them accordingly.
- When the educator assesses the drawings the educator knows whether or not they are done properly.
- Educators can reflect on their own teaching and can promote lifelong learning because the educators want to improve their own teaching.
- Accurate feedback can be provided by the educator.
- The educator can identify which learning approach the students followed – either surface or a deeper approach.

(Killen, 2009; McMillan, 2007; DoE, 2005; Jacobson, Eggen & Kauchak, 1999; Gardner, 1991)

Self-assessment: Students know the outcomes expected for each exercise and therefore know what is expected of them. Thus the students play an important part by self-assessing and pre-assessing before the educator does the final assessment. Self-assessment is an important feature in self-reflection. Students can reflect on their own work and through this, can realise what they need to do to achieve the outcomes at the end of a module. Self-assessments are done in homework drawings, small class tests and smaller projects. A student who uses the deep approach to learning would assess his/her own work better than a student who follows a surface approach and only wants to pass the subject (Biggs & Tang, 2009)

Reasons for using self-assessment:

- Saves time, because the entire class can be graded together in the same time that it would take the educator to grade one paper.
- Upcoming educators see what is expected of them.

- Faster feedback is provided.
- When students see their own mistakes, repetition of mistakes is limited.

(Killen, 2009; McMillan, 2007; DoE, 2005; Jacobson, Eggen & Kauchak, 1999; Gardner, 1991)

Peer assessment: Peers assess each other's drawings based on the educator's benchmarks. Using peer assessment in EGD has the added advantage that students are in fact learning how to assess drawings for the future when they are educators themselves. Using peer assessment empowers students to evaluate their own and others' performance.

Reasons for using peer assessment:

- Saves time, because the entire class can be graded together in the same time that it would take the educator to grade one paper.
- Upcoming educators see what is expected of them.
- Faster feedback is provided.
- When students see their own mistakes, repetition of mistakes is limited.

(Killen, 2009; McMillan, 2007; DoE, 2005; Jacobson, Eggen & Kauchak, 1999; Gardner, 1991)

Figure 12 provides an example of how I use educator assessment, self assessment and peer assessment in EGD. I do most of the assessment in the class but the students also have to gain experience in assessing work because they have to do it one day in their own practice when they teach.

EGD												
Students	Isometric 1	Isometric 2	Isometric 3	Isometric 4	Isometric 5	Isometric 6	Oblique 1	Oblique 2	Oblique 3	Oblique 4	Oblique 5	Oblique 6
a												
b												
c												
d												
e												
f												
	20	20	20	20	20	20	20	20	20	20	20	20
Assessor	Educator	Educator	Educator	Educator	Self	Peer	Educator	Educator	Educator	Educator	Self	Peer

## **Fig. 12 Representation of assessment done in EGD**

### **4.3.3.4 What other forms of assessment do I use?**

As I mentioned before, assessment is one of the most important steps in education because the student must be assessed to determine whether he/she has achieved the specific outcome and is ready to move on to the next outcome. Therefore different forms of assessment are necessary to achieve the outcomes. According to Van der Horst and McDonald (1997:171) and Williams and Williams (1996:187), the three main forms of assessment are diagnostic, formative and summative assessment. The DoE (2005:40) also refers to the above-mentioned three forms of assessment but adds another one, namely baseline assessment.

Baseline assessment is when the student is assessed at the beginning of the module or any learning cycle. Here I can establish what prior knowledge the student has, what the student already knows and what he/she is able to do in EGD (DoE, 2005). With this information I can design the drawings according to the students' knowledge and lead them to new progressive knowledge of EGD.

Diagnostic assessment is used to identify learning barriers so that as educator, I can deal with these accordingly. In detecting these barriers I can identify ways in which to help students towards achieving their potential. Furthermore I can detect whether the students need professional help or remediation (DoE, 2005; Van der Horst & McDonald, 1997). Therefore diagnostic assessment plays an important part for a student to move to the next level in drawing.

Formative assessment is done continuously throughout the module. Any form of assessment that is used to give feedback to students is achieving a formative purpose. Furthermore, formative assessment is used to acquire information on the progress of students. It is very important to give thorough feedback whilst doing this type of assessment (Killen, 2009; Van der Horst & McDonald, 1997).

Summative assessment occurs at the end of a learning activity, module, semester or the end of the year. In EGD it is done mostly at the end of the

semester. In fact summative assessment is a check to see how well the objective of the programme or process has been achieved. The result of summative assessment is to provide a grade and to indicate if the outcomes of the module have been achieved (DoE, 2005; Jacobsen, Eggen & Kauchack, 1999; Williams & Williams, 1996). Furthermore, as educator I can reflect on my own teaching after summative assessment has been done.

The importance of any assessment is as follows: the students should understand why they are assessed, the focus of the assessment must be clear, assessment must be based on the assessment standards of your module to be consistent, and a variety of assessment methods and types should be used to assess the student on more than one level.

#### **4.3.3.5 Learning environment and assessment tasks**

EGD is a subject that allows plenty of room for all the different cognitive levels and their various aspects to be used and accessed as the subject builds progressively on previous knowledge and then expands on it.

In EGD the cognitive level of understanding might be accessed by asking students to identify and describe different snap modes. Assessing this level could include evaluation as simple as monkey puzzles or questions in class.

The next step would be the application of some of this previously acquired knowledge and understanding. At this point the students' ability will be reviewed by way of seeing how a student applies his/her theoretical knowledge in a practical sense when he/she has to make a drawing using his/her EGD know-how.

The synthesis level is reached when, for example, students have to make a drawing of a machine, where its various different features have to be drawn and then assembled. At this point assessment becomes a more elaborate process

as not just surface knowledge and skills are judged but an assembly and interaction of knowledge and skills are required. Evaluation in the form of drawing analysis in terms of assembly and not just the basic line drawings would be suitable for this level.

#### **4.3.4 Grading**

To obtain a final grade I have to assess the students' outputs against a criterion as well as several components of the ATs which will help me to identify if the students have achieved the ILOs of the course. The importance of grading is to check if the students are progressing in the subject and if they have achieved the ILOs.

To grade a student's work it has to be marked or assessed. Tools for grading students' work fall into three categories according to Killen (2009): checklists, rating scales and rubrics. The checklist is the simplest tool for grading, where I can simply "tick" if the student has achieved a specific outcome. I may also use rating scales to identify qualitative aspects of how students achieved in a task or drawing, whilst a rubric provides descriptive feedback about the quality of the students' drawings. When using these grading guides, students should know in advanced how they are going to be graded.

The module EGD is constructively aligned as there are clearly defined ILOs, TLAs, ATs and grading criteria (DoE, 2005; DOE, 2011). These serve to assist lecturers in their planning and to help guide students in addition to their own reflection and expansion of their learning. When these principles are followed they will deliver the required outcomes.

#### 4.4. Summary

A question on the mind of many educators is how to get students to learn what the subject actually requires of them? One of the big problems of education is that educators don't know how to get learners to learn what is expected of them.

According to Houghton (2004:2) the answer to this problem is *constructive alignment*, which is defined by Biggs (1999) as: "the underpinning concept behind the current requirements for programme specification, declarations of Intended Learning Outcomes (ILOs) and assessment criteria, and the use of criterion based assessment" and by Brabrand (2009:video) as "...the learning objectives of the course".

Consequently in order to achieve this constructive alignment, students must structure and then expand on the meaning of the knowledge they have gained, while the educator should bring the learning activities into line with the learning outcomes. Therefore it is important for the teacher to know his/her ILOs and the assessment criteria so that they can sublimely guide the students to achieve these outcomes and initially use a deep approach to achieve these outcomes.

EGD allows for a deep approach to learning as there are clear outcomes available for this subject and when these are realised, constructive alignment is achieved. When the well-defined outcomes are linked with clear assessment understanding, application and synthesis become a possible goal. When an educator's intent becomes clear, realised and measurable by way of a student's activity then this interactive three step process has delivered constructive alignment as per definition.

According to Kember and Gow's study (1994:59) "it is widely agreed that teaching does have a profound effect on student learning", and furthermore they state that "there is now a substantial body of evidence on the effect of teaching/learning activity, learning tasks, assessment demands, and workload

on students approaches to learning”. Different researchers have done research on the effect of teaching/learning activities, learning outcomes and assessment on a deep approach to learning. They all agree that the use of the above-mentioned factors will lead to a deep approach to learning among students (Fransson, 1977; Dahlgren, 1978; Ramsden & Entwistle, 1981; Entwistle & Ramsden, 1983; Thomas & Bain, 1984; Kember & Gow, 1994).

I now know that the use of teaching/learning activities will have a positive effect on my teaching and on the performance of my students. In the next chapter I will apply the teaching/learning activities that the students have chosen and identify how the students rate these activities with the help of their and my own reflection.

## Chapter 5

### Implementation plan and research findings

Question	Lin Norton action research steps	McNiff questions	Chapter layout	Research method
<p>How did I adapt my teaching practices?</p> <p>How effective have the chosen teaching practices been?</p>	<p>Doing it and</p> <p>Evaluating the actual research findings</p>	<p>What can/will I do?</p> <p>What kind of evidence can I gather to show that I am having an influence?</p> <p>How can I explain the educational influence of my new methods?</p> <p>How can I ensure that any judgements I might make are reasonably fair and accurate?</p>	<p><b>Chapter 5</b></p> <p>Implementation plan and research findings</p>	<p><b>Action inquiry</b></p>

#### 5.1 Introduction

According to McNiff (2002) there are different types of action research plans available. The one that has grown in popularity worldwide is the research plan (see 3.4.1.3) that Jack Whitehead has developed (McNiff, 2002). McNiff (2002) describes this action research plan as a plan to encourage me as the expert in my field (EGD) to ask critical questions about my own teaching and find the answers for myself. I used this action plan as a guideline, together with Lin Norton's (2009:70) simple process for carrying out action research (see ITDEM, 3.4.1.3). As it is my teaching and practice I am the only one who can answer these questions honestly and fairly. My students and fellow lecturers may comment and advise me about my teaching but I am the only one who can decide what is suitable for me and my situation.

I will describe the process of action and reflection as I try to answer the question at the heart of my research: How can I improve my teaching in Engineering Graphics and Design? I will use Lin Norton's (2009: 70) steps three and four, which are *doing it* and *evaluating the actual research findings* with the following four action research questions of Whitehead to describe and reflect on my own teaching and improve on it:

- What can/will I do?
- What kind of evidence can I gather to show that I am having an influence?
- How can I explain the educational influence of my new methods?
- How can I ensure that any judgements I might make are reasonably fair and accurate?

## **5.2 The steps/questions of action research**

### **5.2.1 What can I do? What did I do?**

#### **5.2.1.1 What can I do?**

To begin with I decided that I needed to engage with the literature on surface and deep approaches to learning as well as that on different teaching/learning activities which could influence surface and deep approaches to learning. I also needed a better understanding of why students use the surface approach to learning prior to the deep approach to learning.

According to Biggs and Tang (2009), Entwistle (1990), Ramsden (1992), Kember and Gow (1994), Biggs (1999), Tagg (2003) and Floyd, Harrington and Santiago (2009), there are a few factors which may encourage students to follow the surface approach to learning.

From the student's side, the following are important aspects:

- The intention to only attain a minimal pass. One of my students responded this way: "I only need to pass the subject, in order to become an EGD teacher".

- Extramural activities taking precedence over academic activities. I have realised that some of my students are more motivated to excel in their sport than in their academic achievements.
- Not enough time. Some students have too many subjects because they failed some the previous year and must thus complete these along with all of their current subjects.
- Misinterpretation of the learning outcomes and assessment standards. Some students may not understand what is expected of them and they may not achieve as they would have, had they known what was expected of them.
- Students really don't understand the work: it might be too difficult. One of my students responded this way: "I really don't understand all the theoretical aspects of EGD, and I struggle to apply the theory to the drawing board".
- Students may have a pessimistic view of EGD. Students may not like EGD because of a previous teacher's or lecturer's own negativity towards the subject.

From the educator's side:

- The educator might not have the ability to convey information in such a way that students can understand it.
- The educator doesn't clearly state the learning outcomes and assessment standards which the students need to achieve by the end of a class.
- Teaching in ways that encourage negative comments regarding the subject. For example: "I don't like solid geometry; you won't like it either but we have to do it".
- Providing insufficient time to complete the task at hand. Provide enough time for students to complete the task because as Spady describes in

Killen (2009:51), all students can achieve the outcome but not at the same time and not with the same methods.

Furthermore Biggs and Tang (2009) Entwistle (1990), Ramsden (1992), Kember and Gow (1994), Biggs (1999), Tagg (2003) and Floyd, Harrington and Santiago (2009) state the following factors which may encourage students to adopt a deep approach to learning:

From the student's side:

- Intrinsic motivation. Some students are internally motivated to excel in EGD and would follow a deep approach to learning.
- Appropriate background knowledge. If the students understand the basics of EGD they will feel the urge to do work on the next level. Thus it is important to promote progression in my teaching.

From the educator's side:

- Teaching in such a way as to bring out the importance of the work. Students must know what is important and what is expected of them to really understand the work and to achieve the outcome at the end of the session.
- Teaching in such a way that you provoke the students to find the answer themselves. Here we can use different teaching/learning activities like questioning which will lead the student to the answer rather than just giving them the answer.
- Teaching on the basis of what students already know. As I have already mentioned, progression is important, and as the educator, I must build on what students know in EGD. For example, the student must understand how to draw a front view in an orthographic drawing before he/she may move on to the part where he/she uses the front view to create an oblique drawing.

- Teach and assess in such a way that you encourage positive working within the student. The students must know that there is place for making mistakes but that they must learn from this.
- Focus on in-depth learning rather than on breadth of coverage. It is more important to know and understand the basics of EGD than to know only a few aspects of EGD.
- As Biggs and Tang so aptly describe it: “In general, and most important, using teaching and assessment methods that support the explicit aims and outcomes of the course” (2009:25). Here lies the foundation of my research: I have to identify those teaching/learning activities that support the explicit aims and outcomes of EGD.

With the above-mentioned information about surface and deep learning I realise that I, as the educator, and the students, play a huge role in following a deep approach to learning in EGD.

#### **5.2.1.2 What did I do?**

I read a great deal more on teaching/learning activities and the surface and deep approaches to learning. I implemented different teaching/learning activities in my classroom and I searched within the literature for teaching/learning activities that improve a deep approach to learning in EGD.

I discussed with my fellow lecturers, teachers and students my intention of searching for teaching/learning activities that will improve a deep approach to learning.

##### **5.2.1.2.1 What I did in EGD and more specifically in CAD (Computer Aided Design)**

At the institution where I teach, an academic year is comprises 23 weeks during which students attend classes in EGD. Therefore I divided the work of EGD in 20 sessions (i.e. one session per each week). Two of the weeks that I left out were for revision before the examinations and the other week was used to

identify the different teaching/learning activities using brainstorming with my students. Each of the 20 sessions had different aspects that had to be dealt with to achieve the outcomes by the end of a session. To ensure that the students achieved the outcomes by the end of the session, a contact session was divided into the following components: an introduction, outcomes, content of the session, overview, questions and a summary. Every component is very important and may follow chronologically after each other (Avenant, 1990; Borich, 1996; Jacobsen, Eggen & Kauchak, 1999; Killen, 2009).

The *introduction* is where I, as the educator, must hold the students' attention and make sure that they want to know what is going to happen in the session and that they will not deviate. I must also use the introduction time to see what the students know from the previous session and if they are on the correct level to continue with the current session. Therefore the introduction must be relevant to the subject.

It is important to tell the students the *outcomes* required of the session so that they will know what I expect of them and they will know when they have achieved the outcomes and can move forward to the next level of learning.

The *content of the session* is important because it is aligned with the outcome of the session. Which theoretical and practical aspects are addressed in the session? For example, in session one I discussed the different snap modes in CAD. Therefore the content of the session was snap modes.

Whilst busy facilitating the session I must have an *overview* of what the students are doing, and of whether they are achieving the required outcomes. If not, I must change the course in order to point them in the right direction.

Asking *questions* during and after the session is important, to identify whether all the students have achieved the required outcomes. The students must also be given time to ask questions during and at the end of the session, which will help me to identify if they have achieved the outcomes.

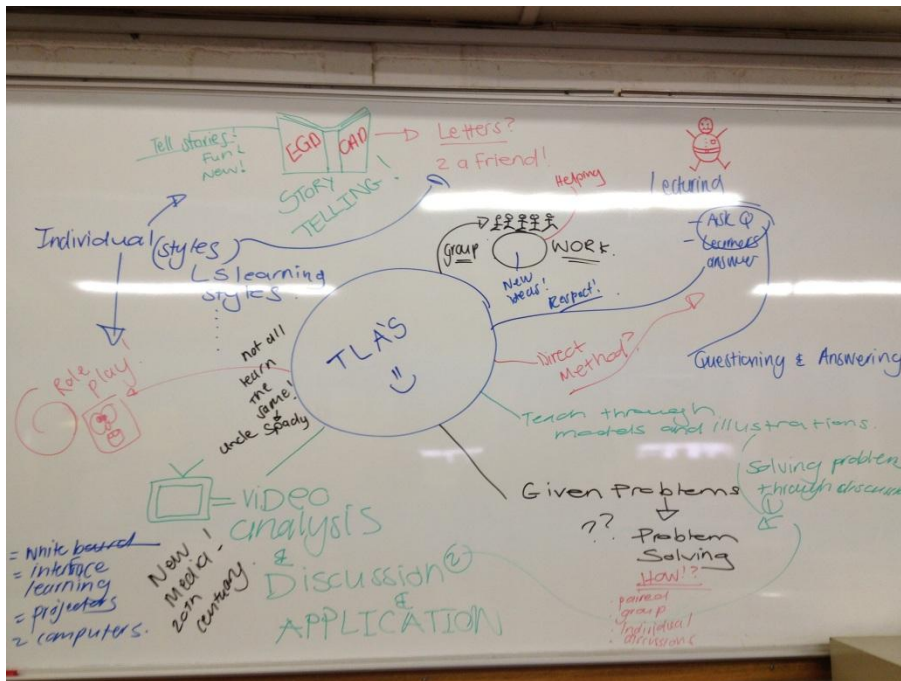
It is always good to have a *summary* at the end of the session, of what was done throughout the session. I must do a quick recap of what was done during the session and I must make sure that all the students have achieved the outcomes and that they understand the work they have covered. Preferably the lesson should end with an attention getter, to help the students remember what was done. For example, I could show a video relevant to what they have done in the session while also recapping verbally on what was done.

The above-mentioned components must be used throughout every contact session with the EGD students. After each session it is important for me to reflect on my own teaching, and for the students to reflect on the following: the teaching learning activity; the advantages of the teaching activity; the disadvantages of the teaching activity (Appendix 5). Then I will compare what the students have said and what I have said, after which I will make my conclusion about the teaching learning activity.

### **5.2.1.3 Week 1 to week 23**

#### **5.2.1.3.1 Week 1: Identifying the different teaching/learning activities**

I made use of brainstorming (see Fig. 7, 3.4.1) to identify eight different teaching/learning activities with my students. I told the students about the challenges (see 2.7) I identified in EGD, whereupon they agreed with me that they also saw these as possible challenges in EGD. After I discussed the difference between surface and deeper approaches to learning (see 4.2) with them, I told them that we could address these challenges with teaching/learning activities. I then gave them the opportunity to identify different teaching/learning activities which they liked and which they felt might address the challenges in EGD. They were very eager to do so and I led them to use brainstorming to identify the teaching/learning activities. This resulted in a mind-map on the drawing board (see Fig.13) which I then used to identify the eight different teaching and learning activities.



**Fig. 13 Brainstorming exercise**

The students chose the following eight teaching/learning activities: Lecturing, Question and answer, Role-play, Problem solving, Storytelling, Group work, Video analysis, discussion and application, Letter to a friend.

**5.2.1.3.2 Week 2: Session 1 Lecturing**

Avenant (1985: 311) states that “a speech or a lecture is a presentation-oriented one-way communication during which a teacher addresses a group of pupils and/or adults on a particular topic” (see 4.3.2.2.2).

I started my lesson with a video clip of an oblique and an isometric drawing as the introduction. When the video was finished I stood in front of the class to show them step by step how to create an oblique and isometric drawing on CAD. By the end of the lesson the students were supposed to complete an isometric as well as an oblique drawing on CAD. Because I used lecturing as a teaching/learning activity, there was only one-way communication since I did the talking and the students listened and followed my instructions. With this type of teaching/learning activity only a surface approach to learning is followed

because the students do the task with the minimum of trouble, while appearing to meet course requirements.

Own reflection:

As a former positivist I also liked the lecturing method but whilst doing research for my study I came to the conclusion that there are many other teaching/learning activities that could promote a deep approach to learning in students. Therefore I am in favour of new teaching/learning activities. One of the reasons why I think that I liked the lecturing method is because when I attended school it was the only method most of the educators used, but now that I know that there are other and better methods, I will practise them.

During the overview part of my lesson, I realised that some of the students were asking each other for assistance. I furthermore realised through the lesson that some of the students were annoyed because I showed them step by step what to do and they wanted to explore the CAD program and learn the steps by themselves. From my own reflections I realised that lecturing is not the best method to follow with young learners who really want use their higher cognitive abilities to achieve the outcomes.

A few advantages according to the students:

- “As all aspects were new and learners had no previous experience, this was a good way to get a basic idea with a step by step process.”
- “The educator could quickly see if someone was not at the right stage, so learners couldn’t fall behind.”
- “Could give students a positive attitude towards EGD as they quickly could establish that the educator has subject knowledge.”

A few disadvantages according to the students:

- “This method does take up a bit more time because the educator must do it step by step.”
- “When slower students struggle the advanced students may become disruptive and talk as the educator is busy helping the slower students.”

- “I could have done the work at home because everything is in the study guide, I could follow the steps by myself.”

Conclusion:

In my opinion a deep approach to learning cannot be obtained by only using lecturing as a teaching/learning activity. I must combine lecturing with different teaching/learning activities as well as assignments which will lead students to use their higher cognitive abilities to complete the assignment. One example that will work in EGD is as follows: Whilst using lecturing as teaching/learning activity, I can explain the difference between an oblique and isometric drawing and give the students an orthographical drawing. From this orthographical drawing, they have to create an oblique or isometric drawing.

#### **5.2.1.3.3 Week 3: Session 2 Role-play**

Killen (2009: 280) defines role-play as follows “The education literature contains descriptions of several types of role-play that all fit the broad definition of requiring learners to put themselves in someone else’s shoes or stay in their shoes and put themselves in an imaginary situation” (see 4.3.2.2.6).

As I knew that the students were supposed to prepare for class, I told them what the expected outcomes of the session were and also that they were supposed to create an orthographic drawing from an isometric drawing. I then told them that today I would be taking the part of the student, and they would all act as the educator. We quickly divided the work among the students so that they would all be able to play the part of the educator.

Own reflection:

I must say I really enjoyed this method. I played the student while the students played lecturer. Each student had an opportunity to stand in front of the class and use the computer program CAD to explain how to create an orthographic drawing from an isometric drawing to their fellow classmates and me. They all had the opportunity to stand in front of a classroom full of students and feel what it would be like to be the educator.

There were a few things that I picked up whilst playing student. Most of the students enjoyed using the role-play method and playing the lecturer. They demanded that their friends call them Sir or Ma'am. Some of the students however did not enjoy this and tried to get it over as quickly as possible. I suspect this was mainly because they were afraid of being teased by the other students if they made a mistake.

I could also reflect on my own teaching and saw how some of the students tried to copy my techniques of teaching.

A few advantages according to the students:

- "Sometimes it is easier to understand difficult terms if someone of your own age explains them to you."
- "It is much easier to learn while you teach."
- "I have learned from my peers and it was funny to address my friend as sir."
- "It helps me to prepare for the day when I will stand in front of a class."
- "Students are actively involved."

A few disadvantages mentioned by the students:

- "I was afraid of doing something wrong and the others would laugh at me."
- "Learners who are shy will never get involved because they fear to be challenged."
- "I might waste the other students' time if I am not prepared for the class."

Conclusion:

I have found through experience that role-play does indeed lead to deep learning since students cannot simply rely on their most basic of knowledge to get by. During role-play students need to be able to extend beyond their usual roles as they must interact with other role-players as well, which means that they have to be prepared and informed beyond basics to be able to cope with the unexpected (as included by other players) during role-play. This

preparation thus demands that they have a firm understanding and wider scope regarding their field thus placing them firmly within the deep learning field. They cannot simply stick to the most basic learning but in fact have to have a deep understanding regarding their field as well as related fields.

#### **5.2.1.3.4 Week 4: Session 3 Group work**

Brown (1992: 8) defines group work as follows: “Group work provides a context in which individuals help each other; it is a method of helping groups as well as helping individuals; and it can enable individuals and groups to influence and change personal, group, organizational and community problems” (see 4.3.2.2.1).

I started session 3 purely with the lecturing method: I talked and the students listened and followed the steps shown on a projector. We did the following aspects of CAD: intersections, tangent lines, line length, parallel lines, orthogonal and radial dimensioning.

At the end of session 3 I divided the class into groups of three members each and they worked a session through where they had to draw and modify simple line and circle geometry and create a 2D drawing of a wheelbarrow. I still played the part of educator and was there to help whenever anyone needed any assistance.

The students had been given clearly worked out guidelines to follow, and they exactly knew what was expected of them and how to reach the outcome. After they completed the drawing of the wheelbarrow they had to compile a title block template which they could use for any future drawing.

Own reflection:

What I acknowledged during this session was that some students wanted to work individually and not with other students in a group, while other students preferred group work because they felt this to be an advantage and that it made the work easier. The students understood each other well and were not shy of each other (peer-teaching).

I also noticed that some of the students prevented other students from doing their work. These were usually the students who did not like the work themselves. The more gifted students felt that they were being held back by the not so gifted students, and that these students were wasting their time.

A few advantages according to the students:

- “Gives students access to different explanations”.
- “Student doesn’t feel stupid asking fellow students, might feel this way if asking the educator continuously”.
- “We help each other to learn the work but also learn from each other and get know each other”.
- “It is nice to work with someone else”.

A few disadvantages according to the students:

- “Learners who understand and is progressing must stop what they are doing and figure out where fellow students are and what they are doing wrong so that they can help them”.
- “I could have succeeded faster if I was working on my own”.
- “Have to wait for the other student”.
- “Could move away from work and start talking about something else”.
- “Some of the learners don’t want to participate”.

Conclusion:

With group work it is possible to follow a deep approach to learning if as educator I still maintain a guiding role although in a covert sense as students do not realise the strong influence the educator still maintains as they discuss matters amongst themselves. Another aspect of group work that lends itself successfully to the deep approach is that students get to know the work in easily understandable terms as they interact with one another and explain work in a less jargon-filled and more relaxed conversation. Students working together also then tend to challenge one another as they share and discuss their different ideas and thus in the process challenge one another to perform

better and produce more. As educator I must work out a progressive group work task that will lead students to use higher cognitive thinking to complete the task.

#### **5.2.1.3.5 Week 5: Session 4 Question and answer**

Avenant (1985:287) portrays question and answer method as follows: “This method consists of the teacher guiding his pupils to gradual and progressive discoveries of new relationships by purposeful and systematically asked questions” (see 4.3.2.2.5).

I started the lesson by asking questions about the previous week’s work. As I was asking questions I realised that they didn’t have a thorough knowledge of all the previous work, and I decided to prepare a class test for the next session of EGD.

During this session I continually asked the students questions about the work and I could see that they remembered the work better when they were physically involved with the computer and the CAD program. Therefore I can say that if you use visual aids in class the students do remember better what was done.

Own reflection:

I acknowledge that some students do not participate when questions are being asked, perhaps because they are afraid of giving wrong answers and then being laughed at by the class. On the other hand, there are students who want to answer the questions all of the time. There is no way for me to know if the learners who do not answer, understand the work or not. It is also difficult to know whether it is safe to move on to the next work and whether the outcomes have been reached. What I did realise however was that the students were more involved and I had their attention for the whole session, although this may have been because they were afraid that I would ask them a question for which they didn’t have an answer.

A few advantages according to the students:

- “It forces students to come prepared for class.”
- “Grabs students’ attention.”
- “Could learn from other students’ answers which may differ from the educator’s answer but still be correct.”
- “It is an important teaching/learning activity for educators because they can see what the students know and who are struggling and need attention.”
- “It helps me to remember the work of the previous session.”

A few disadvantages according to the students:

- “It wastes time if students don’t know the answer to the questions.”
- “Students may be afraid of answering incorrectly.”
- “Not all the students want to answer and it is the same students answering all the time.”
- “There might be a problem singling out a student who is unprepared, they may feel picked on and this will influence his/her motivation.”
- “It hinders fast learners and forces them to learn at a slow pace.”

Conclusion:

The question and answer method relies on questions to access the deep approach to learning as it is not possible to access this level when in simple discussion. The questions of the educator should guide, challenge and inspire the ideas and theories of students. Different kinds of questions will enable the educator to lead students deeper and deeper in their learning as they are faced with progressively more challenging and thought-provoking questions. The educator can use Bloom’s (1956) (Ketteridge & Marshall, 2009; Atherton, 2009) verbs as guide to these increasingly more perplexing questions thus shifting the thoughts of students from simple knowledge to understanding and insight, application and analysis and then to the even more complex synthesis and finally to evaluation. Questions should thus be planned well in advance in order to move questions from the simple knowledge-checking questions like “name

the different line types”, to helping them assimilate and differentiate their new knowledge by way of leading questions like “distinguish between the first angle orthographic drawing and third angle orthographic drawing and then create an oblique drawing accordingly”. All the different levels can be accessed along the way and eventually students can be led to the evaluation phase of their knowledge by allowing the students to assess one another’s drawings.

#### **5.2.1.3.6 Week 6: Session 5 Letter to a friend**

According to Prosser and Trigwell (1990), a letter to a friend is written by a student to a friend, imaginary or real, about the relevant course to reflect on the unit. This will provide useful feedback to the educator on aspects of the relevant course (see 4.3.22.3).

As mentioned in session 4, I decided to let the students write a test on the previous session’s work. For me, the letter to a friend was a very interesting method when I first read about it, and I used it in a theoretical test for the students. The assignment was to send a letter to a friend in another province who also has EGD as a subject and uses CAD as drawing aid. The test question was: Write a letter to a friend and explain the steps you would take to save a drawing in paperspace and print it in CAD.

Own reflection:

The students were rather sceptical in the beginning about this kind of test, but once they started the test I could see that they enjoyed writing their letters. I really enjoyed reading the tests in letter format and I almost forgot that it was a test.

A few advantages according to the students:

- “Combines EGD with a language where you have to use your letter writing skills to write a test.”
- “It was a fun way of writing test; it didn’t feel like I was writing a test. It made test writing interesting and enjoyable.”
- “This method tickles your creativity.”

- “You can explain the steps in a more informal way in which I understand it.”

A few disadvantages according to the students:

- “You may focus so on the letter you may forget your answers.”
- “Some students like to write answers in bullet form and now they must do it in an informal way.”
- “I don’t like this method, since it wastes my time.”

Conclusion:

The “letter to a friend” method lends itself to a deep approach as students must re-evaluate and analyse their own work before they can explain it to someone else. This re-assessment of their work thus moves it from a pure knowledge state to something that has been reflected upon and understood in a new way, then also analysed and applied in new terms as they seek to verbalise and apply their ideas in a way that another student may be able to understand fully and finally in their own terms. This is quite a shift from simply knowing work and being able to contemplate the work alone; students must be able to make it their own and be able to convey it to someone else in such a manner that they can understand and use it themselves. Once a student moves to the synthesis and evaluation phase of their own and other’s work, I can rest assured that their learning has moved to the deep approach.

#### **5.2.1.3.7 Week 7: Session 6 Problem solving**

Problem solving (see 4.3.2.2.4) is a strategy for “posing significant, contextualized, real-world situations, and providing resources, guidance, and instruction to learners as they develop content knowledge and problem-solving skills” (Mayo, Donnelly, Nash & Schwartz, 1993:227).

I started my class by showing the learners a music video about Linkenpark, called “What I’ve done”. The music video is about how people have a negative impact on the earth and the inclination that they have to destroy everything, including the earth. The video furthermore shows how people are responsible

for bad things that happened in this world, like the atomic bomb and the world wars. The introduction to the video is about all the problems worldwide and, it is suggested that we must find solutions for these problems.

The problem I proposed to the students was much more ordinary.

Problem: We as the EGD class must design a boat to rescue the penguins in the oily water after an oil rig has exploded. Students had to find a solution and a design for a boat to transport the penguins to land. The students came up with different designs of boats, with various places to put the penguins.

Own reflection:

I could see that the students were touched by the music video as they realised that human beings are responsible for bad things happening on earth. That is why I appealed to the moral standards of the learners and sent them away with the understanding that they would make better choices and that they shouldn't do anything without thinking about the consequences first. I further realised that the students had come up with very creative ideas for the problem: more creative than just the drawing what I would possibly have given them to do.

A few advantages according to the students:

- “Development of problem solving skills.”
- “Development of holistic thoughts.”
- “I may use my creative skills to develop a solution for the problem.”

A few disadvantages according to the students:

- “Less gifted students may feel at loss.”
- “It is easier to just create a drawing than to think about a problem and then design an answer for the problem and then create the drawing. It is too much work.”

Conclusion:

Once I ask a student to solve any particular problem, their learning quickly shifts from the surface approach to the deep approach. This shift happens since students have to assemble knowledge thus far gained and structure it in a new and creative way in order to solve the given problem. Seeing their learning in such a new way allows the deeper approach to learning as they analyse, apply and connect new clusters of knowledge.

#### **5.2.1.3.8 Week 8: Session 7 Video analysis, discussion and application**

Poskiene (n.d.:2 of 4) describes video analysis, discussion and application as “a method which leads a student and educator to a deeper negotiation and case analysis. The main advantage of this method is that the student’s creativity and inventiveness are disclosed” (see 4.3.2.2.8).

I started the lesson by showing a light bulb to the students, and then sent the bulb around the class so that they could see and touch it. Then I asked them how they thought it was manufactured. After listening to their explanations I showed them a video on how it was done in practice. After that we discussed the steps in making a light bulb and then we discussed the steps involved in drawing a light bulb. Lastly we applied what we had learned and they drew the bulb according to scale 1:1.

Own reflection:

I could see that the students had enjoyed the lesson. It was easy to see that the students were wondering about the relationship between EGD, CAD, a light bulb and the manufacturing of a light bulb.

A few advantages according to the students:

- “There is an integration of visual, hearing and an emotional aspect in the lesson.”
- “Attracts my attention and keeps it longer.”

- “Brings the real world into the classroom.”
- “Application helps you to understand the content better.”
- “The discussion part helped me to understand what was expected of me.”
- “It plays a vital role in learning, since I paid more attention to how steps were carried out while manufacturing bulbs. It became easier for me to follow the steps accordingly during the practical session on how to draw a light bulb.”

A few disadvantages according to the students:

- “Requires more preparation time from the educator.”
- “Requires media which certain schools may not possess.”
- “Maybe if the video is too long I could lose my concentration.”
- The facilitation of video playing, discussion and application can be time consuming.”

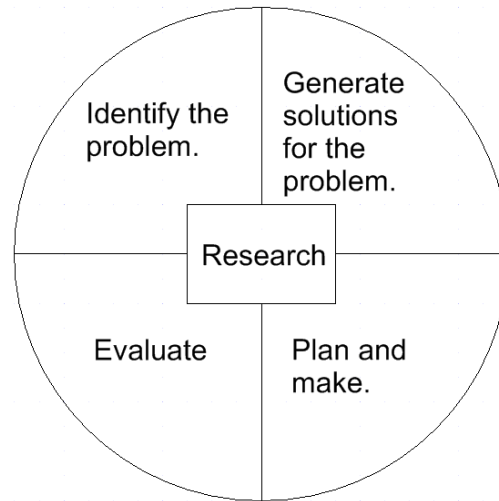
Conclusion:

During lessons where I used video media, learning quickly deepened and moved away from simple surface approach learning. This was due to the fact that students were stimulated to use more senses during the watching of the video, and they also received more information than just the basic storyline from the video. A deep approach to learning was clearly followed since students then took part in the discussion after the show and thus shared and challenged one another’s ideas. Clearly we are dealing with higher cognitive thinking here: students had to apply their skills to what they had learned from the video and then they had to use and apply both in order to make the required drawing

#### **5.2.1.3.9 Week 9: Session 8 Storytelling**

Hunter and Hunter (2006:273) describe storytelling as “one of the oldest methods of communication, stories provide a framework for life. Stories serve to educate others, record historical facts, teach cultural values, bridge generations, set standards and values, and share common experiences” (see 4.3.2.2.7).

I introduced the lesson by beginning with a historical story about Shaka Zulu. I recounted to the students who he was and what had made him important in history. Furthermore I explained the design process (see Fig. 14) and how Shaka used it – without knowing that he did.



**Fig. 14**      **Design process**

I started by creating a problem: It is very warm in Graaff-Reinet, about 48°C, and we only have R200,00. What are we going to do about it?

Students gave possible solutions like buying or building a fan, or buying cool drinks. They chose to build the fan. We then started drawing a fan on CAD.

Own reflection:

I really liked this method of storytelling. Perhaps this is because I like history, or perhaps it brought out the inner child who has a love of stories. The students enjoyed the history and waited in anticipation to learn how the story of Shaka and EGD fitted together. I could furthermore see that some of the students tried to identify the part that their own families might have played in those sequences. Whilst telling the story of Shaka Zulu I had control of the students because they were all waiting with bated breath to find out what was going to happen next.

A few advantages according to the students:

- “Grabs students’ attention and keeps it.”
- “Makes class enjoyable as a more relaxed atmosphere is created.”
- “In South Africa with all our different cultures all the cultures could be involved with different history stories of each culture.”
- “It is an interesting way to learning, I didn’t even realise I was busy learning the design process.”
- “Makes way for creativity in class.”

A few disadvantages according to the students:

- “Educator may have to bring learners back to the topic as discussions evolve and may stray.”
- “Requires more preparation time from the educator.”
- “Learners may struggle to understand how the subject fits together with the story.”
- “If the story isn’t interesting students’ minds may wander off.”

Conclusion:

A deep approach to learning was used since students had to apply the knowledge they had gained during the story to find a solution to a given a problem. Once again students needed to rethink what they had learned, and to work out how to use and apply this knowledge in different ways in order to find solutions to problems. This led them down the path to a deeper approach to learning.

#### **5.2.1.3.10 Week 10: Session 9 and rating the teaching/learning activities.**

I started the class by handing out copies of the table below (see Table 2). The students and I then rated the 8 different teaching/learning activities which we had covered in the previous sessions. I asked them to rate the teaching/learning activities as follows: 1 is the best and 8 is the worst.

**Table 2 Teaching/learning activities**

<b>Teaching/learning activities</b>	
Lecturing	
Role-play	
Group work	
Question and answer	
Letter to a friend	
Problem solving	
Video analysis, discussion and application	
Storytelling	

I rated the teaching/learning activities as indicated in Table 3. Then I waited in anticipation to see how the students would rate them. As I was busy rating the teaching/learning activities, I realised that in the beginning I had said that I preferred lecturing as a method of teaching and now I had rated it as the worst teaching/learning activity. My reflection brought about quite a change of mind for me and I am sure students will experience the same.

**Table 3 Rating of teaching/learning activities**

<b>Teaching/learning activities</b>	
Lecturing	8
Role-play	4
Group work	5
Question and answer	6
Letter to a friend	7
Problem solving	2
Video analysis, discussion and application	1
Storytelling	3

After comparing all the students' ratings, the above was the end result. The five most effective teaching/learning activities according to the students were: storytelling, video analysis, discussion and application, problem solving, group work and role-play. What I realised very soon was that the five teaching/learning activities that I had chosen were the same as those that the students had chosen. Now that the most effective teaching/learning activities were established, I applied each method twice during the next few weeks. After this the students would rate these five teaching/learning activities for the last time and we would establish which teaching/learning activity is the best to encourage deep learning within students.

In the following few weeks the students didn't reflect on the advantages and disadvantages of the teaching/learning activities because this had already been done in the previous weeks. Now, on their own, they would reflect on the teaching/learning activities as aids to improve a deep approach to learning and they would use these reflections in the last session to rate the five teaching/learning activities.

#### **5.2.1.3.11 Week 11: Session 10 Storytelling**

In this session I made use of storytelling as a teaching/learning activity again. I started the session with the history of Jan van Riebeeck who came to South Africa in 1652 to build a castle which would be a "pit-stop" for other sailors on their way to the East to get spices.

After a brief history of Jan van Riebeeck, the students were supposed to put themselves into the shoes of Jan van Riebeeck and create a floor plan drawing of how they would build the castle in Cape Town. They also had to explain what had led them to design their castle as they did. They then had to do the floor plan on CAD and give the 2D drawing a 3D face lift by inserting height into the drawing.

Own reflection:

As I mentioned before, I like the storytelling method because I am interested in history. As I was telling the story of Jan van Riebeeck I could see that the students enjoyed the history and were waiting in anticipation to understand the connection between Jan van Riebeeck and EGD. Whilst telling the story of Jan van Riebeeck I felt that I had control over the students because they were all waiting and listening intently. Furthermore I realised that the students were very interested when giving them a brief history of the circumstances in 1652 in Cape Town. The history made them realise some of the dangers that there may have been, and to think about how they would compensate for these dangers in their planning of the castle. The jump from 2D to 3D drawings also made them use their cognitive abilities to imagine what their castles would finally look like.

Conclusion:

A deep approach to learning was clearly used because the students had to design a castle with only basic prior knowledge of floor plans and the brief history of Jan van Riebeeck. In order to be able to make the jump from 2D to 3D drawings, students needed to adjust their knowledge completely to move from more straightforward 2D drawings to much more challenging 3D drawings. During this process they moved to the deep approach to learning as they accessed their higher cognitive thinking skills to make the change between the two types of drawings.

#### **5.2.1.3.12 Week 12: Revision for examination**

Whilst doing revision I realised that the students had made a correlation between what was done theoretically and the teaching/learning activity that had been used. For example, when I was talking about the design process the students remembered the story of Shaka Zulu and how he used the design process without even knowing it, and they remembered the process without even learning it for this revision session. One of the students stated the following: “Maybe there is value in using teaching/learning activities to remember work”. This made me realise that I was not wasting my time in

preparing each class with a different teaching learning activity: this is what I wanted these future educators to gain with the different teaching/learning activities.

#### **5.2.1.3.13 Week 13: Session 11 Video analysis, discussion and applications**

In this session I made use of video analysis, discussion and applications as a teaching learning activity to do orthographical machine drawings. I started the session by playing a video showing different crane hooks. We then discussed the uses of these hooks in real life whilst sending a small 3D model of a hook through the class so that the students could see and touch a real hook. Then I played a video showing how such hooks are manufactured. The students then made use of their prior knowledge of orthographical drawings and the information they had just gained to apply what they already knew, together with the new knowledge they had gained, to do a machine drawing of a crane hook with a front view, top view and a sectional right view.

Own reflection:

I could see that the students were wondering about the relationship between EGD, CAD and the video of different crane hooks and the manufacturing of a crane hook. Throughout the discussion part the students helped each other to visualise and understand where and how crane hooks are used in real life situations.

Conclusion:

A deep approach to learning was followed since the students had to use their prior knowledge and what they had seen in the video and discussed in class, to fit the different parts of the crane hook together to complete the machine drawing. If higher cognitive thinking skills had not been used the students would not have been able to fit the pieces together to complete the crane hook. The students had to see how the parts fitted together in their minds before they

could apply the knowledge to do the drawing; consequently, they accessed higher cognitive faculties and deeper learning.

#### **5.2.1.3.14 Week 14: Session 12 Problem solving**

In this session I made use of problem solving as a teaching learning activity. I started the session by reading a newspaper article on floods that were devastating the Free State at that time. I showed pictures of roads and bridges that had collapsed because of the rains. I then gave the students the following problem to solve: A small town in the Free State is surrounded by water and the only bridge leading to the town has collapsed. How can we take food to the survivors while the bridge is being fixed? Create a drawing of a possible solution to this problem.

Own reflection:

When I read the newspaper article I realised that all the students were well aware of this problem in the Free State. A real life situation was therefore identified, for which the students had to design a solution.

Conclusion:

Working on the problem, the students became absorbed by it. Churning the facts around in their heads, fitting their already gained knowledge this way and that in order to make it all fit in a new way, they became totally involved with the theory of solving the problem. The way some of the students tackle problems is virtually the same as the way a professional researcher tackles research problems. Hence, through problem solving, a deep approach to learning is followed because doing research increases insight as well as the students' knowledge about the subject and the problem which needs to be solved.

#### **5.2.1.3.15 Week 15: Session 13 Group work**

In this session I made use of group work as a teaching learning activity. Group work is however always one of the more difficult teaching/learning activities for me to use in the EGD class. EGD is about the student's individual effort to

create drawings on the drawing board, and this presents a problem in starting an EGD session using group work as a teaching/learning activity.

I started the session with a short introduction about solid geometry and showed the students an elementary drawing, also indicating how it should be done on the drawing board. I then divided them into small groups of three students to a group, where they, as a group, had to do a more complex solid geometry drawing on CAD.

Own reflection:

As I walked through the class while they were busy with the drawing I realised again that they were busy with peer coaching: they were helping each other and explaining the work in a more informal way than what I had done at the beginning of the session. Furthermore I could see that some of the students understood the work better when one of the peers explained it. I also realised that the students in the group motivated each other to understand the work and that they wanted to succeed and to be better than the other groups. Competition, here, was certainly not a bad thing.

Conclusion:

During group work a greater number and diversity of alternatives can be developed whilst sharing information and knowledge as students communicate and challenge one another's ideas. It seems to clear to me that a deep approach to learning was followed whilst doing group work because students develop knowledge and skills for future use and students motivate each other in the groups to succeed.

#### **5.2.1.3.16 Week 16: Session 14 Role-play**

In this session I made use of role-play as a teaching learning activity. I gave a few students different roles in a building exercise: an architect, a quantity surveyor, a builder, a plumber, an electrician and a carpenter. They then had to dress up according to their roles and discuss a new building that they had to build. The architect started, showing the others the floor plan of the building.

Then the quantity surveyor showed the calculations of the quantities of different materials necessary to build the building. The builder then told the rest how he and his building team would construct the building. Then the carpenter, electrician and plumber explained the roles they would play in finishing the building. After this was done I showed the students how to create a floor plan and left them to design their own dream house.

Own reflection:

The first thing I realised was that the students had done very good research on the topic. The audience also learned a lot of new facts about the various role-players in the building exercise, as well as about what would be expected of them in real life situations. One of the reasons why I liked this method was because we brought the building exercise to the classroom, not needing to go to a building site.

Conclusion:

Role-play encourages deep learning in that it creates a learning environment in which learners are highly motivated and involved because of the realism and the relevance of the learning activity. Furthermore role-play provides a clear focus for learning by emphasising the application of knowledge in real life situations rather than just the accumulation of knowledge for assessment purposes. Ideas are critically evaluated and assimilated, leaving the student with a greater learning experience than simply regurgitating facts as they challenge and inspire one another during their carefully considered role-play.

#### **5.2.1.3.17 Week 17 -21: Session 15 – Session 19**

In the next five weeks I made use of the above-mentioned teaching/learning activities. I did the same in the teaching/learning activities as I had done before but now the theoretical topics differed from the previous sessions. Now that I had a guideline to follow when using the different teaching/learning activities it was easier to link different theoretical aspects with the teaching learning activity

and what seemed at first to be an impossible task was becoming easier because I had done it a few times. Practice does make perfect.

#### **5.2.1.3.18 Week 22: Session 20**

In this session I did a fast recap of what had been done over the previous 19 weeks. I defined the various teaching/learning activities again and asked the students what they thought of what was being done in EGD with regard to the teaching/learning activities that were used. Here are some of their responses:

- “It makes EGD interesting and more enjoyable.”
- “It helps us with the practical application of the theoretical work.”
- “Some of the teaching/learning activities made me understand the work better.”
- “It helped me to develop my cognitive thoughts.”
- “Some of the teaching/learning activities where we were involved made place for our own imagination and creativity.”
- “I could relate some of the theory to the teaching/learning activity used.”

After our discussion about teaching/learning activities, I asked the students to rate the five teaching/learning activities from the best to worst according to their own experiences with the teaching/learning activities. I also rated the teaching/learning activities in Table 4, thus I can compare my ratings with those of the students in Table 5.

**Table 4 My rating of the teaching/learning activity**

<b>Teaching/learning activity</b>	
Role-play	4
Group work	5
Problem solving	2
Video analysis, discussion and application	1
Storytelling	3

**Table 5 Students' rating of the five teaching/learning activities**

<b>Teaching learning activity</b>	
Role-play	4
Group work	3
Problem solving	2
Video analysis, discussion and application	1
Storytelling	5

If I compare my ratings to those of the students, our ratings were same except for storytelling and group work. The students liked group work more than storytelling. As I mentioned before, the reason why I like storytelling as a teaching/learning activity is because I like history. However, we are all individuals and perhaps the students are not as keen on history as I am.

Overall I am quite satisfied with the results, because video analysis, discussion and application was the most effective teaching/learning activity in the view of both myself and my students.

### **5.2.2 What kind of evidence can I gather to show that I am having an influence?**

I collected a great deal of data which enabled me to assess the educational value of using different teaching/learning activities to ensure a deep approach to learning in EGD.

#### **5.2.2.1 My reflections in my journal**

I monitored my practice by keeping notes and records in my personal journal from April 2010. The journal contains the following information: my preparation for the sessions; my own reflection before, during and after the sessions; what I expected to happen in the session and what really happened in the session; my opinion of advantages and disadvantages of the different teaching/learning activities used; how each teaching learning activity could encourage a deep

approach to learning prior to a surface approach to learning. It was important for me to reflect on my teaching after each session whilst the information was still fresh in my mind. I could then identify what wasn't working in the session and adapt it for the next session.

#### **5.2.2.2 The students' reflection sheets (Appendix 5)**

Here the students recorded what happened in class; which teaching learning activity was used; the advantages and disadvantages of the teaching learning activity according to them; whether they enjoyed the teaching learning activity; whether they thought the teaching learning activity had enhanced a deep approach to learning within themselves. I believe that these reflection sheets have been an excellent record of the students' understanding of teaching/learning activities and the deep approach to learning.

#### **5.2.2.3 Peer reflection (Appendix 6)**

I have observation sheets of two fellow EGD educators, with 50 years of experience in teaching EGD between them, who reflected on my teaching. After the teaching session I told them what I was doing in EGD, and here are some of the comments they made:

- "It seems that the students enjoy the teaching learning activity to help them understand the work."
- "I am also going to try this way of teaching with my students."
- "I again realise that a deep approach to learning will help to get a 100% passing rate because the learners want to succeed. Therefore a deep approach to learning is very important."
- "The students still rely on the educator for assistance but they know they are capable of doing the work."

The overall impression I gained from my peers' observations was that they also saw the importance of using a deep approach to learning within EGD and they supported the idea of using different teaching/learning activities to enhance a deep approach to learning.

#### **5.2.2.4 Photographs and video material of students**

I took photographs of the students while they were busy with group work, writing tests, and most important, I made videos of when they were busy with role-play. My students and I watched the videos afterwards and discussed the educational value of role-play in the EGD class. Furthermore, I now use these videos in class to assist me in my teaching.

#### **5.2.2.5 Mark sheets**

I compared the EGD students' marks with those of the previous year and there was an increase in their marks. In 2009 the class average for CAD was 61% and at the end of 2010 the class average for CAD was 69%. This isn't enough information to substantiate what I am doing however because the reliability and validity of each test plays a role.

#### **5.2.2.6 Unprepared tests**

When I compared the results of two different unprepared tests which followed the previous day's teaching/learning activity (teaching/learning activities lecturing and video analysis, discussion and application), more students failed the test after only lecturing was used as a teaching/learning activity in comparison with all the students passing the unprepared test when video analysis, discussion and application were used.

#### **5.2.2.7 Rating sheets**

The rating sheets (see 5.2.1.3.17) I used showed me how the students rated the teaching/learning activities and which, in their view, were the best teaching/learning activities. When I compared their ratings with what they said about the teaching/learning activities in their own reflections I could see why they rated the methods as they rated them.

### **5.2.3 How can I explain this educational influence?**

- I believe that the above qualitative data supports the conclusions I reached in terms of educational influence, as indicated below. The

students did reach a deep approach to learning when different teaching/learning activities were used.

- As their educator I could see the difference in understanding of the work when using different teaching/learning activities.
- Their motivation to learn and improve the quality of their work has increased.
- I made some of my colleagues more aware of different teaching/learning activities and the importance of a deep approach to learning in any subject (see 5.2.2.3).

#### **5.2.4 How can I ensure that any judgements I might make are reasonably fair and accurate?**

According to McNiff (2002) the word “*prove*” does not exist in action research but I can produce reasonable evidence to substantiate what I feel really did happen and that I am not making it up. I want to support what McNiff has said with a quote from Albert Einstein quoted in (Pritscher, 2010: 24): “If we knew what it was we were doing, it would not be called research, would it?”

The validation group which I used included the research participants (my students), colleagues and fellow EGD educators, who all helped me to produce evidence to back up what I have said.

Furthermore I made use of participant review (member checks) and triangulation as guidelines to validate what I have said thus far. Method triangulation and member checks are used to ensure the trustworthiness of my interpretations of colleagues’, educators’ and students’ perspectives (Shenton, 2004).

Creswell (2008:266) explain method triangulation as a “process of corroborating evidence from different individuals (e.g., a principal and a student), types of data (e.g., observational field notes and interviews), or methods of data collection (e.g., documents and interviews) in descriptions and themes in qualitative research”. As I mentioned earlier I made use of different individuals

in my study and they are as follows: my students, my colleagues and fellow EGD educators.

Furthermore Creswell (2008:267) describes participant review (member checks) as “a process in which the researcher asks one or more participants in the study to check the accuracy of the account”. I gave feedback on what I used in my study in interview form with my various participants and after that was done and they said the description was complete and realistic I included the accurate and fair interpretations in my study.

### **5.3 Summary**

This chapter reflects the different teaching/learning activities I implemented to ensure a deep approach to learning among my EGD students. It furthermore shows my role as educator in EGD, as well as an action researcher, reflecting on my own teaching to improve my teaching in EGD. The study furthermore indicates how I worked with my students and my fellow EGD educators, and elucidates my own experiences during the study. I also identified different values which guided me to do this study.

As a result of the rating system that I used with the students, I now know which teaching/learning activities they enjoy most whilst using a deep approach to learning. I will use these teaching/learning activities in the coming years as a guide during my teaching of EGD. Further studies may derive from my initial study.

## Chapter 6

### Conclusions and recommendations

Question	Lin Norton action research steps	McNiff questions	Chapter layout	Research method
How can I modify my teaching practices in the future?	Modifying future practice	How will I change my practice with regard to my evaluation?	<b>Chapter 6</b> Conclusions and Recommendations	<b>Comprehensive summary and integration</b>

#### 6.1 Introduction

In this chapter there are various goals that I would like to achieve. The first is to remind the reader of the aim of my study and to determine whether my research project achieved its aims. Furthermore I have to review the steps I took throughout my study, as well as any problems I ran into during my study. I then have to discuss the recommendations I formulated from my study. I must then also explain the significance of the research to me, the significance of writing up the research, the significance to my work place and lastly the contribution to educational theory.

#### 6.2 Conclusions

The aim of my study was to identify and rate the most effective teaching practices in EGD which will lead students to a higher cognitive level of thinking which will ultimately lead to a deep approach to learning. I also wanted to improve my own teaching and teaching experience. The following questions were identified in Chapter 1 (see 1.5):

- What are the best teaching practices that I can implement to improve my teaching of EGD?
- What is the nature of EGD and what are the challenges involved in the teaching of this subject?
- How can I adapt my teaching practices to improve student learning?

- How did I adapt my teaching practices?
- How effective have the chosen teaching practices been?
- How can I modify my teaching practices in future?

If I consider the above-mentioned questions that I identified at the beginning of my study, I can now clearly see that I have answered these questions and that I was able to improve my teaching practices to such an extent that I am now able to create deep learning experiences for my EGD students. If I compare my students' marks when using the teaching/learning activities, with the marks from when I did not use the teaching/learning activities, there was an increase in marks as a result of using the teaching/learning activities (see 5.2.2.5). As mentioned in Chapter 4 (see 4.4), any teaching learning activity one uses has an effect on the approach to learning that students follow (Kember & Gow, 1994). I also saw the effect of teaching/learning activities on teaching in my own teaching. Therefore I can say that my students and I did identify teaching/learning activities which will lead to a higher cognitive level of thinking as well as a deep approach to learning. As for the rating of the teaching/learning activities we identified, the students rated the teaching/learning activities from best to worst in Chapter 5 (see 5.2.1.3.18). Therefore I believe that I have achieved the aim and objectives of my study.

In order to show clearly that I have answered all of these questions, I shall cross-reference what I have done throughout the study with each research question in the Matrix (see 6.2.1). The matrix shows how and in which part of my dissertation I answered the different research questions. It may appear that overlapping is occurring but this is not the case, as it simply emphasises the fact that Lin Norton's steps and McNiff's questions are integrated throughout the study. In the following paragraphs I will discuss the answers to my various research questions to show how I addressed the various issues facing me during my studies.

## 6.2.1 Matrix for the cross-referencing of my research questions

Improving my teaching experience with students in Engineering Graphics and Design: an action inquiry			
Primary question	Lin Norton action research steps	McNiff questions	Cross-reference
What are the best teaching practices that I can implement to improve my teaching of EGD?	Identification of problem	What issue am I interested in researching? Why do I want to research this issue?	1.2 1.3 1.5 1.12 2.7
Secondary questions	Lin Norton action research steps	McNiff questions	Cross-reference
What is the nature of EGD and what are the challenges involved in the teaching of this subject?	Identification of problem	What issue am I interested in researching? Why do I want to research this issue? What kind of evidence can I gather to show why I am interested in this issue?	2.2 2.3 2.5 2.7
How can I adapt my teaching practices to improve student learning?	Thinking of ways to tackle the problem	What can/will I do? What kind of evidence can I gather to show that I am having an influence?	1.3 1.4 1.7 3.2 3.3 3.4 3.6 4.2 4.3 5.2.1.1 5.2.1.2 6.2.1.5
How did I adapt my teaching practices?  How effective have the chosen teaching practices been?	Doing it and evaluating the actual research findings	What kind of evidence can I gather to show that I am having an influence? How can I explain the educational influence of my new methods? How can I ensure that any judgements I might make are reasonably fair and accurate?	1.8 3.5 3.7 5.2.1 5.2.2 5.2.3 5.2.4 6.2.1.5
How can I modify my teaching practices in the future?	Modifying future practice	How will I change my practice with regard to my evaluation?	1.7.6 1.9 1.12 6.2 6.3 6.4 6.5

### **6.2.1.1 What are the best teaching practices that I can implement to improve my teaching of EGD?**

The first challenge I faced was the identification of challenging issues facing the teaching of EGD (Chapter 1 and Chapter 2). These challenges (see 2.7) ranged in their scope of difficulty from the relatively simple task of making the subject more interesting to the much more challenging task of unlocking the contents of a very exact discipline and leading students from a surface approach to learning to a deep approach. The solution to these challenges seemed to me to be in my own hands as it depended upon the teaching practices I used to unlock the subject for my students. This led me to the constructive alignment of my subject by way of addressing intended learning outcomes, teaching and learning activities, assessment tasks and grading. This research question was therefore collectively answered by the secondary questions (see 6.2.1.2 to 6.2.1.6, 6.6).

### **6.2.1.2 What is the nature of EGD and what are the challenges involved in the teaching of this subject?**

What is the nature of EGD and what are the challenges involved in the teaching of this subject?

In Chapter 2 I focused on the science of drawing, mentioning how exact it is and that there is very little leeway allowed in terms of delivering and interpreting the drawings (see 2.2, 2.3). To some this makes the subject very rigid and precise and thus demands a fairly specific range of skills to deliver the drawings in question in the meticulous manner required. Many find this rigidity wearisome and uninteresting, leaving me with the challenge of making this subject appealing and attention-grabbing by way of using various teaching practices (see 2.7). In attracting the interest of students and delivering to them a certain set of skills, I consequently necessarily also lead them from the surface approach to learning toward the deep approach. These above-mentioned aspects confirm that I had to conduct research into a variety of teaching practices to improve my teaching.

### **6.2.1.3 How can I adapt my teaching practices to improve student learning?**

In Chapter 3 I discussed the research process (see 3.4) I used after I had identified the problem. The problem was that students did not use a deep approach to learning during their EGD studies. I then used action research to improve my own teaching and enhance a deep approach to learning among my students. I acted on the problem using different teaching/learning activities (see 4.3.2, 5.2) to lead the students to a higher cognitive thinking level. During my research process I observed and reflected on everything that had happened. These observations and reflections led me to improve upon my teaching and also led the students to higher cognitive thinking levels. The literature in chapters 2 and 4 gave me the direction to follow regarding the different teaching learning activities that exist and which ones I used. The research process I used is illustrated in Figures 7 and 8 in Chapter 3 further more I used Biggs's constructive alignment model as main theoretical framework (see chapter 4).

### **6.2.1.4 How did I adapt my teaching practices?**

In Chapter 4, I identified possible teaching practices like video analysis, discussion and application; problem solving; storytelling; role-play; group work; question and answer; letter to a friend and lecturing (see 4.3.2). In Chapter 5 I implemented and reflected on a variety of teaching practices (see 5.2.1.2) with an aim to create opportunities for deep learning and to make my subject more interesting for my EGD students. This furthermore shows my roles as educator in EGD (see 2.6) and as action researcher (see 3.6), reflecting on my own teaching to improve my teaching in EGD. It indicates how I worked with my students, my fellow EGD educators and my own experiences during the study. The rating system I used with the students enabled me to find out which teaching practices they enjoyed most whilst still using a deep approach to learning. These five favourite teaching/learning activities are video analysis, discussion and application; problem solving; group work; role-play and storytelling. I will use these teaching/learning activities (see 5.2.1.3.18) in the coming years as a guide during my teaching of EGD.

### **6.2.1.5 How effective have the chosen teaching practices been?**

The most important factor of my research was to improve my own teaching practice, which, if I take a look at the positive responses (see 5.2.1.3.18, 5.2.2.3) from my students in their informal evaluation of my classes, I managed to do.

- “Mr Kemp made his subject more modern ... He uses technology and his goal is to train us to become educators.”
- “He is not satisfied with good work, he requires perfect work.”
- “Mr Kemp has a huge influence in the developing of my knowledge because of his interesting, lively and humoristic way of teaching.”
- “I look forward to attending his classes.”
- “Classes are well presented with humour and he keeps my attention.”
- “After Mr Kemp explained the reasons for the usage of the different teaching/learning activities to improve a deep learning experience, I realised that our higher cognitive levels of thinking were enhanced.”
- “I now understand work better because I can link what was done during the class using a teaching/learning activity to the theory which I have to know.”

These responses from my students do indeed indicate that I have a positive influence on the students whilst using the different teaching/learning activities combined with my personal values as an educator. The process of teaching is an on-going one and I can state that I am living my values to the utmost in my classes. I can also see that the students now understand the importance of using teaching/learning activities to enhance higher levels of cognitive thinking.

During this action research I reflected on my teaching and I changed my practice in such a way that I feel that I have reached an acceptable level of professional competence. As a result of my personal and professional growth I have developed educational values and have contributed to existing educational theories. I have furthermore learned a great deal about my subject, EGD (see 2.2 to 2.6), different teaching/learning activities (see 4.3.2) and the approaches

to learning (see 4.2). During the reflective process I have seen myself and my students grow in our values and beliefs in relation to education, thus making this study an exciting and meaningful one to me.

#### **6.2.1.6 Recommendation: How can I modify my teaching practices in future?**

I plan to introduce the “most” effective teaching/learning activities that I have identified, in all my future classes. However as a life-long learner (see 2.6), I know that with time I will identify new teaching/learning activities which will also contribute to a deep approach to learning and I will incorporate these into my teaching. Therefore I may state that I will probably never find the perfect method of teaching but I will try to improve my teaching in such a way that my students will always benefit from it.

Furthermore I have initiated teaching/learning activities such as video analysis, discussion and application; problem solving; group work; role-play; storytelling. These could help current and future educators to guide their students to follow a deep approach to learning in EGD.

Whilst testing the different teaching/learning activities, I made my classes more fun and more enjoyable for the students while they were learning and “playing”. The students also gained the following: as future educators they have learned that there are different teaching/learning activities that one can use to encourage a deep approach to learning, within themselves and for their students in the future.

I would advise any educator at pre-primary, primary, secondary and tertiary level to use teaching/learning activities to enhance higher cognitive thinking among students. If there is not a deeper approach to learning in implementing different teaching/learning activities, it is doubtful that the students will enjoy the class more than they enjoy a class which is facilitated with lecturing as only teaching/learning activity.

I believe that it is of the utmost importance to align the module you are teaching constructively, because a constructively aligned module encourages clarity in the design of the curriculum, and gives a clear understanding of the connection between learning and assessment. Furthermore a constructively aligned module encourages deep learning as the activities are designed for that purpose. Whilst teaching inspiring young educators of the future, you are preparing and assisting them to be effective educators. In using a constructively aligned module you will improve the quality of teaching and learning in your subject.

The recommendations are aimed at improving teaching in EGD. These recommendations are mainly directed at two stakeholders, specifically the student and the educator.

#### **6.2.1.6.1 The student**

A constructively aligned module will help the student to know what is expected of them to complete the module whereas the teaching/learning activities will make the subject more interesting while also leading to a deep approach to learning. Furthermore deep learning can extract meaning and understanding from the module materials. It also helps students to think critically and helps them to succeed in the module.

#### **6.2.1.6.2 The educator**

A constructively aligned module will help the educator to better understand the work and know what is expected of the student. The teaching/learning activities will stimulate the student's interest while simultaneously leading the students from a surface and strategic approach to a deep approach to learning. In doing this the educator must focus on the intended learning outcomes, teaching/learning activities, assessment tasks and the grading of students' work (see 4.3.1, 4.3.2, 4.3.3, 4.3.4).

### 6.3 Limitations

I have identified the following possible challenges which might have affected my research findings:

- Classes lasted for 22 weeks, which may not have been long enough for me as researcher to observe all of the students' abilities to perform in EGD classes and show more interest in a deep approach to learning. It might have been better if the study had been done over a longer time.

I would have liked to have had more time to observe the students and the teaching/learning activities. However I realise now that I am in fact still doing research, because I still use teaching/learning activities in my class to improve deep learning. I also reflect all the time on my teaching because this has now become a habit that I gained from my study.

- Second, the population of participants is small, only 43 students, and might not represent the majority of the students of the Further Education and Training (FET) level.

At the beginning of my study I thought that this would be a problem for my study, but with the first reflection sheets that I analysed I reached a saturation point with ten students. Therefore, for my study, 43 students were enough to make my conclusions.

- Third, since the reflection sheets were designed to identify the students' attitudes towards different teaching/learning activities and the enhancement of a deep approach to learning, they might have provided useful information about the impact of teaching/learning activities and their ability to improve a deep approach to learning; it seems however that they did not to provide enough evidence of the students' actual performance in the use of a deep approach to learning.

I still see this challenge as a problem but with the comparison of their mark sheets I can see that there was an increase in marks. With this data I realised that this wasn't a limitation.

- In addition, since the study was conducted by me, it is unavoidable that a certain degree of subjectivity can be found.

This challenge was not a problem because I made use of critical friends to read my work and reflect on what I had done. Therefore no major prejudice occurred throughout my study.

## **6.4 Significance of my research**

### **6.4.1 Importance of writing up my research**

After reading through my dissertation and especially my personal journal, I now see what I have achieved in the short period of two years. I have improved my own teaching practice: where I only relied on lecturing as a teaching/learning activity when I started teaching, I now use different teaching/learning activities in every class. My students enjoy the classes even more when I use different teaching/learning activities, which I realise especially at the end of a term when they evaluate my teaching.

Reading through my own reflections I realise and understand the journey of my own educational development as an educator in EGD. There are things a person can only learn through personal experience, things I didn't learn throughout my degree studies in education, things I would have never learned if I had not made use of a personal reflection journal. The importance of writing up my research is that I can reflect on my teaching and I have the freedom in my own hands to improve on my teaching and also to remain a lifelong learner.

### **6.4.2 Importance to my workplace**

In my view and that of my colleagues, such a study had never previously been done in our department. This makes my study so important for fellow educators

and the aspiring educators which I may train in the future. The importance to my work situation is that I am busy improving my education in regard to the encouragement of higher cognitive thinking. My next goal will be to motivate all of my colleagues to improve their teaching by using teaching/learning activities to enhance a deep approach among their own students. It could cause a ripple effect, the same as when I throw a pebble into a pond. If I am the pebble which makes the first ripple, I could influence my colleagues, and they will be the next ripple. As we are teaching, we will influence our students who are themselves aspirant educators, and this will be the next ripple. They will then influence their learners, who may just study education as well (see Fig. 15 below)!



- A: Me
- B: My colleagues
- C: Aspirant teachers
- D: Learners
- E: Aspirant teachers of the future

**Fig. 15**      **The ripple effect of my study**

## **6.5 Summary and own contribution to an educational theory**

As a student I attended many classes in education where some lecturers used different teaching/learning activities, while others used lecturing only as a teaching/learning activity. The classes which were facilitated with teaching/learning activities I enjoyed more; however, the lecturing classes made me realise that there was room for improvement in education as well as in my own teaching where I used lecturing as a teaching/learning activity. Using

action research involves me as an educator in my own classroom, dealing with my own concerns about the usage of teaching/learning activities to enhance a deep approach to learning.

Whilst continuing to use action research to improve on my teaching/learning activities, attitudes, values and my continuing professional development as an educator, I would like other educators to use this as an educational model to enhance their own teaching with the use of different teaching/learning activities. I contributed the five teaching/learning activities which improved my teaching, as well as the approach to learning that students adopt. My students and I improved on our personal attitudes and values in an on-going process of professional development in education. I believe that this model should be available for teachers and lecturers as a guide to be more innovative in changing their own educational environments. The DoE and tertiary educational institutions should introduce this to their staff to implement in the educational system. Using only the traditional way of teaching is not acceptable in our modern era of teaching.

I think I have made a contribution to educational research and theory with the support of my own reflections and the studies of other researchers who have done research on this problem. Most important of all is that I made a contribution to my own educational research and theory, and I improved my quality of teaching for myself and my students.

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## Appendix 1 Letter Jack Whitehead

Dear Albert

You haven't 'missed the mark'. Your writings are clear, well organised and are certainly at a level of quality that I associate with masters writings. Your dissertation writings show how you have engaged with the ideas of others in a sufficiently critical way and also demonstrate your own creativity in the way you have developed your enquiry and knowledge-creation within your own context.

I'm not suggesting you modify you text but I thought you might like Dadds' and Hart's idea of methodological inventiveness because it helps to emphasise the importance of your own creativity within your 'engineering design and graphic's' context.

I particularly liked your Chapter 5 as it gave a very clear understanding of your action research.

I do hope that you continue with a doctoral research programme. I think you might find that your original contribution to knowledge extends your points in section 6.6.4 in a way that might connect with some of the points I'm making in a paper to be presented at the American Educational Research Association in April 2012 - you can see the latest draft at: <http://www.actionresearch.net/writings/jack/jwaera12noffke200212.pdf>

I hope that these responses are helpful - I do congratulate you on what you have already achieved.

Love Jack.

-----  
When Martin Dobson, a colleague, died in 2002 the last thing he said to me was 'Give my Love to the Department'. In the 20 years I'd worked with Martin it was his loving warmth of humanity that I recall with great life affirming pleasure and I'm hoping that in Love Jack we can share this value of common humanity.

Jack Whitehead , Professor, Liverpool, UK. Hope University  
Visiting Fellow, University of Bath, UK

## Appendix 2 Written permission: Students



April 2010

Educational Students in EGD

Faculty of Education

UFS

**Re: Participating in a research project which forms part of Master study**

I am presently a registered Master student in Higher Education Studies at UFS, and the title of my dissertation is *“Improving my teaching experience with students in Engineering Graphics and Design: An Action Inquiry”*.

I cordially appeal to you as students in EGD to participate in this exciting research project to improve my own teaching and learning in this subject. You will be requested to write reflections on my teaching and these will be submitted anonymously by you for my perusal. You are under no obligation whatsoever to participate should you not wish to. All the data obtained will be treated with confidentiality.

I anticipate that all of you will find joy in this very exciting research project should you participate. Please sign the consent form provided to indicate your participation.

Kind Regards

**Mr Albert Kemp**

**Lecturer: EGD**

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Technology Education

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U.F.S.  
U.V.

<del>Am</del>	<del>Shaker</del>
Wheeler	Thorn
Gilbert	Winter
<del>W.B.</del>	G. Nicks
Madanraj	R. P. Suman
D. N. Ganesan	Al. L.
Arbit	Brook
M. Botma	Ala
P. P. Chong	F. S. S. S.
Harsveld	Amalivoo
Boyer	Scott
<del>M.</del>	Nester
Q. S.	
M. de	
L. S. S.	
L. P. S.	
W. S.	
V. S.	
<del>S.</del>	
M. K. S.	
B. S.	
R. P. S.	
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M. S.	
<del>S.</del>	
E. S.	
R. M. S.	
J. S.	
P. S.	
M. S.	

## Appendix 3 Ethical clearance



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20 June 2011

### ETHICAL CLEARANCE APPLICATION:

*IMPROVING MY TEACHING EXPERIENCE WITH STUDENTS IN ENGINEERING GRAPHICS AND DESIGN: AN ACTION INQUIRY*

Dear Mr A Kemp

With reference to your application for ethical clearance with the Faculty of Education, I am pleased to inform you on behalf of the Ethics Board of the faculty that you have been granted ethical clearance for your research.

Your ethical clearance number, to be used in all correspondence, is:

**UFS-EDU-2011-0008**

This ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension in writing.

We request that any changes that may take place during the course of your research project be submitted in writing to the ethics office to ensure we are kept up to date with your progress and any ethical implications that may arise. At the conclusion of your research project, please submit a project report, no more than 500 words in length, which should contain only a brief summary focusing primarily on ethical considerations, changes and issues that may have arisen and steps taken to deal with them during the course of the research. Upon receipt of this report, a final ethical clearance certificate will be issued to you, which will form part of your final dissertation.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours sincerely,

Andrew Barclay  
Faculty Ethics Officer



## Appendix 4 Written permission: Head of School



April 2010

Mr Albert Kemp

Lecturer

School of Mathematics Natural Sciences and Technology Education

Faculty of Education

UFS

**Re: Permission granted to conduct a research project which forms part of Master study.**

I hereby grant you, Albert Kemp 2005005604, permission to conduct a research project which form part of your Master studies in Higher Education Studies "*Improving my teaching experience with students in Engineering Graphics and Design: An Action Inquiry*".

With consent of the students in EGD, 1st to 4<sup>th</sup> year, TTK 114, TTK 214, TTK 314 & TMT 114 you may conduct the study with a mutual understanding that it is not compulsory for students to participate and that all data collected will be anonymous.

Kind Regards

---

Prof GP Combrinck

Head: School of Mathematics Natural Sciences and Technology Education

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## Appendix 5 Reflection sheet

UNIVERSITY OF THE  
FREE STATE  
UNIVERSITEIT VAN DIE  
VRYSTAAT  
YUNIVESITHI YA  
FREISTATA



Reflection sheet

Teaching/learning activity: \_\_\_\_\_

Advantages of this teaching/learning activity:

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Disadvantages of this teaching/learning activity:

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Does this teaching/learning activity enhance a deep approach to learning:

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## Appendix 6 Peer observation

My expertise in lecturing as seen by peers	
Do I ensure that venues are adequate- in terms of seating, lighting, heating, ventilation, audio-visual facilities, etc.?	Venue:
Do I ensure that students understand the aims of the session? Do they understand what they can expect to achieve from the session?	Aims and purposes:
Is my lecture material well organized, so that students can follow the structure or sequence I use?	Structure:
Are my lectures pitched at a level that the students can cope with?	Level:
Do I act sensitively to students as individuals?	Responding to students as individuals:
Do I use a variety of questioning strategies in a sensitive and flexible manner?	Questioning:
Do I use opportunities to interact with students?	Interaction:
Are my lectures clearly presented? Are the explanations that I give understood by the students?	Clarity:
Do I use examples or illustrations whenever helpful to students in grasping key points?	Use of examples:
Do I give positive attention to what student say? Do I reflect readiness to listen in verbal responses and in body language?	Listening:
Do I make appropriate use of handouts or other study materials?	Handouts:
Do I use audio-visual aids wherever appropriate in conveying the subject matter?	Audio-visual aids:
Can I be clearly heard even by students at the back and sides of the lecture hall?	Audibility:
Do I present the material in a lively and enthusiastic way?	Enthusiasm:
Do I make provision for summarizing what has been achieved?	Closing: